Prosodic form and identity effects in German

Renate Raffelsiefen
Free University of Berlin

1. Introduction

Identity effects in phonology are deviations from regular phonological form (i.e. canonical patterns) which are due to the relatedness between words. More specifically, identity effects are those deviations which have the function to enhance similarity in the surface phonological form of morphologically related words. In rule-based generative phonology the effects in question are described by means of the cycle. For example, the stress on the second syllable in cond[ɛ]nsation as opposed to the stresslessness of the second syllable in comp[ə]nsation is described by applying the stress rules initially to the stems thereby yielding condénse and cómpensàte. Subsequently the stress rules are reapplied to the affixed words with the initial stress assignment (i.e. stress on the second syllable in condense, but not in compensate) leaving its mark in the output form (cf. Chomsky and Halle 1968). A second example are words like lie[p]los 'unloving' in German, which shows the effects of neutralization in coda position (i.e. only voiceless obstruents may occur in coda position) even though the obstruent should 'regularly' be syllabified in head position (i.e. bl is a wellformed syllable head in German). Here the stem is syllabified on an initial cycle, obstruent devoicing applies (i.e. lie[p]) and this structure is left intact when affixation applies (i.e. lie[p]los) (cf. Hall 1992). As a result the stem of lie[p]los is identical to the base lie[p].

While accounting for phonological resemblance between related words in the examples illustrated above identity is always epiphenomenal on the cyclic approach (cf. Benua 1997). That is, cyclic rule application does not have the purpose to enhance surface similarity between related words; there is nothing desirable about such similarity. The manifestation of cyclic effects in surface forms is no more remarkable than the destruction of such effects by subsequent rule application (e.g. in the noun explanation the cyclic stress preservation on the second syllable (i.e. expláin) is presumably lost as a result of subsequent destressing rules applying in open syllables). In fact, the notion of the "Strict Cycle" generally causes distinctness in the surface forms of related words. For example, Trisyllabic Laxing is said to apply in serenity because of the synchronic relatedness to serene but it does not apply in nightingale because the relatedness between nightingale and night is said to no longer be recognized by the speakers. In cases like these cyclic rule application accordingly results in the opacity rather than enhancement of transparency between surface forms of related words (i.e. ser[ɛ]nity - ser[iː]ne).

By contrast, in Optimality Theory the relevant deviations from regular phonological form can be conceptualized as violations of phonological constraints which result from the satisfaction of a higher-ranking 'correspondence' constraints, which require identity of surface forms (cf. Benua 1995, McCarthy and Prince 1995, Raffelsiefen 1995). Conceptually, this approach is close to the traditional view of leveling in that strictly phonological constraints and identity constraints are recognized as inherently conflicting constraints on surface forms. Reference to identity constraints captures the traditional insight that the phonological form of words is subject to constraints which require identity of (surface) form with respect to related words.[1] Accounting for identity effects in terms of ranked constraints differs from the traditional view in that identity (or leveledness) is not seen as a 'repair' strategy to 'clean up' the phonological opacity within paradigms which results from fossilized historical sound changes (cf. Leskien, Brugmann, Osthoff and Brugmann). Rather, identity constraints can dominate phonological constraints thereby 'protecting' the leveledness of paradigms from being rendered opaque by sound changes. These are of course empirical issues to be resolved on the basis of historical studies.

In this paper I will investigate prosodic identity effects in German inflected adjectives and argue that such effects are best described in terms of the interaction of a constraint on paradigmatic levelling and certain prosodic wellformedness constraints. To prove the point it is necessary to clarify principles of prosodic wellformedness in German, especially those which relate to the distribution of schwa and principles of syllabification. An important distinction to be drawn is that between genuine identity effects, i.e. effects with a paradigmatic dimension and 'domain effects', which superficially resemble identity effects but are purely epiphenomenal in that they are determined by similarities in syntagmatic prosodic structure. For example, surface identity of German <u>lie</u>[p] and <u>lie</u>[p]los is conditioned by the fact that pwords constitute the domain of syllabification and consonant-initial suffixes are not integrated into the pword of the stems, but rather form their own pword. The relevant pword structures are hence $(\text{lie[p]})_\omega$ and $(\text{lie[p]})_\omega(\text{los})_\omega$. That is, the identical syllabification of the [p] in coda position in these two words does not presuppose any type of association between <u>lieblos</u> and <u>lieb</u> by the speaker but follows entirely from 'alignment constraints' which align pword boundaries with morphological boundaries and syllable boundaries with pword boundaries.

To establish the properties of genuine identity effects it is necessary to exclude all domain effects. This point as well as other generally neglected factors which need to be considered before identiy effects can be established are discussed in section 2. In section 3 I will review previous work on the distribution of schwa in German, emphasizing the inadequacies which result from the rule-based cyclic approach. In section 4 I will identify 'regular' patterns of schwa distribution and syllabification in German by investigating the evidence from sound change (i.e. the context-sensitivity in schwa loss and glide formation). The goal of this section

[1] In cases of so-called contamination the words in question need not be morphologically (or etymologically) related. Well-known examples include the replacement of [ð] for [d] in English <u>father</u>, to enhance similarity to the words <u>mother</u> and <u>brother</u>. The phenomenon is especially common in basic number terms where it always involves consecutive numbers, (e.g. the replacement of Germanic [p] for [hw] in <u>petwor</u> 'four' in analogy with <u>pempe</u> 'five' (cf. Greek tetra 'four', pente 'five'), the replacement of Russian [d] for [n] in <u>dev'at'</u> in analogy with <u>des'at'</u> 'ten'). The changes always serve to enhance similarity in the surface forms of related words.

is to establish a ranking of constraints which describes systematic preferences for syllable structure and conditions for the occurrence of dactyls in German. In section 5 it will be shown how deviations from these regular patterns in inflected words can be described in terms of the interaction between phonological constraints and identity constraints.

2. The recognition of identity effects: things to consider

2.1. The proper basis for establishing identity effects

To establish deviations from the regular sound patterns of a language it needs to be clarified how to identify such patterns. Obviously deviations can only be established on the basis of those words whose sound patterns are uninfluenced by related words. While proper nouns (names) may appear to be prima facie examples of such words (cf. the well-known example Tatamagouchi to prove the existence of a cyclic effect in words like originality) there is evidence that they ought to be excluded from consideration. That is, names (and interjections) can often be shown to deviate from regular sound patterns, perhaps to enhance their perceptual salience. For example, there has been a historic tendency for four syllable English nouns which end in a liquid to develop initial main stress (e.g. sàlamánder > sálamànder, òleánder > óleander, polyéster > pólyester). The opposite tendency exists for names (Álexànder > Àlexánder). On the basis of the regular sound patterns in nouns like sálamànder it can be established that the stress contour in the noun rècomménder qualifies as a genuine identity effect (with respect to the base recomménd). This insight would be obscured if the sound patterns of names (e.g. Àlexánder, Madagáscar, Ebenézer) were used to establish identity effects.[2]

While reference to underived common words is the ideal basis for establishing identity effects the paucity of relevant examples can make it necessary to consider derived words as well. However, one has to be careful to exclude derived words which themselves exhibit identity effects. A well-known example is the pair condensation – compensation cited above. While it seems reasonable to invoke the notion of an identity effect to explain the distinct stress patterns in these words it is not clear that *both* words exhibit identity effects. In fact, reference to phonologically comparable words which lack a base and therefore do not exhibit identity effects such as chìmp[æ]nzée, sèr[ɛ]ndípity reveals that only the stress pattern of compensation is deviant. This is because, condensation is like chimpanzee or serendipity in that the second syllable, which is closed by a nasal, can bear secondary stress but can also reduce to a schwa syllable. By contrast, the second syllable in compensation cannot bear secondary stress, apparently because such stress would violate the identity to the base compensate. The conclusion that only compensation, but not condensation, exhibits identity effects is significant in that only compensation can be synchronically derived by suffixation. This example thus supports the claim that underived common words are the ideal basis for

[2] For more examples see Raffelsiefen 1993:90ff.

establishing identity effects.

A third point to keep in mind when establishing identity effects is the possibility that words belonging to different syntactic categories may have different canonical patterns. For example, there are nouns in English which include a word-internal sequence of two unstressed syllables (e.g. cátamaràn, rígamaròle) but this canonical pattern does not exist for verbs. In verbs, such stress patterns are always identity effects (e.g. hóspitalìze – hóspital, rádicalìze – rádical).

2.2. Identity effects versus domain effects

In section 1 I argued that identity effects need to be distinguished from (superficially similar) domain effects, because the latter do not involve association of related words by the speaker. Rather, domain effects only indicate the recognition of affixes along with the appropriate alignment constraints. To support this argument I will first review the evidence for the claim that the domain of syllabification of complex words is determined by the phonological form and position of the affixes. In section 2.2.2 I will illustrate the distinction between domain effects and identity effects with some examples.

2.2.1. The domain of syllabification

There is evidence that the domain of syllabification in both English and German requires reference to morphological structure and certain phonological properties of affixes. Consider first the result of historical schwa loss in the German suffixed words in (1). The near-minimal pair (ver)gé[p]lich - né[b]lig shows that schwa loss correlates with devoicing of the preceding obstruent only if a consonant-initial suffix follows.

(1)	MHG vergëbe+lich 'forgive+Suf'	a.	vergé[bəl]ich > NHG vergé[pl]ich 'in vain'
	MHG nëbel+ic 'fog+Suf'		né[bəl]ic > NHG né[bl]ig 'foggy'

The evidence from sound change in (1) correlates with the evidence from word formation. New coinages by -lich-suffixation which involve the truncation of stem-final schwa also show obstruent devoicing as is illustrated in (2).[3]

[3] The adjective [e:əlɪç] ehelich 'marital' derived from [e:ə] Ehe 'marriage', which is the only case where a stem-final schwa is preserved, supports the claim that consonant-initial suffixes are not integrated into the pword of the stem. This is because the exceptional preservation of schwa serves to satisfy a constraint against prosodic words consisting of a single segment. This constraint concerns neither moraic structure as is shown by the existence of words like [ze:] See 'sea', [re:] Reh 'deer' nor 'X-slot'-structure as is shown by the existence of words consisting of single diphthongs (e.g. Ei 'egg', Au 'pasture'). The constraint in question is not obeyed in interjections (e.g. [a:] 'ah', [i:] 'i', [o:] 'oh', [e:] 'äh', in accordance with the fact that a good interjection violates wellformedness conditions for pwords (e.g. the interjections hui and pfui, which violate a constraint against rising diphthongs, the interjections sch and pst which violate a constraint against syllables without a sonorant nucleus).

(2) NHG Er[b]e+lich -> er[p]lich
'heritage+Suf'

Provided that the voicing contrast for German obstruents is neutralized in coda position (cf. the plural past tense forms tru[.g]en 'carried' vs. bu[.k]en 'baked' with the corresponding singular forms tru[k] - bu[k], in which the velar obstruent appears in coda position) the data in (1) and (2) indicate that vowel-initial, but not consonant-initial, suffixes are syllabified together with their stem. Assuming that the pword is the domain of syllabification this analysis can be expressed in terms of the structures in (3).

(3) (vergeb)$_\omega$(lich) (neblig)$_\omega$

Suffixes which consist only of consonants and therefore cannot form a syllable are integrated into the pword of the stem as is shown in (4). The syllabification of consonantal affixes is hence indistinguishable from the syllabification of corresponding consonants in underived words. Also phonological rules which are sensitive to syllable structure affect both types of words alike. For example, vowel lengthening before tautosyllabic clusters consisting of r plus a coronal stop applied both in Bart (i.e. B[a]rt > B[a:]rt) and the suffixed word Fahrt (i.e. F[a]rt > F[a:]rt):

(4) Fahr+t -> (Fahrt)$_\omega$ Bart -> (Bart)$_\omega$
'ride+Suff' 'beard'

Turning now to prefixes we find that historical devoicing in (5a) and the occurrence of glottal stops in the vowel-initial stems in (5b) indicate that prefixes are not integrated into the pword of the stem. Again, the prosodic representation of the prefixes is ignored here (for discussion, see Hall (1999), Raffelsiefen (2000))

(5)a.	ab-	MHG. aberede > NHG A[p]rede	A[p](rede)$_\omega$
	ob-	MHG obeliegen > NHG o[p]liegen	o[p](liegen)$_\omega$
b.	auf-	auf[ʔ]essen	auf([ʔ]essen)$_\omega$
	er-	er[ʔ]ahnen	er([ʔ]ahnen)$_\omega$
	ent-	ent[ʔ]eignen	ent([ʔ]eignen)$_\omega$

For prefixes it also holds that their integration can be determined by their phonological form as is shown by s-prefixation in English. Note that stops are aspirated in syllable-initial position, but are unaspirated after s. The fact that the stem-initial stops in (6) are unaspirated shows that the prefix is syllabified together with the stem.

(6)	s+[t^h]rample 'trample'	s[t]rample 'strample'	(cf. s[t]reet 'street')
	s+[k^h]runch 'crunch'	s[k]runch 'scrunch'	(cf. s[k]ream 'scream')
	s+[p^h]lunge 'plunge'	s[p]lunge 'splunge'	(cf. s[p]leen 'spleen')

Because it is output-oriented the parenthesized condition in (11) violates the spirit of generative phonology. That condition, however, is necessary to prevent S-schwa-epenthesis from applying to sichern or dunkeln (i.e.*sich[ə]r[ə]n, *(ver)dunk[ə]l[ə]n) and also to prevent "L-schwa-epenthesis" from applying to syllabifiable verb stems like faul- 'rot' or quirl- 'whisk' (*fau[ə]l-, *quir[ə]l-.

Consider next the agentive nouns in (12):

(12) (Ver)sich[ə]r[ə]r 'insurer'
(Ver)dunkl[ə]r 'darkener'
Trockn[ə]r 'drier'

As is shown by the pair (ver)dunk[ə]ln - (Ver)dunkl[ə]r the application of L-epenthesis to the stem (ver)dunkl- depends on the suffix: the rule applies if -n is subsequently attached but not if -r is attached. This type of "global" dependency could be accounted for by extrinsically ordering r-suffixation before L-schwa-epenthesis as is illustrated in (13).[6]

(13)

(ver)dunkl-]$_V$	(ver)dunkl-]$_V$	trockn-$_V$	trockn-]$_V$	
(Ver)dunklr]$_N$		Trocknr]$_N$		r-suffixation
(Ver)dunkl[ə]r]$_N$	(ver)dunk[ə]l-]$_V$	Trockn[ə]r]$_N$		L-schwa-epenthesis
	(ver)dunk[ə]ln]$_V$		trocknn]$_V$	n-suffixation
			trockn[ə]n]$_V$	S-schwa-epenthesis

While yielding correct output forms in the cases considered so far the analysis presented above is somewhat redundant. The redundancy concerns the inherent sonority of the suffixes and their relation to the sonority specification of the consonants triggering schwa-epenthesis. The key to correct schwa insertion is to specify the epenthesis-rules such that the sonority of the rule-triggering class (e.g. the class of liquids) does not exceed the sonority of the suffix to be attached next. This approach obscures the observation that the distribution of the schwa in (9) and (13) depends strictly on the sonority relations among the consonants in the 'output' regardless of whether or not those consonants are suffixes. The relevant generalization is that the schwa prevents 'sonority violations' in syllable codas by 'breaking up' the rightmost cluster in which sonority fails to decrease (e.g. the boldfaced clusters in (14)).

(14) (Ver)dun**kl[ə]r**, (ver)dun**k[ə]l**n, Troc**kn[ə]r**, troc**kn[ə]n**

Sonority relations are determined with respect to the hierarchy in (15), which will be refined in section 4.

[6] Both the suffix -r and the suffix -n attach only to verb stems which renders superfluous additional ordering restrictions.

(15) increasing sonority decreasing sonority

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Vowels	r	l	Nasals	Fricatives	Stops

The empirical inadequacy of the rule-ordering approach, which merely mimics the relevance of the sonority relations of *all* consonants in the fully derived word by clever rule ordering, is revealed by words in which the schwa is followed by a sequence of consonants C_iC_j, where C_j is not a suffix. Again the schwa breaks up the the rightmost cluster in which sonority fails to decrease (e.g. the boldfaced clusters in (16)). That is, in (16) the schwa also has the function of making the words 'syllabifiable' but none of the epenthesis rules allows for this generalization to be expressed.

(16) hun**d[ə]rt** 'hundred', **Ab[ə]nd** 'evening', Ge**g[ə]nd** 'area', tau**s[ə]nd** 'thousand', **Jug[ə]nd** 'youth', **Tug[ə]nd** 'virtue', al**b[ə]rn** 'silly', bu**ss[ə]rl**n 'to kiss', ges**t[ə]rn** 'yesterday', Ga**ll[ə]rt** 'jelly'

German differs thus from English, where simplexes contrast with respect to the site of the schwa. That is, the schwa may either break up the rightmost cluster for which sonority increases as in (17a) or follow that cluster as in (17b):

(17)a.	stan**d[ə]rd** 'standard'	b.	hun**dr**[ə]d 'hundred'
	pa**t[ə]rn** 'pattern'		pa**tr**[ə]n 'patron'
	ta**v[ə]rn** 'tavern'		che**vr**[ə]n 'chevron'
	sa**t[ə]rn** 'Saturn'		a**pr**[ə]n 'apron'
	ci**t[ə]rn** 'cittern'		ci**tr**[ə]n 'citron'

While the patterns in (17b) exist also in German there is a crucial restriction on their occurrence which has gone unnoticed in previous work. That is, the pattern in (17b) occurs only in certain inflected word forms and is always conditioned by paradigmatic leveling and qualifies therefore as an identity effect. In the remaining German words, including all uninflected words, schwa never occurs in the site illustrated in (17b). Wiese (1996:244) is thus wrong when he asserts that in German "instead of *hundert*, we could just as well have *hundret* (cf. English *hundred*![7])". Wiese has to resort to an English example to back up his claim because such patterns do not occur in German uninflected words. His misstatement of the facts is symptomatic for other LP work as well in that syllabifiability (i.e. sonority relations) is the only phonological condition on schwa epenthesis which is recognized.[8]

[7] The exclamation mark is Wiese's.

[8] While invoking syllabifiability in (4) Wiese 1988 emphasizes that syllabic wellformedness alone does not account for the site of the schwa in (16). He argues that while preference for widm[ə]n over *wid[ə]mn could indeed be explaimed with reference to syllabic wellformedness non-occurring verbs like *klettr[ə]n would be equally acceptable as klett[ə]rn as far as syllable structure is concerned.

but not the one in between, i.e. the l. This particular problem is characteristic of inflected adjectives in German and will henceforth be referred to as the "sonority puzzle".

The suspicion that the true factor determining the distribution of the schwa in (21) is not strictly phonological is enhanced by the observation that the schwa patterns are identical for all adjectives belonging to the same paradigm. A paradigm is here defined as the set of the inflected forms of a word whose distribution is determined solely by agreement with another element within some grammatical configuration. In German the forms of attributive adjectives depend on the preceding determiner (definite, indefinite, or none), as well as on case, number, and gender within the determiner phrase. Due to considerable syncretism there are only five distinct forms in each paradigm as is illustrated in (22):

(22) ein **dunkles**]$_{\mathrm{AINFL}}$ Brot
'a dark bread'
das **dunkle**]$_{\mathrm{AINFL}}$ Brot
'the dark bread'
statt **dunkler**]$_{\mathrm{AINFL}}$ Brote
'instead of dark breads'
mit **dunklem**]$_{\mathrm{AINFL}}$ Brot
'with dark bread'
die **dunklen**]$_{\mathrm{AINFL}}$ Brote
'the dark breads'

Adjectives in predicative position are not inflected and are therefore not part of the paradigm in (22) (e.g. Das Brot ist dunkel. 'The bread is dark.' Die Brote sind dunkel. 'The breads are dark.'). The point of interest here is that all members of an adjectival paradigm have identical phonological forms except for the word-final consonant, that is, the suffix. In particular, they never differ with respect to either the number or the sites of schwas. Perfect leveling in adjectival paradigms is without exceptions. In contrast to other inflectional paradigms in German there is no suppletion of any kind.[11]

(23)	dunkl[ə]s	trock[ə]n[ə]s	lock[ə]r[ə]s	makabr[ə]s
	dunkl[ə]	trock[ə]n[ə]	lock[ə]r[ə]	makabr[ə]
	dunkl[ə]r	trock[ə]n[ə]r	lock[ə]r[ə]r	makabr[ə]r
	dunkl[ə]m	trock[ə]n[ə]m	lock[ə]r[ə]m	makabr[ə]m
	dunkl[ə]n	trock[ə]n[ə]n	lock[ə]r[ə]n	makabr[ə]n

The 'sameness' of the schwa patterns in (23) cannot be explained on strictly phonological grounds. Certain illformed paradigms like the one given in (24) have better syllable structures because in each inflected form the schwa breaks up the rightmost cluster in which sonority fails to decrease.

[11] In fact, even the paradigms of adjectives ending in an unstressed full vowel, which are exceptional in that they take no endings, are perfectly leveled.

(24) * dunk[ə]ls
dunk[ə]l
dunkl[ə]r
dunk[ə]lm
dunk[ə]ln

Preference for the leftmost paradigm in (23) over the one in (24) follows from the essentially morphological condition of 'leveled' paradigms (cf. Vennemann 1982:289)[12]. The relevant generalizations cannot be adequately expressed in rule systems for which individual inflected words are the domain of description. Once leveling is recognized as a wellformedness condition for paradigms, the occurrence of schwa before stem-final r or nasal, but not before l (i.e. "the sonority puzzle") follows from the independent fact that r and n are adjectival inflectional suffixes whereas l is not. This connection between leveling and the inventory of suffixes will be made precise in section 5. Also, the "celebrated minimal pair" (Rubach 1990:88) in (25) will be shown to follow straightforwardly from the condition that paradigms must be leveled.

(25) dunkl[ə]n]$_{\mathrm{AINFL}}$ - Dunk[ə]ln]$_{\mathrm{NINFL}}$

As will be shown in section 5, the different sites of the schwa in (25) follow from the fact that adjectival paradigms include a suffix which is more sonorous than l, e.g. the suffix r, whereas the most sonorous suffix in the nominal paradigm, e.g. the nasal n, is less sonorous than l:

(26)

adjectival paradigm:	nominal paradigm:
dunkl[ə]s	Dunk[ə]l
dunkl[ə]	Dunk[ə]l**n**
dunkl[ə]**r**	Dunk[ə]ls
dunkl[ə]m	
dunkl[ə]n	

The data in (26) have led many to posit that adjectival, but not nominal inflectional suffixes, are lexically represented as "ə(C)" (cf. Strauss (1982)[13], Becker (1990)[14], Féry (1991), Noske (1993)). This stipulation expresses a correct surface generalization since adjectival suffixes are indeed invariably associated with schwa. However, as will be shown association

[12] Vennemann (1982) argues that the site of the schwa in inflected German verbs is historically determined by "Systemzwang" i.e. paradigmatic leveling.
[13] Strauss (1982) who describes the distribution of German schwa in terms of deletion rules stipulates that schwas preceding adjectival suffixes are 'undeletable'.
[14] Becker writes that for stems which end in the sequence schwa plus sonorant, suffixes remain syllabic in adjectival inflection, whereas in the nominal inflection the nonsyllabic allomorph is chosen (1990:131).

with schwa in (26) is not a property of adjectival suffixes per se but follows from their sonority (i.e. the inventory of adjectival inflectional suffixes - unlike those of other categories - include a liquid) and from the condition of paradigmatic leveling.[15]

3.3. Lexical versus epenthetic schwa

In generative descriptions epenthetic schwas are distinguished from lexical schwas. The occurrence of the former is determined by applying rule (11) as is illustrated in (27a). The latter schwas are already present in underlying representations as is illustrated in (27b).

(27)a.	sichr	sich[ə]r	b.	Tug[ə]nd
	Wackr	wack[ə]r		Gall[ə]rt
	Eifr	Eif[ə]r		alb[ə]rn

As was pointed out above, the schwa in both types of words is equally "predictable" in that they "break up" the rightmost cluster with decreasing sonority in the respective words. While some generative linguists would argue that both schwas should be treated as epenthetic (cf. Wiese 1988)[16] there is presumably a consensus that word-final schwas are always lexical. However, there are problems for the concept of the underlying level as repository for unpredictable information here as well. Specifically, there are certain types of words where word-final schwas are almost always preceded by a voiced obstruent. One such type is the class of adjectives; illustrated in (28):

(28) träg[ə] 'lazy', öd[ə] 'barren', bö[z][ə] 'mad', prüd[ə] 'prudish', frigid[ə] 'frigid', solid[ə] 'solid', mürb[ə] 'crumbly', lei[z][ə] 'quiet'

The words in (28) are similar to those in (27) in that they are unpronounceable without the schwa. In both cases the unpronounceability is due to constraints on syllable codas which are inviolable in German. Without the schwa the words in (27) include a coda with increasing sonority whereas those in (28) include a coda with voiced obstruents. Why then could the schwas in (28) not be analysed as epenthetic to ensure pronounceability in parallel with the schwas in (27)?

(29)a. si[çr] → si[çər] 'sicher' b. trä[g] → trä[gə] träge

The problem for the parallel treatment of the cases illustrated in (29) lies in the use of two ontologically distinct sources for determining underlying forms. That is, underlying forms do

[15] It is true that adjectival inflectional endings are also preceded by schwa in cases where no member of the paradigm requires schwa for phonological reasons (e.g. roher [ro: ər] 'raw', zäher [tse: ər] 'tough'). However, the relevant generalization here is that words with a sonorant suffix regularly end in a schwa syllable in German including words derived with the agentive suffix -r (e.g. [se:ər] Seher 'seer'), the diminutive suffix -l (e.g. Greu[ə]l 'horror', the infinitival suffix -n [se:ən] sehen 'see'), and others.

[16] Wiese 1988 assumes that the schwa in the cases in (27b) is followed by two consecutive suffixes. This is obviously an ad hoc solution.

not only have the function of representing information which is not predictable on phonological grounds. In addition they have the function of providing unitary forms for alternations in morphologically related words. It is the second function which distinguishes the cases in (29) since there are two types of obstruent-final adjectives as is illustrated in (30):

(30)a. har[t] har[t]er 'hard' b. kar[k] kar[g]er 'barren'

To account for the alternation between voiceless and voiced obstruents in the related forms in (30b) versus the lack of alternation in (30a) the relevant obstruents are distinguished in underlying forms as follows:

(31)a. har/t/ b. kar/g/

If this analysis, which is motivated by considerations of parsimony in the lexicon, is accepted the parallel treatment of the schwas in (29a) and (29b) is no longer possible. This is because underlying representations like trä/g/ and kar/g/ would no longer allow for the 'epenthesis- cases' in (29b) to be distinguished from the 'alternation-cases' in (31b). To avoid this problem, nothing is said about the phonological conditioning of the final schwas in (28) in rule-based generative descriptions in that they are analysed as 'lexical', that is, 'unpredictable'. This problem will be solved in the constraint-based description in section 4.

To summarize, previous descriptions of schwa patterns have been inadequate in three respects. First, the description of phonological conditions on schwa occurrence suffers from two problems. While it is recognized that the distribution of schwa has to do with syllabifiability the domain for the epenthesis rules is misstated. A proper description of schwa requires reference to the phonological word (i.e. the stem plus all consonantal and vowel-initial suffixes) rather than stems. In addition the conditions for schwa epenthesis are insufficient in that they refer only to sonority (i.e. syllabifiability) to the exclusion of all other constraints on syllabic wellformedness (e.g. constraints on head complexity, constraints on the form of syllable shells). The relevant generalizations, which pertain to the syllable structure of (morphologically complex) phonological words, are obscured by spurious reference to morphosyntactic structure and level distinctions. Second, the fact that putatively phonological epenthesis rules conspire to yield leveled paradigms is treated as a coincidence. In general, analogical influences are not considered in LP descriptions on German schwa. Third, the distinction between "epenthetic" and "lexical" schwas obscures the fact that the occurrence of both types is governed by phonological conditions.

4 Canonical patterns

It is the purpose of this section to establish canonical prosodic patterns in German to provide a basis for recognizing identity effects. Methodologically I will primarily evaluate the evidence from recent sound changes and patterns of loan word adoption to establish those patterns. The sound changes include schwa loss and Glide Formation. It will be shown that the context-sensitivity of those sound changes is best described in terms of as system of ranked constraints. The rankings in question describe principles of syllabification and the conditions for the occurrence of dactylic feet in German.

4.1 The constraint *SCHWA

While all unstressed vowels reduce to schwa in the transition from OHG (Old High German) to MHG (Middle High German) only a subset of those schwas have disappeared in NHG (New High German).[17] The glosses refer to the current meanings:

	OHG	MHG	NHG	
(32)	gimáhalo	g[ə]máh[ə]l[ə]	G[ə]mahl	'spouse'
	giná:da	g[ə]nád[ə]	Gnad[ə]	'mercy'
	hánaf	hán[ə]f	Hanf	'hamp'
	óvan	óv[ə]n	Of[ə]n	'oven'

Assuming that every language change amounts to a "local improvement" (cf. Vennemann 1988) the question arises in what respect the NHG forms are better than the corresponding MHG forms. The relevant constraint is tentatively stated in (33) (cf. Mester and Ito (1994)):

(33) *SCHWA
Schwa is prohibited.

Evaluation of candidate forms with respect to the constraint *SCHWA is illustrated with MHG g[ə]lükk[ə], NHG Glück 'luck' in (34):

(34)	Input			*SCHWA
	g[ə]lükk[ə]		g[ə]lükk[ə]	**
			g[ə]lükk	*
			glükk[ə]	*
		→	glükk	

Not all schwas disappeared (cf. the data in (32)), which shows, that *SCHWA is violable.[18] In the remainder of this chapter it will be shown that the stability of schwas can be described in terms of satisfaction of independently motivated constraints.

4.2 The VOICE stability effect

[17] The data are based on Lexer (1878) and Drosdowski (1989).

[18] The constraint *SCHWA was never violated in OHG, which shows that it was undominated then. Vowel reduction in MHG indicates that *SCHWA came to be dominated by a prosodic constraint which expresses a preference for a single stressed syllable within the prosodic word.

Assuming that schwa loss after sonorants or voiceless obstruents in the adjectives in (35a) serves to satisfy *SCHWA the question arises of why schwa remained after voiced obstruents as shown in (35b).

(35)	OHG	MHG	NHG	
a.	chálo	kal[ə]	kahl	'bald'
	hréini	rein[ə]	rein	'clean'
	sámfto	sanft[ə]	sanft	'gentle'
b.	múodi	müed[ə]	müd[ə]	'tired'
	trá:gi	træg[ə]	träg[ə]	'sluggish'
	lí:so	lei[z][ə]	lei[z][ə]	'quiet'

According to Wilmanns (1911:364) the deletion patterns in (35) have historically been related to the absence of voiced obstruents in syllable-final position in German (cf. Adelung 1781). The constraint in question can be formulated as follows (cf. Shibatani 1973):

(36) CODA VOICE
Voiced obstruents in coda position are prohibited.

Tableau (37), which compares forms with schwa with the corresponding schwaless forms, shows that the ranking CODA VOICE >> *SCHWA accounts for the data in (35). The examples in (37a,b,c) represent words in which the final schwa is preceded by a voiceless obstruent, a sonorant, and a voiced obstruent, respectively. The exclamation mark indicates a "fatal" violation, which leads to the elimination of the candidate.

(37)		candidates	CODA VOICE	*SCHWA
a.		dick[ə]		*!
	√	dick		
b.		rein[ə]		*!
	√	rein		
c.		træg	*!	
	√	træg[ə]		*

The fact that CODA VOICE is never violated in German has led proponents of rule-based approaches to conclude that there is an automatic rule of "Final Devoicing" in German. The observation that the final schwa in words like <u>træg</u>[ə] has been stabilized by the illformedness of the form <u>træ</u>[g] argues against the existence of such a rule. Yet the question arises of what rules out the "devoiced" candidate <u>træk</u>. This candidate cannot be eliminated on phonological grounds but rather calls for a different type of constraint which relates candidates to input forms. Ranking the constraint PRESERVE VOICE stated in (38) higher than *SCHWA yields the desired effect:[19]

(38) PRESERVE VOICE
The feature [±voice] must be preserved

Tableau (39) shows how the ranking of the three constraints considered so far accounts for the preference of schwaless forms unless the schwa is preceded by a voiced obstruent.[20]

(39)	Input		candidates	CODA VOICE	PRESERVE VOICE	*SCHWA
a.	dick[ə]		dick[ə]			*
		√	dick			
b.	rein[ə]		rein[ə]			*
		√	rein			
c.	træg[ə]		træg	*!		
			træk		*!	
		√	træg[ə]			*

All input forms in (39) end in schwa to match the historical starting point of schwa deletion. Specifically, the input forms in (39) represent the surface forms which were historically encountered in language acquisition. The constraint ranking accounts for the forms selected by learners on the basis of those input forms, which then surfaced in their own speech (i.e. the forms dick, rein, and træg[ə] in (39)). "Schwa deletion" thus refers to an era when learners were more likely to encounter words ending in schwa than to render that schwa in their own speech with the result that input forms like dick[ə] and rein[ə] were eventually replaced by the restructured forms dick and rein.

Consider now the rare cases of adjectives in which schwa deleted despite being preceded by a voiced obstruent. The adjectives elend and fremd differ from the other adjectives under consideration in that they consisted of a ternary foot in MHG (i.e. MHG éllènde, vrémede) provided that a foot consists of a stressed syllable and the following less stressed syllables within the phonological word.[21] The tendency in German not to exceed binary feet was

[19] This description raises the question of whether or not the Voice Stability Effect is contingent on the fact that [±voice] is a contrastive feature in German. Consider noncontrastive features like aspiration or glottalization in American English: voiceless stops are aspirated in onset position but glottalized in coda position. Could there for example exist a stability effect in American English which is based on the constraint against aspirated stops in coda position? I suspect that such an effect could not exist but that contrastiveness is a crucial prerequisite for stability effects.

[20] In words like strenge 'strict', enge 'narrow', and bange 'anxious' word-final schwa deleted presumably *after* postnasal g-deletion occurred (e.g. stre[ŋgə] > stre[ŋə] > stre[ŋ]). This is because, unlike the obstruent [g], the nasal [ŋ] is unmarked for the feature [±voice] in coda position and therefore does not stabilize the following schwa. The deletion of final schwa in those words argues against the analysis proposed by Hall (1992) and Wiese (1994) who derive the velar nasal *synchronically* from an underlying cluster /ng/.

[21] In accordance with the prosodic hierarchy feet are limited by phonological word boundaries. The words in (i)

already observed by Heyse (1838). His observation can be stated in terms of the following constraint:[22]

(40) $(\sigma^2)_F$
Feet must be maximally binary.

The fact that schwa systematically deleted after voiced obstruents in words consisting of ternary feet indicates that the constraint $(\sigma^2)_F$ dominates PRESERVE VOICE. Recall that *CODA VOICE is never violated in MHG and NHG:

(41)	Input		candidates	CODA VOICE	$(\sigma^2)_F$	PRESERVE VOICE	*SCHWA
			éllènd	*!			
	éllènd[ə]		éllènd[ə]		*!		
		√	éllènt			*	

The tableau in (41) illustrates the general form of a schwa stability effect. Both a constraint on syllable wellformedness and a constraint on preservation dominate *SCHWA. Schwa stability effects can be obscured because of higher-ranking constraints on the maximal number of syllables allowed within prosodic constituents.

From a historical point of view the description of the VOICE Stability Effect in terms of the constraint ranking in (41) is superior to a description in terms of a schwa deletion rule which would require disjunct rule ordering (sonorants and voiceless obstruents do not constitute a natural class). All constraints in (41) can be motivated independently. The constraint ranking in (41) also has synchronic significance: it accounts not only for the synchronic stability of schwas which are preceded by a voiced obstruent but also accounts for the adoption of loan words. The fact that schwas have been stabilized by preceding voiced obstruents but are never inserted to preserve voicedness in obstruents (e.g. Ba[g]da[d] is adopted as Ba[k]da[t], rather than Ba[gə]da[də]) shows furthermore that PRESERVE VOICE is dominated by a constraint against epenthesis in German.

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differ from words like éllènde, vrémede in that they consist of two phonological words. The schwa in (i) is therefore stable according to the ranking in tableau (39), although the stress contour of those words is similar to that of historically fused compounds like éllènde, in which the schwa disappeared:

(i)	MHG > NHG	
	$(\text{snít})_\omega(\text{kàese})_\omega$ > $(\text{Schnítt})_\omega(\text{käs[ə]})_\omega$	'sliced cheese'
	$(\text{glás})_\omega(\text{òuge})_\omega$ > $(\text{Glás})_\omega(\text{àug[ə]})_\omega$	'glass eye'
	$(\text{vür})_\omega(\text{sòrge})_\omega$ > $(\text{Für})_\omega(\text{sòrg[ə]})_\omega$	'welfare'
	$(\text{úr})_\omega(\text{kùnde})_\omega$ > $(\text{Úr})_\omega(\text{kùnd[ə]})_\omega$	'document'

[22] The constraint in (40) differs from the constraint FTBIN in Prince and Smolensky in that it imposes an upper limit on the size of feet rather than require binary feet. This modification is necessary to account for the general preference of monosyllabic over trochaic forms in German.

4.3 The SON Stability Effect

Assuming again that schwa loss in the adjectives in (42a) serves to satisfy *SCHWA the question arises of why schwa remained in (42b).

(42)	OHG	MHG	NHG	
a.	kárag	kar[ə]c	karg	'meagre'
	érnust	ern[ə]st	ernst	'serious'
	sóli:h	sol[ə]ch	solch	'such'
b.	mágar	mag[ə]r	mag[ə]r	'lean'
	óffan	off[ə]n	off[ə]n	'open'
	túnkal	tunk[ə]l	dunk[ə]l	'dark'

It appears that the relevant difference between the words in (42a) and (42b) concerns the sonority relation between the consonants which flank the schwa. Specifically, in the words in (42a) the schwa is preceded by a sonorant and followed by an obstruent whereas the opposite order is found in the words in (42b). Schwa loss would accordingly yield a cluster with decreasing sonority in (42a), but not in (42b). As a result schwa loss in (42b) would yield a violation of a constraint on sonority defined in (43) (cf. also Sievers 1901).[23]

(43) SON
A segment in the syllable head may only be followed by segments of higher sonority; a segment in the syllable coda may only be preceded by segments of higher sonority.

That is, for every segment in the syllable shell (i.e. head and coda) the sonority level must increase toward the nucleus. The constraint in (43) is evaluated with respect to the sonority hierarchy tentatively stated in (15). The deletion patterns in (42) are described by ranking the constraint SON above *SCHWA as is illustrated in (44):

(44)	Input:			SON	*SCHWA
a.	kar[ə]c		kar[ə]c		*!
		→	karc		
b.	mag[ə]r	→	mag[ə]r		*
			magr	*!	

To rule out candidates like mag or mar, which violate neither SON nor *SCHWA, I will refer to the constraint PRESERVE C stated in (45):

(45) PRESERVE C
All consonants in the input must be preserved in the output.

[23] Those laws say that the more sharply the sonority increases towards the nucleus the more syllable heads and codas are preferred (cf. Vennemann 1988:13ff).

In contrast to SON, the constraint PRESERVE C has been violable in German as is shown by historical developments like MHG we[rlt] > NHG We[lt] 'world', MHG la[mp] > NHG La[m] 'lamb', etc.

(46)	Input:			SON	PRESERVE C	*SCHWA
			magr	*!		
	mag[ə]r		mar		*!	
		→	mag[ə]r			*

The need to distinguish PRESERVE C from PRESERVE VOICE is demonstrated by the fact that both schwas in dactyls are stable to satisfy PRESERVE C.

(47)	Input:			SON	PRESERVE C	$(\sigma^2)_F$
			Tugnd[ə]n	*!		
	Tug[ə]nd[ə]n		Tug[ə]ndn	*!		
			Tund[ə]n		*!	
		→	Tug[ə]nd[ə]n			

The rankings in (47) account for the similarities between 'epenthetic' and 'lexical' schwas described in section 3.3. in terms of stability conditions. That is, while the VOICE Stability Effect accounts for the historical stability and synchronic occurrence of schwas which are preceded by voiced obstruents the SON Stability Effect accounts for the historical stability and synchronic occurrence of schwas which are flanked by segments for which sonority increases.

4.4. Syllable complexity

Consider the patterns of schwa loss in dactyls illustrated in (48), where the last schwa is flanked by consonants with decreasing sonority.

(48)	MHG	NHG	
	seg[ə]l[ə]n	seg[ə]ln (*segl[ə]n)	'to sail'
	gest[ə]r[ə]n	gest[ə]rn (*gestr[ə]n)	'yesterday'
	zitt[ə]r[ə]n	zitt[ə]rn (*zittr[ə]n)	'to tremble'

Syncope typically leads to more complex consonant clusters thereby yielding violations of one of the two constraints in (49). Both constraints in (49) are supported by independent phonological evidence (cf. Vennemann 1988:).

(49) *COMPHEAD
Complex syllable heads are prohibited
*COMPCODA
Complex syllable codas are prohibited

As was noted in section 3 coda complexity is preferred to head complexity in German,[24] which indicates the ranking in (50). The fact that seg[ə]ln is preferred to seg[ə]l[ə]n indicates furthermore that *COMPCODA is dominated by $(\sigma^2)_F$.

(50)	Input			*COMPHEAD	*COMPCODA
	se.g[ə].l[ə]n		se.gl[ə]n	*!	
		→	se.g[ə]ln		*

Putative counterexamples as in (51) do not show that the ranking between *COMPHEAD and *COMPCODA can also be reversed, but indicate rather that both constraints are dominated by SON.

(51)	seg[ə]l[ə]r	Se.gl[ə]r (se.g[ə]lr)	'sailor'
	ad[ə]l[ə]r	a.dl[ə]r (*a.d[ə]lr)	'eagle'
	red[ə]n[ə]r	re.dn[ə]r (*re.d[ə]nr)	'speaker'
	schuld[ə]n[ə]r	Schul.dn[ə]r (*schul.d[ə]nr)	'debtor'

The data in (51) show furthermore that not only *COMPCODA but also *COMPHEAD is dominated by $(\sigma^2)_F$. The rankings between the relevant constraints is shown in (52):

(52)	Input			SON	$(\sigma^2)_F$	*COMPHEAD	*COMPCODA
a.			se.g[ə].l[ə]r		*!		
	seg[ə]l[ə]r		se.g[ə]lr	*!			
		→	se.gl[ə]r			*	
b.			se.g[ə].l[ə]n		*!		
	seg[ə]l[ə]n	→	se.g[ə]ln				*
			se.gl[ə]n			*!	

The description in (52) raises the question of how to eliminate the candidates with heterosyllabic clusters, which violate none of the constraints above (e.g. *seg.l[ə]n, *seg.l[ə]r). One possible approach is to rank the constraint HEADMAX defined in (53) above *COMPHEAD:

(53) HEADMAX
Prevocalic consonants must be syllabified in head position

Dominated by SON the constraint HEADMAX expresses the Maximum Onset Principle.[25]

[24] German differs hence from English where comparable cases of syncope gave rise to complex heads:

Engl. hun.d[ə].r[ə]d > hun.dr[ə]d
Engl. chil.d[ə].r[ə]n > chil.dr[ə]n

(54)	Input			SON	HEAD MAX	*COMP HEAD
a.	a.d[ə].l[ə]r		ad.l[ə]r		*!	
		→	a.dl[ə]r			*

While there is little controversy that words like Segler have indeed a complex head cluster (i.e. Se.[gl]er), the question of whether the remaining words have a complex head is far less clear. What is at issue here is the question of whether HEADMAX is dominated by the LOI stated in (55):

(55) LOI
Syllable heads must be a subset of the occurring word-initial heads

The evidence from Final Devoicing indicates that the LOI does not dominate HEADMAX in standard German.[26] That is, all obstruents in (51) remain voiced in Standard German after syncope has applied, regardless of the following sonorant (cf. Drosdowski, Giegerich). This indicates their syllabification in head rather than coda position. Violations of HEADMAX as in (56a) typically involve consonant-initial suffixes or consonant-final prefixes in support of the claim that those affixes do not form a single domain of syllabification together with the stem (cf. section 2.2.).

(56)a. Zeug.nis (Zeu[k]+nis) b. Zeu.gma (Zeu[g]ma)
Ab.laß (A[p]+laß) O.blate (O[b]late)

Assuming the correctness of the generalizations in 2.2. the HEADMAX violations in (56a) are explained by the prosodic structures in (57a):

(57)a. $(\text{Zeug})_\omega(\text{nis})_\omega$ b. $(\text{Zeugma})_\omega$
$(\text{Ab})_\omega(\text{laß})_\omega$ $(\text{Oblate})_\omega$

Reference to HEADMAX rather than the Law of Initials (henceforth LOI) in (54) may seem to be at odds with the fact that schwa loss in the word-initial syllable in (58) applied

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[25] The ranking Head Max > Comp Head is also supported by loanword phonology (cf. the nonapplication of Syllable Final Devoicing in Sti[g]ma as opposed to Ba[k]dad)

(i)	Input			SON	HEAD MAX	*COMP HEAD
a.	stigma	→	sti[.g]ma			*
			sti[k.]ma		*!	
a.	bagdad		ba[.g]dad	*!		
		→	ba[k.]dad		*	

[26] Cf. Giegerich 1987

only if the resulting cluster satisfied the LOI.[27] That is, while word-initial clusters like gr, br, gl, bl, and gn existed prior to schwa loss in German, there were no words with initial gm, bm, gv, bn, etc.:

(58)a.

MHG	NHG	
g[ə]róp	grob	'coarse'
b[ə]ríIle	Brille	'glasses'
g[ə]lít	Glied	'limb'
g[ə]lükke	Glück	'luck'
g[ə]lí:ch	gleich	'like'
g[ə]lóuben	glauben	'to believe'
b[ə]lí:ben	bleiben	'to stay'
g[ə]náde	Gnade	'mercy'

b.

MHG	NHG	
g[ə]mách	g[ə]mách	'slowly'
g[ə]méin	g[ə]méin	'mean'
g[ə]máhel	G[ə]máhl	'husband'
b[ə]mérken	b[ə]mérken	'to remark'
b[ə]mánnen	b[ə]mánnen	'to man'
b[ə]nîden	b[ə]néiden	'to envy'
b[ə]nénnen	b[ə]nénnen	'to name'
g[ə]wínnen	g[ə]wínnen	'to win'

The stability patterns in (58) accordingly support the relevance of the LOI and indicate the following constraint ranking:

(59)	Input			LOI	*SCHWA	COMPHEAD
a.	g[ə]náde		g[ə]náde		*!	
		→	gnáde			*
b.	b[ə]néiden	→	b[ə]néiden		*	
			bnéiden	*!		

Assuming that the description in (59) is adequate, what accounts for the LOI-violations observed in (51)? Significantly, schwa loss results in LOI-violations only in originally dactylic forms. The crucial difference between words like MHG [bə.n]îden and MHG huo[bə.n]er, both of which include the string [bə.n], lies accordingly in their foot structure.

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[27] Schwa is in general less likely to delete between an obstruent and a nasal than between an obstruent and a liquid. Some words in which schwa failed to delete between g and n are given in (i):

	MHG	NHG	
(i)	g[ə]nësen	g[ə]nesen	'to recuperate'
	g[ə]nicke	G[ə]nick	'neck'
	g[ə]nou	g[ə]nau	'exact'
	g[ə]nôse	G[ə]nosse	'comrade'
	g[ə]nuoc	g[ə]nug	'enough'
	g[ə]næme	g[ə]nehm	'suitable'

The fact that schwa tends to be stable between an obstruent and a nasal suggests that some complex heads are worse than others. That is, schwa stability between an obstruent and a nasal, but not between an obstruent and a liquid, may reflect a preference for a maximally sharp sonority increase in syllable heads (cf. Vennemann 1988:13ff). Such a preference is also manifested in the fact that obstruents delete before nasals (e.g. [gn]at > [n]at, [kn]ee > [n]ee) but not before liquids (e.g. [kr]y, [gl]ue) in Middle English (cf. Vennemann 1988:19) and calls for splitting *COMPLEX HEAD into several constraints which differ w.r.t. the sonority increase.

The apparent paradox can thus be resolved by ranking $(\sigma^2)_F$ above LOI but below HEADMAX:[28]

(60)	Input			SON	HEAD MAX	$(\sigma^2)_F$	LOI	*SCHWA	COMP HEAD
a.	b[ə].nî.den	→	b[ə].nî.den					*	
			bnî.den				*!		
b.			huo.b[ə].ner			*!			
	huo.b[ə].ner	→	huo.bner				*		
			huo[p].ner		*!				

The constraint ranking in (60) also explains the relevance of the LOI in the suffixed verbs in (19) and (20) discussed in section 3. That is, the suffix -ieren differs from the suffix -er in that it has initial stress and hence does not yield violations of the constraint $(\sigma^2)_F$.

(61)			SON	HEAD MAX	$(\sigma^2)_F$	LOI	*SCHWA	COMP HEAD
	→	nù.mm[ə]ríer[ə]n					*	
		nùmm.ríer[ə]n		*!				
		nù.mmríer[ə]n				*!		
		fìl.t[ə]ríer[ə]n		*			*	
	→	fìl.tríer[ə]n		*				
		fìlt.ríer[ə]n		**!				

Consider finally the ranking of COMPCODA. Since we know independently that *COMPHEAD dominates *COMPCODA it follows that schwa will delete in trochaic words even when yielding complex clusters. Examples are given in (62):

(62)	MHG	NHG	
	ern[ə]st	ernst	'serious'
	sanft[ə]	sanft	'gentle'
	sam[ə]t	samt	'along with'
	sim[ə]ʒ	Sims	'window sill'
	han[ə]f	Hanf	'hemp'

[28] While I consider the analysis in (60) to be basically correct it should be admitted that it rests more on my intuition than on facts. The problem is simply that there are almost no relevant examples to substantiate it. Specifically almost all cases of schwa loss in (58) involve the prefixes be- and ge-. The claim that schwa would fail to delete in words like d[ə].lX, d[ə].nX (as opposed to ád[ə].ler > á.dler, réd[ə].ner > ré.dner) can therefore not be tested. The paucity of relevant examples is made worse by the fact that schwa in those prefixes often fails to delete if the prefix combines with an independent word (e.g. b[ə]+laden (cf. laden 'to load'), b[ə]+rüeren (cf. rüeren 'to move')). This is presumably because stem boundaries align with prosodic word boundaries in these words (i.e. be+(laden)$_\omega$) and schwa deletion applies only within pwords (e.g. be+(laden)$_\omega$ vs (b[ə]lîben)$_\omega$). As a result schwa stability in b[ə]nîden could also be due the prosodic structure b[ə](nîden)$_\omega$ (cf. nîden 'to hate, to envy').

kel[ə]ch	Kelch	'goblet'
pferr[ə]ch	Pferch	'pen'
mön[ə]ch	Mönch	'monk'

Schwa loss in (62) is described in (63):

(63)	Input			*SCHWA	*COMPCODA
a.	er.n[ə]st		er.n[ə]st	*!	
		→	ernst		

While schwa loss has preserved word-initial phonotactic constraints it has given rise to many new word-final clusters. Indeed none of the clusters in (62) existed prior to MHG schwa loss in German. However, it is unclear whether this asymmetry is theoretically significant or whether it merely reflects the more limited distribution of schwa in wordinitial syllables.[29]

4.5. The SHELL stability effect

Consider the conditions of schwa loss in the near minimal pairs in (64a,b):

(64)a.	grüb[ə]l[ə]r	Grübl[ə]r	'brooder'	b.	zoub[ə]r[ə]r	Zaub[ə]r[ə]r	'magician'
	sam[ə]l[ə]r	Samml[ə]r	'collector'		kam[ə]r[ə]r	Kämm[ə]r[ə]r	'chamberlain'
	wand[ə]l[ə]r	Wandl[ə]r	'changer'		wand[ə]r[ə]r	Wand[ə]r[ə]r	'hiker'

Schwa loss in (64a) has already been described in tableau. The crucial difference between the words in (64) is presumably the flanking of the last schwa by two identical consonants in (64b), but not in (64a). However, reference to a constraint against syllables in which the nucleus is flanked by identical consonants obviously fails to distinguish between wellformed dactylic words like zoub[ə]r[ə]r, kam[ə]r[ə]r and the corresponding illformed trochaic forms zoubr[ə]r and kamr[ə]r. This problem is solved by the definition in (65), which is based on Vennemann's observation that identical speech sounds flanking the nucleus are especially disfavored when the syllable shell includes additional speech sounds (1988:11f).[30]

(65) SHELL
A syllable with the form CC_iNC_i is prohibited.

Schwa stability in (64) is described by ranking the constraint SHELL above $(\sigma^2)_F$, but below HEADMAX:

[29] Recall that schwa by and large only occurred in the prefixes be- and ge-.
[30] One of the few German words which violates the constraint SHELL is fror, the past tense form of frieren 'to freeze'.

(66)	Input			SON	HEAD MAX	SHELL	$(\sigma^2)_F$
a.	wan.d[ə].l[ə]r		wan.d[ə].l[ə]r		*[31]		*!
		→	wan.dl[ə]r		*		
			wan[t].l[ə]r		**!		
a.	wan.d[ə].r[ə]r	→	wan.d[ə].r[ə]r		*		*
			wan.dr[ə]r		*	*!	
			wan[t].r[ə]r		**!		

Reference to HEADMAX rather than the LOI is hence based on two independent observations. First, the syllabification of all prevocalic consonants in head position (for as long as SON is satisfied) accounts for the preservation of voicedness in obstruent-sonorant clusters which do not occur word-initially (e.g. adeler > A[dl]er, redener > Re[dn]er, huobener > Hü[bn]er). Second, reference to HEADMAX accounts for the SHELL stability effect. If HEADMAX were dominated by LOI the stability of both schwas would be accounted for only in (67a), but not in (67b).

(67)	MHG	NHG	
a.	zoub[ə]r[ə]r (*zou.[brər]	Zaubə]r[ə]r	'magician'
b.	kam[ə]r[ə]r (*ka.[mrər]	Kämm[ə]r[ə]r	'chamberlain'
	wuoch[ə]r[ə]r (*wuo.[xrər]	Wuch[ə]r[ə]r	'profiteer'
	beȥȥ[ə]r[ə]r (*be.[srər]	(Ver)Bess[ə]r[ə]r	'improver'

The context-sensitivity of schwa loss exhibited in (64) can accordingly be cited in support of a principle of head-maximization in German, to be constrained only by SON. That is, even clusters of sonorants are allowed in head position as is shown by the description of the near-minimal pair Sammler, Kämmerer in (68):

(68)	Input			SON	HEAD MAX	SHELL	$(\sigma^2)_F$
a.	sa.m[ə].l[ə]r		sa.m[ə].l[ə]r				*!
			sam.l[ə]r		*!		
		→	sa.ml[ə]r				
a.	kä.m[ə].r[ə]r	→	kä.m[ə].r[ə]r				*
			käm.r[ə]r		*!		
			kä.mr[ə]r			*!	

While syllabifications like Sa.mler may strike some readers as odd very similar conclusions have been drawn by Hooper (1976) based on her study of schwa loss in American English.

[31] Candidates which incur no HEADMAX violations are ruled out by SON (e.g. wa.nderer).

Consider the patterns of schwa loss in (69a,b) (cf. Zwicky). Schwa loss applies only in dactyls (e.g. sé[pər]ate > sé[pr]ate, but sé[pər]ate) and is sensitive to word frequency (e.g. sé[pər]ate > sé[pr]ate, but obstré[pər]ous (*obstré[pr]ous)):

(69)a.	sé[pər]ate > sé[pr]ate	c.	thé[rəp]y *> thé[rp]y
	lí[bər]al > lí[br]al		sy[ləb]le *> sy[lb]le
	bró[kəl]i > bró[kl]i		aspá[rəg]us *> aspá[rg]us
	chán[səl]or > chán[sl]or		é[ləf]ant *> é[lf]ant
b.	bé[vər]age > bé[vr]age		cy[nək]al *> cy[nk]al
	cá[θəl]ic > cá[θl]ic		compá[rəs]on *> compá[rs]on
	fá[məl]y > fá[ml]y		é[ləg]ant *> é[lg]ant
	cá[mər]a > cá[mr]a		ó[rəj]in ó[rj]in
	gé[nər]al > gé[nr]al		é[ləm]ent *> é[lm]ent
	tó[lər]ant > tó[lr]ant		có[lən]y *> có[ln]y

As was noted by Hooper the stability of schwa is determined by the relative sonority between the flanking consonants. If sonority rises schwa tends to disappear (cf.69 a,b). If sonority falls schwa is stable (cf.69c). Hooper interprets this generalization in support of a principle of Head Maximization constrained not by the language-specific LOI, but only by a universal constraint which requires sonority to rise in syllable heads. Indeed, unless one were to claim that schwa loss applies when yielding a bad syllable contact but not when yielding a good syllable contact Hooper's conclusion that the syllable boundaries in (69a,b) always precede the bracketed clusters regardless of the quality or quantity of the preceding vowel has to be accepted. Even clusters of liquids are tolerated for as long as SON is satisfied. Hooper's insight could be expressed in terms of the following ranked constraints:[32]

(70)	Input			SON	HEAD MAX	$(\sigma^2)_F$
a.	tól[ə]rant		tó.l[ə].rant			*!
			tól.rant		*!	
		→	tó.lrant			
a.	thér[ə]py	→	the.r[ə].py			*
			ther.py		*!	
			the.rpy	*!		

The types of context-sensitivity exhibited by schwa loss in dactyls indicates accordingly that word-internal syllabification in both languages is determined by universal sonority constraints (e.g. German Sa.[ml]er, English to.[lr]ant), rather than the language-specific LOI.

[32] Assuming that both schwas are stable in words like murderer one would have to assume that SHELL dominates $(\sigma^2)_F$ also in American English.

While supporting the principle of head maximization the English data also indicate an inviolable constraint on head complexity. That is, syllable heads must consist of maximally two segments. This constraint, which dominates HEADMAX and will be referred to as HEADBIN (headbinarity), accounts for the stability of schwa in cutlery (cf. (71)). The high ranking of HEADBIN in English is also shown by constraints on historical glide insertion before [u:]: the glide is not inserted if two consonants precede (e.g. [lu:]cid > [lju:]cid, but no insertion in [klu:] 'clue'). This is because the syllable head would otherwise include three segments (e.g. *[klju:]).

(71)	Input			SON	HEAD BIN	HEAD MAX	$(\sigma^2)_F$
a.			cú.tlry		*		
	cútl[ə]ry		cút.lry			*	
		→	cú.tl[ə].ry				*

HEADBIN, as is shown by schwa loss in words like boist[ə]rous, mast[ə]ry. Syllable-initial s also does not count with respect to the process of English Glide Insertion (e.g. [stu:] 'stew' > [stju:]). Syllable-initial s differs from other segments in the syllable head in that it is not subject to SON. Both SON and HEADBIN must accordingly be interpreted as referring to the 'core head' , that is, the head without initial s. There is evidence to be reviewed below that HEADBIN is inviolable in German as well.

Returning to the SHELL Stability Effect in German note that the ranking in (68) accounts for stable dactyls only if both schwas are necessary to prevent a complex syllable head. In other cases trochaic forms will be optimal as is illustrated in (72):

(72)			SON	HEAD MAX	SHELL	$(\sigma^2)_F$
a.		mau.[ə].r[ə]r				*!
	→	mau.r[ə]r				
		ma.ur[ə]r	*!			

The schwa pattern in (72) is difficult to describe in terms of the epenthesis rule in (11), which has been proposed within Lexical Phonology. Recall that epenthesis is sensitive to the sonority structure within a given morphological domain, but cannot look ahead to the suffixes to be attached later. The inadequacy of such an approach can be illustrated with agentive nouns like Kämmerer versus Maurer, which would be derived from the "unsyllabifiable stems" kämmr and maur. The epenthesis rule in (11) would apply in both cases with the result that Maurer cannot be generated. The correct form can be selected only if fully derived words are evaluated as is shown in (72). The crucial difference between Kämmerer and Maurer is that the cluster [mr] is a wellformed syllable head whereas [ur] is not.

In contrast to SON, the constraint SHELL is violable under two conditions. The first case is illustrated with the inflected adjectives in (73):

(73)a.	maka**br[ə]r** 'macabre'	b.	sau**b[ə]r[ə]r** 'clean'
	inte**gr[ə]r** 'having integrity'		ha**g[ə]r[ə]r** 'haggard'
	illus**tr[ə]r** 'illustrious'		düs**t[ə]r[ə]r** 'gloomy'
	sinis**tr[ə]r** 'sinister'		fins**t[ə]r[ə]r** 'dark'

According to Drosdowski (ed.) 1984:290, the pattern in (73a) (i.e. the SHELL violations) is characteristic of nonnative adjectives. The fact that loans such as clever from English and koscher from Yiddish, both of which violate native phonotactic patterns[33], follow the pattern in (32b) (i.e. clev[ə]r[ə]r, kosch[ə]r[ə]r) casts doubt on that explanation. An alternative account refers to overall word length. Assuming that SHELL is dominated by a constraint "$(\sigma^3)_\omega$", which restricts the number of syllables in prosodic words to maximally three syllables, the data in (73) are explained:

(74)			SON	HEAD MAX	$(\sigma^3)_\omega$	SHELL	$(\sigma^2)_F$
a.		ma.ká.b[ə].r[ə]r			*!		
		ma.káb.r[ə]r		*!			
	→	ma.ká.br[ə]r				*	
b.		saub.r[ə]r		*!			
		sau.br[ə]r				!*	
	→	sau.b[ə].r[ə]r					*

The existence of prosodic words with four or more syllables (e.g. Tohuwabohu 'chaos' Parallelogramm 'parallelogram'), which may even include schwa (e.g. Fisimatent[ə]n 'excuses, fuss', Hämorrhoid[ə]n 'haemorrhoids'), shows that the constraint $(\sigma^3)_\omega$ is dominated by constraints like SON and PRESERVE PLACE.

The other case in which SHELL violations occur are verbs, which shows that the ranking of constraints can depend on the syntactic category of words.[34] In table (75) inflected adjectives are compared with infinitives:

(75)a.	inflected adjectives (acc. sg. masc.):	b.	verbs:
	trock[ə]n[ə]n 'dry'		trockn[ə]n 'to dry'
	eb[ə]n[ə]n 'flat'		ebn[ə]n 'to flatten'
	eig[ə]n[ə]n 'own'		eign[ə]n 'to be suited'
	off[ə]n[ə]n 'open'		öffn[ə]n 'to open'

[33] The adjective clever does not conform to German phonotactics in that voiced fricatives are never preceded by lax vowels in native words (cf. Löwe 'lion', Wiese 'meadow'). The adjective koscher is marked in that the fricative [s] is preceded by a tense vowel. This pattern does not occur in native words with the exception of wusch, which is the past tense form of waschen 'to wash'.

[34] The claim that phonological wellformedness conditions are category-specific is also supported by English stress patterns. In fact, even phonotactics may be sensitive to the syntactic category of words as is shown by the distribution of voiced versus voiceless interdental fricatives in English.

Historically, verbs had the same prosodic forms as the adjectives in (75a). A possible interpretation of the difference in (75) is that in verbs the order between SHELL and "$(\sigma^2)_F$" reversed in NHG.

4.6 A note on sonority

Assuming that the account of syllabification in (74) is basically correct the evidence from schwa loss also sheds light on the sonority hierarchy. For example, the stability of both schwas in Kämmerer indicates that r is more sonorous than m in accordance with the tentative hierarchy in (15). Consider now the only phonologically conditioned rule of schwa epenthesis in the transition from MHG to NHG, which coincided with the diphthongization of long high vowels:

(76)	fi:r > faɪ[ə]r	'celebration'
	fy:r > fËɪ[ə]r	'fire'
	mu:r > mau[ə]r	'wall'

While all long high vowels became diphthongs consisting of a low nucleus followed by a high glide, epenthesis applied only before r (e.g. fu:l > faul, not *fau[ə]l, fi:n > fain, not *fai[ə]n). This particular restriction indicates that the conditions on schwa insertion in (76) relate to sonority. This is because high vowels, being the least sonorous vowels, are adjacent to r, which is the most sonorous consonant, as is shown in the more detailed sonority hierarchy of sonorants shown in (77):

(77) increasing sonority decreasing sonority

<--->

low vowels	mid vowels	high vowels	r	l	nasals

Assuming that glides are high vowels syllabified in non-peak position and that individual languages allow for the merger of adjacent sonority classes epenthesis in (76) can be described by revising the sonority hierarchy as follows:

(78) increasing sonority decreasing sonority

<--->

low vowels	mid vowels	high vowels	glides r	l	nasals

Ignoring the constraints describing diphthongization historical schwa insertion in (76) is described simply by the ranking in (79). This is because according to the hierarchy in (79) sonority fails to decrease in the coda [ur].

(79)	Input			SON	SCHWA
a.	mu:r		maur	*!	
			mau[ə]r		*

Consider next the evidence for sonority distinctions between nasals. Recall the analysis of schwa deletion in American English in terms of the constraint ranking in (71). The additional data in (80) show that schwa disappears between m and n, but not if the order of the nasals is reversed:

(80)a.	fé[mən]ine > fé[mn]ine	b.	é[nəm]y (*é[nm]y)
	dó[mən]ant > dó[mn]ant		ecó[nəm]y (*ecó[nm]y)
	nó[mən]al > nó[mn]al		cí[nəm]on (*cí[nm]on)
	Gér[mən]y > Gér[mn]y		Pá[nəm]a (*Pá[nm]a)
	stá[mən]a > stá[mn]a		a[nəm]al (*a[nm]al)

To account for the data in (80) Hooper assumes that n is more sonorous than m. Assuming that schwa loss in (80a) is indeed determined by the relative sonority between the consonants which flank the schwa it follows that the sonority hierarchy needs to be refined as in (81):

(81) increasing sonority   decreasing sonority

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vowels low ---------high	r	l	n	m	fricatives	stops, affricates

Independent evidence in support of this assumption comes from phonotactic restrictions in Greek and Irish. Both languages allow the word-initial cluster mn, but not nm. Assuming that the occurrences of the two consecutive schwa syllables in the inflected adjectives in (75a) are also manifestations of the SHELL Stability Effect the German data can also be cited in support of the hierarchy in (81).[35] This is because the effect exists in the adjective vollkomm[ə]n[ə]n 'complete', which has the prosodic structure $(\text{voll})_{\omega}(\text{kommenen})_{\omega}$.

If the correlations observed here held universally this would argue for a more finely grained universal sonority hierarchy where sounds are further classified in terms of distinct places of articulation. Individual languages would on this view allow for the merger of adjacent slots such that the relative ranking between the merged sound classes and other classes within the hierarchy are retained.

4.7 Glide Formation

In view of the significance of the (controversial) principle of head maximization (rather than

[35] The claim that the inflected adjectives in (75a) exhibit the SHELL stability effect is supported by the fact that dactyls occur only in those paradigms which include at least one member which violates SHELL(e.g. tróckenen, óffenen, múnterer, wáckerer, but not férnen, ármem, or any adjective whose stem-final consonant is not identical to one of the four suffixes (i.e. n, m, r, s), such as inflected forms of dunkel, übel, etc)

the LOI) for the account of schwa stability I will discuss additional evidence in support of that principle. Consider the rule of optional Glide Formation in Standard German (cf Drosdowski 1990), which (contrary to the description in Hall 1992) applies only in dactyls and thus differs from obligatory Glide formation in non-initial prestress position (e.g. Relig[j]ón (*Religion)) and from for many speakers unacceptable glide formation in the word-initial syllable (e.g. ??P[j]áno). Glide Formation in German differs from schwa loss in American English in that it is insensitive to word frequency:

(82)a.	Óp[j]um 'Opium'	b.	Mor[f][j]um 'Morphium'	c.	Hafn[i]um 'Hafnium'
	Kál[j]um 'Kalium'		Kal[t^s][j]um 'Kalzium'		Natr[i]um 'Natrium'
	Gall[j]um 'Gallium'		Olymp[j]a 'Olympia'		Osm[i]um 'Osmium'
	Itál[j]en 'Italien'		Órg[j]e 'Orgie'		Omn[i]um 'Omnium'
	Tragöd[j]e 'Tragödie'		Líl[j]e 'Lilie'		Hydr[i]a 'Hydria'
	Millén[j]um 'Millenium'		Kamb[j]um 'Kambium'		Re[kv][i]en 'Requien'

Glide formation always applies if one consonant precedes (cf. (82a)). If two consonants precede Glide Formation applies only if the sonority decreases according to the hierarchy in (81), but not if sonority increases. These facts suggest that both consonants preceding the i in (82c) are syllabified in head position, regardless of language-specific LOI-restrictions. Glide Formation is accordingly described by the ranking in (83), which is identical to the ranking describing schwa loss in American English. The fact that Glide Formation does not apply in words like Omnium, where i is preceded by the cluster [mn], supports the claim that n is more sonorous than m.

(83)	Input			SON	HEAD BIN	HEAD MAX	$(\sigma^2)_F$	*COMP HEAD
a.			Mó.r[fi]um	*!				
	Mór[fi]um		Mór.[fi]um			*	*!	
			Mór.[fj]um			*		
			Há.fn[i]um					
	Háfn[i]um		Há.fn[j]um		*!			
			Háf.n[j]um			*!		
			Há.fn[i].um				*	

The fact that glide formation applied in words like Bestie, Hostie shows that the syllable-initial coronal fricative does not count regarding the constraint on the "core head" to maximally two positions. The fact that glide formation applied in words like Kalzium, Razzia, Aktie supports the claim that affricates are monosegmental in German.

5. Identity effects in adjectival paradigms

In this section I introduce a constraint, LEVEL, which explains the occurrence of certain phonologically unmotivated schwas in terms of a condition of paradigm leveling.

As was noted in section 3, on the basis of purely phonological criteria the forms of the inflected adjectives listed in (84A_{lock}) are preferable to the actual forms listed in (84B_{lock}). This is because paradigm A_{lock} has fewer violations of the constraint $(\sigma^2)_F$.

(84)	A_{lock}	B_{lock}	C_{lock}	D_{lock}
	lock[ə]r[ə]r	lock[ə]r[ə]r	lock[ə]rr	lockr[ə]r
	lock[ə]rs	lock[ə]r[ə]s	lock[ə]rs	lockr[ə]s
	lock[ə]rn	lock[ə]r[ə]n	lock[ə]rn	lockr[ə]n
	lock[ə]rm	lock[ə]r[ə]m	lock[ə]rm	lockr[ə]m
	lock[ə]r	lock[ə]r[ə]	lock[ə]r	lockr[ə]

In paradigm A_{lock} all schwas are phonologically motivated: they are needed to satisfy the constraints SON and SHELL. The reason for preferring paradigm B_{lock} to paradigm A_{lock} lies in the fact that B_{lock} is more leveled. Being 'more leveled' means that the members of a paradigm bear a greater phonological similarity to each other. Specifically, the members of paradigm B_{lock} all have the same number of syllables which is not true for the members of paradigm A_{lock}. Assuming that there is a constraint LEVEL which requires all members of the paradigm to have the same number of syllables the preference of paradigm B_{lock} over paradigm A_{lock} is explained as follows. Recall that the ranking between SON, SHELL, and $(\sigma^2)_F$ has been established in section 4. While satisfying LEVEL to the same extent as the winning paradigm B_{lock}, candidates C_{lock} and D_{lock} are both fatally flawed. Paradigm C_{lock} is eliminated because it includes the SON-violator lock[ə]rr. Paradigm D_{lock} is eliminated because it includes a member which violates SHELL, e.g. lockr[ə]r.

(85)			SON	LEVEL	SHELL	$(\sigma^2)_F$
		A_{lock}		*!		
	→	B_{lock}				****
		C_{lock}	*!			
		D_{lock}			*!	

The observation that the existence of one potential SHELL-violator among the members of an adjectival paradigm (e.g. the form lock[ə]r[ə]r) implies that *all* members end in two schwa-syllables strongly supports the analysis in (85). That is, the constraint ranking in (85) solves the "sonority puzzle" first presented in (21). The three adjectives contrasted there are those which are framed in (86):

(86)			
	lock**[ə]r[ə]r**	trock[ə]n[ə]r	dunkl[ə]r
	lock[ə]r[ə]s	trock[ə]n[ə]s	dunkl[ə]s
	lock[ə]r[ə]n	trock**[ə]n[ə]n**	dunkl[ə]n
	lock[ə]r[ə]m	trock[ə]n[ə]m	dunkl[ə]m
	lock[ə]r[ə]	trock[ə]n[ə]	dunkl[ə]

Looking at the three framed adjectives in isolation, the distribution of schwa is mysterious indeed. However, once we look at the respective paradigms as a whole the patterns are explained. Because the inventory of inflectional adjectival suffixes include nasals and r the paradigms of adjectives in which a 'stem-final' nasal or r follows a less sonorous consonant regularly include at least one member which potentially violates SHELL and therefore ends in two schwa syllables (cf. the words with the boldfaced segments in (86)).[36] The high ranking of LEVEL w.r.t. $(\sigma^2)_F$ implies that all members of the respective paradigms end in two schwa syllables. By contrast, paradigms of adjectives with a 'stem-final' l (e.g. dunkel 'dark' übel 'evil' etc.) never include a potential SHELL violator because the inventory of adjectival inflectional suffixes does not include l. Consequently, the inflected forms of such adjectives always end in a single schwa syllable.

To summarize, on the analysis in (85) all dactylic forms in (86) other than those including bold-faced segments are analysed as identity effects. A prerequisite of such an analysis is that the candidates to be evaluated in (85) consist of complete paradigms rather than individual words. Empirically, the analysis embodies a claim that the basis for leveling in inflectional paradigms is not necessarily the most frequent or least marked form. Rather, the basis for leveling is determined by constraint ranking. That is, lock[ə]r[ə]r in A_{lock} is not leveled to adjust to the phonologically optimal trochaic forms in that paradigm. Rather, all forms are leveled on the basis of lock[ə]r[ə]r, because SHELL dominates $(\sigma^2)_F$.

While not motivating the existence of phonologically unwarranted schwas, the constraint LEVEL is crucial for explaining the distribution of schwas in the paradigm of dunkel. Specifically, the fact that in most members of that paradigm the schwa appears in the

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[36] Recall that there exists one class of adjectives which does not end in two schwa syllables even if matching the sonority structure in question, that is, the polysyllabic adjectives like makaber, integer, etc. discussed in section 2.2. The fact that the derived forms of those adjectives fail to satisfy SHELL (e.g. makabrer, integrer) has been taken to indicate that SHELL is dominated by a constraint "$(\sigma^3)_\omega$" which limits the number of syllables in prosodic words. The ranking "$(\sigma^3)_\omega$ >> SHELL, LEVEL >> *SCHWA" leads us to expect that the optimal inflectional paradigms of those adjectives are leveled such that all forms end in a single schwa syllable. This is in fact correct as is illustrated in (i):

(i)	makabr[ə]r	integr[ə]r
	makabr[ə]s	integr[ə]s
	makabr[ə]n	integr[ə]n
	makabr[ə]m	integr[ə]m
	makabr[ə]	integr[ə]

Paradigms of adjectives where the 'stem-final' consonant follows a more or equally sonorous segment (e.g. fern 'far', or sau[ə]r 'sour') do not include a potential SHELL-violator regardlesss of the inflectional suffix added and therefore must not include any forms ending in two schwa syllables. In fact, they never do as the tableau in (62) describes correctly. The actual paradigms of fern and sauer are listed in (ii):

(ii)	fern[ə]r	saur[ə]r
	fern[ə]s	saur[ə]s
	fern[ə]n	saur[ə]n
	fern[ə]m	saur[ə]m
	fern[ə]	saur[ə]

phonologically disfavored site is due to LEVEL. Compare A_{dun}, the actual paradigm, with B_{dun}, the paradigm containing the phonologically optimal forms:

(87)	A_{dun}	B_{dun}	C_{dun}	D_{dun}
	dunkl[ə]r	dunkl[ə]r	dunk[ə]lr	dunk[ə]l[ə]r
	dunkl[ə]s	•dunk[ə]ls	•dunk[ə]ls	dunk[ə]l[ə]s
	dunkl[ə]n	•dunk[ə]ln	•dunk[ə]ln	dunk[ə]l[ə]n
	dunkl[ə]m	•dunk[ə]lm	•dunk[ə]lm	dunk[ə]l[ə]m
	dunkl[ə]	•dunk[ə]l	•dunk[ə]l	dunk[ə]l[ə]

All forms marked with a dot in (87) are phonologically superior to the corresponding forms in the actual paradigm in that the schwa breaks up the rightmost cluster in which sonority fails to decrease (e.g. kl) rather than follows that cluster (cf. sections 2, 3). The tableau in (88) shows why candidate A_{dun} is nonetheless optimal:

(88)			SON	LEVEL	SHELL	$(\sigma^2)_F$	COMP HEAD
	→	A_{dun}					*****
		B_{dun}		*!			
		C_{dun}	*!				
		D_{dun}				*****!	

Despite incurring fewer violations of COMPHEAD than the optimal paradim, both B_{dun} and C_{dun} are fatally flawed: B_{dun} is phonologically optimal, but not leveled whereas A_{dun} which is leveled, includes a SON-violator (e.g. dunk[ə]lr). This dilemma, as it involves LEVEL, is specific to paradigms, explaining the fact that in German all words with the schwa in the disfavored site (e.g. dunkl[ə]n rather than dunk[ə]ln) are members of paradigms (cf. section 2.). Candidate D_{dun} is eliminated because of gratuitious occurrences of $(\sigma^2)_F$-violations.

The analysis of the disfavored sites of the schwa in the winning paradigm in (88) also explains the 'celebrated minimal pair' in (25) which is repeated in (89):

(89) dunkl[ə]n$]_{AINFL}$ - Dunk[ə]ln$]_{NINFL}$

The reason for the distinct sites of the schwa in (89) becomes clear in view of the complete paradigms. Compare the adjectival paradigm candidates of dunkel in (90a) with the corresponding nominal paradigm candidates in (90b) (the respective actual paradigms are framed):[37]

[37] Following German orthography, the subscript in the name of the nominal paradigms is capitalized, thereby differing from the adjectival paradigms.

(90)a. adjectival:

A_{dun}	C_{dun}
dun**kl**[ə]r	dun**k**[ə]**l**r
dun**kl**[ə]s	dun**k**[ə]**l**s
dun**kl**[ə]n	dun**k**[ə]**l**n
dun**kl**[ə]m	dun**k**[ə]**l**m
dun**kl**[ə]	dun**k**[ə]**l**

b. nominal:

A_{Dun}	B_{Dun}
Dun**k**[ə]**l**	Dun**kl**[ə]
Dun**k**[ə]**l**s	Dun**kl**[ə]s
Dun**k**[ə]**l**n	Dun**kl**[ə]n

Crucially, adjectival and nominal paradigms differ with respect to their suffixes, in particular, regarding the question of sonority values. The inventory of adjectival inflectional suffixes includes the sonorant r, (which is more sonorous than the stem-final l in dunkel), whereas the most sonorous suffix in the nominal paradigm is the n (which is less sonorous than the stem-final l in Dunkel). As a result, leveling in the nominal paradigm is achieved at no phonological expense: each member in A_{Dun} would beat all corresponding forms in other paradigms if the words were evaluated individually. By contrast, as was discussed above, leveling in the adjectival paradigm can only be achieved at the expense of including the forms with the disfavored site of the schwa. The different sites of the schwa in (89) result accordingly from the fact that the constraint COMPHEAD plays a role in the evaluation of the nominal but not of the adjectival candidates as is shown in tableau (91):

(91)			SON	LEVEL	SHELL	$(\sigma^2)_F$	COMP HEAD
	→	A_{dun}					*****
		C_{dun}	*!				
		A_{Dun}					
		B_{Dun}					***!

The reason for 'celebrating' the pair in (89) in Lexical Phonology concerns the claim that the distribution of the schwa reveals the existence of distinct strata. Alternatively, it has been suggested that that distribution shows that adjectival inflectional suffixes are lexically associated with schwa whereas nominal suffixes are not (cf. the references on page 149).[38] In contrast to both of these approaches I have argued that the distribution of the schwa in (89) follows straightforwardly from the independent observations that (i) inflectional paradigms in German are leveled and (ii) the inventories of adjectival and nominal inflectional suffixes differ with respect to their sonority values. This analysis renders superfluous both the assumption of distinct strata and the stipulation that some suffixes are lexically associated with schwa whereas others are not.

[38] The fact that adjectival suffixes are also associated with schwa in the absence of potential sonority violations (e.g. the paradigm of roh 'raw': roh[ə]r, roh[ə]n, roh[ə]s, etc.) is part of a wider generalization according to which all sonorant suffixes regardless of their category are associated with schwa. This generalization is discussed in section 2.5.1.

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