

Topics in German Phonology
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Handout 2

1 The velar nasal and [ŋg] clusters

1.1 Problem #1: No velar nasal in initial position

- (1) Surface contrasts between the three nasal consonants [m], [n] and [ŋ]:
- | | | | | | | | |
|----|-------|--------|---------|----|---------|--------|-------------------|
| a. | Wamme | [vamə] | ‘jowl’ | b. | schlimm | [ʃlɪm] | ‘bad’ |
| | Wanne | [vanə] | ‘tub’ | | Sinn | [zɪn] | ‘sense’ |
| | Wange | [vaŋə] | ‘cheek’ | | sing | [zɪŋ] | ‘sing (imp. sg.)’ |
- (2) The velar nasal occurs neither word-initially (in b), nor in initial position after a consonant (in d):
- | | | | |
|----|---------|--------|-----------|
| a. | nett | [net] | ‘nice’ |
| | Mann | [man] | ‘man’ |
| b. | | *[ŋan] | |
| c. | Schnee | [ʃne:] | ‘snow’ |
| | Schmuck | [ʃmʊk] | ‘jewelry’ |
| d. | | *[ŋʊk] | |
- (3) The velar nasal is nonoccurring word-internally after a consonant:
- | | | | |
|----|---------|------------|----------|
| a. | Urne | [ʊʀnə] | ‘urn’ |
| | Ärmel | [ɛʀməl] | ‘sleeve’ |
| | Almosen | [almɔːzən] | ‘alms’ |
| b. | | *[ʊʀŋə] | |
- (4) The velar nasal occurs in absolute word-final position (in a) or in word-final position followed by [s], or [t] (in b):
- | | | | |
|----|--------|---------|------------|
| a. | Ding | [dɪŋ] | ‘thing’ |
| | Sprung | [ʃpʀʊŋ] | ‘jump’ |
| b. | Angst | [aŋst] | ‘fear’ |
| | Hengst | [hɛŋst] | ‘stallion’ |
| | sing-t | [zɪŋt] | ‘sings’ |

(5) The cluster [ŋg] occurs intervocalically (see a). Examples like these will be discussed in greater detail in section 1.3 below. [ŋg] cannot occur initially (in b) or finally (in c).

a. Tango [tʌŋgo] ‘tango’
 Ungarn [ʊŋgʌrn] ‘Hungary’

b. *[ŋgan]

c. *[dɪŋg]

(6) [ŋk] clusters occur intervocalically (in a) and finally (in b) but never initially (in c):

a. Anker [ʌŋkɐ] ‘anchor’

b. Bank [bʌŋk] ‘bank’

c. *[ŋkan]

Note: A complete treatment would have to account for the fact that [ŋk] is occurring in (6a-b) and that [nk] is not. This gap is usually accounted for by positiing a rule of (regressive) Nasal Place Assimilation (see 9c below).

(7) Summary of the distribution of [ŋ] and [ŋg]:

	[ŋ]	[ŋg]
a. syllable-initial	no	no
b. syllable-final	yes	no

(8) There are cooccurrence restrictions that will not be discussed below:

a. No velar nasal after a long vowel or diphthong, e.g. *[di:ŋ], cf. [dɪŋ] ‘thing’

b. No velar nasal in word-final position after a consonant, e.g. [dɪŋ], cf. [halm] ‘blade’

In rule-based phonology these gaps would follow if the velar nasal is not a phoneme, but instead derived from /ŋg/ (or /nk/). Thus, given underlying forms (for hypothetical words) like /di:ŋg/ and /dɪŋg/ then both gaps follow from constraints on syllable structure (see Hall 2002).

In OT the gaps would follow given inputs like /di:ŋg/ and /dɪŋg/, but it is not clear how (a) and (b) could be accounted for given inputs like /di:ŋ/ and /dɪŋ/.

1.1.1 A rule-based analysis

(9) The complementarity of [ŋ] and [ŋg] can be captured if it is assumed that [ŋ] is not a phoneme and that it derives from /ŋg/ or /ŋk/ (see a-b) with the rules in (c-d):

a. Ding /dɪŋg/ [dɪŋ] ‘thing’

b. krank /krɒŋk/ [krɒŋk] ‘sick’

c. Nasal-Place Assimilation (NPA): $n \rightarrow [\alpha\text{Place}] / _ _ [-\text{son}, -\text{cont}, \alpha\text{Place}]$

d. g-Deletion (g-Del): $g \rightarrow \emptyset / _ _ [\text{ŋ} _ _]_{\sigma}$

Some linguists who follow this tradition: Issachenko (1963), Kloeke (1982), Hall (1992), Wiese (1996). This approach captures the gaps in (7a):

- [ŋg] cannot occur initially because this cluster would violate sonority sequencing.
- If [ŋ] derives from /ŋg/ then [ŋ] cannot occur in initial position because g-Deletion only applies syllable-finally.

1.1.2 An OT solution

(10) Two constraints (see Féry 2003 for a treatment along these lines):

a. $*_{\sigma}[\text{ŋ}]$: The velar nasal is not permitted syllable-initially

b. SONORITY SEQUENCING GENERALIZATION (SSG): Onsets show a sonority rise and codas a sonority fall.

Note: The constraint $*_{\sigma}[\text{ŋ}]$ derives typological motivation; see Anderson (2005).

(11) Given an input /ŋa/ (for a hypothetical and nonoccurring word) the ranking $*_{\sigma}[\text{ŋ}] \gg \text{FAITHFULNESS}$ predicts that the velar nasal cannot surface faithfully. It is assumed here that the output of this mapping would be [na]:

	/ŋa/	$*_{\sigma}[\text{ŋ}]$	FAITHFULNESS
a.	[ŋa]	* !	
b.	→ [na]		*

- (12) Given an input /ŋga/ (for a hypothetical and nonoccurring word) the ranking *_σ[ŋ], SSG » FAITHFULNESS also predicts that the velar nasal cannot surface faithfully:

/ŋga/	* _σ [ŋ]	SSG	FAITHFULNESS
a. [ŋa]	*!		*
b. [ŋga]		*!	
c. → [na]			*

1.2 Problem #2: No [ŋk] (from /ŋg/) in final position

1.2.1 A rule-based treatment

- (13) Examples of surface and underlying representations:

a. Ding	/dɪŋg/	[dɪŋ]	‘thing’
b. krank	/kɾaŋk/	[kɾaŋk]	‘sick’

- (14) Rules requires (from 9c-d) :

a. Nasal-Place Assimilation (NPA): $n \rightarrow [\alpha\text{Place}] / _ _ [-\text{son}, -\text{cont}, \alpha\text{Place}]$

b. g-Deletion (g-Del): $g \rightarrow \emptyset / _ _]_{\sigma}$

This approach captures the generalizations in (7b): [ŋg] cannot occur in final position (but [ŋ] must occur in this position) because the /g/ is deleted by rule (14b).

- (15) Derivations of the velar nasal in word-final position (*Ding*), and before /k/ (*krank*):

	/dɪŋg/	/kɾaŋk/
1. Syllab.	.dɪŋg.	.kɾaŋk.
2. NPA	.dɪŋg.	.kɾaŋk.
3. g-Del	.dɪŋ.	-----
4. Final Devoicing	-----	-----
	[dɪŋ]	[kɾaŋk]

- (16) g-Deletion must be ordered before Final Devoicing to prevent the syllable-final /g/ from being devoiced to [k]. In certain dialects spoken in Northern Germany the devoicing of the /g/ to [k] is correct:

	<i>Standard</i>	<i>Northern German</i>	
Ding	[dɪŋ]	[dɪŋk]	‘thing’
krank	[kraŋk]	[kraŋk]	‘sick’

In rule-based treatments one could account for the Northern German pronunciation by ordering Final Devoicing before g-Deletion (Kiparsky 1971/1982).

1.2.2 Two OT treatments

- (17) Féry (2003) posits a number of constraints to account for the velar nasal facts. The three relevant ones are given here:
- MAX (N, D): Penalizes deletion of a nasal or a dorsal segment
 - BIMOR: Syllables are maximally bimoraic
 - *ŋg: [ŋg] is ungrammatical

- (18) Evaluation of a word like [dɪŋ] given the input /dɪŋg/:

/dɪŋg/	BIMOR	MAX (N, D)	*ŋg
a. [dɪŋg]	*!		*
b. [dɪŋ.g]			*!
c. [dɪŋ]		*!	
d. → [dɪŋ]			

- (19) How could [dɪŋ] be selected given the input /dɪŋg/ (see Féry’s tableau (23))?

/dɪŋg/	BIMOR	MAX (N, D)	*ŋg
a. [dɪŋg]	*!		*
b. → [dɪŋ.g]			*
c. [dɪŋ]		*!	
d. [dɪŋ]		*!	

(20) How would the constraints in (17) work for a word with an /ŋk/ cluster, e.g. [baŋk]?

/baŋk/	MAX (N, D)	BiMOR	*ŋg
a. [baŋg]		*	*!
b. [baŋ]	*!		
c. → [baŋk]		*	

(21) How do these constraints work with words ending in other nasal-stop sequences?

/bunt/	MAX (N, D)	BiMOR	*ŋg
a. [bunt]		*	
b. → [bun.t]			
c. → [bun]			
d. [but]	*!		

(22) Ito and Mester (2003) posit the following constraints:

a. *VC: *VOICOBNS & *COD (penalizes voiced obstruents in coda)

b. *CDC: *COD & *DORSPLNS & *COMPLX (penalizes [ŋg] and [ŋk] clusters)

c. MAX: No deletion

c. IDENT (voice): Input and output agree in the feature [voice]

(23) Ranking responsible for Final Devoicing:

/ta:g/	*VC	MAX	IDENT (voice)
a. [ta:g]	*!		
b. [ta:]		*!	
c. → [ta:k]			*

Note: The ranking *VC » MAX follows from the general M » F ranking schema.

(24) How does one account for the deletion of /g/ in a word like [dɪŋ]? The assumed input is /dɪŋg/ (see Ito & Mester's tableau (35), p. 288):

/dɪŋg/	*CDC	*VC	MAX	IDENT (voice)
a. [dɪŋg]	*!	*		
b. [dɪŋk]	*!			*
c. → [dɪŋ]			*	

(25) Incorrect winner selected if the word ends in /ŋk/:

/baŋk/	*CDC	*VC	MAX	IDENT (voice)
a. [baŋg]	*!	*		*
b. [baŋk]	*!			
c. ←[baŋ]			*	

(26) The correct analysis requires that *CDC be locally conjoined with a faithfulness constraint (see Ito & Mester's tableau (39), p. 290):

/dɪŋg/	*VC	*CDC & IDENT (voice)	MAX	*CDC	IDENT (voice)
a. [dɪŋg]	*!			*	
b. [dɪŋk]		*!		*	*
c. → [dɪŋ]			*		

Note: This analysis is intended to express the fact that only *derived* /k/ deletes. The following tableau shows that *nonderived* /k/ is retained.

(27) For words ending in /ŋk/ the conjunction is satisfied in the faithful output form:

/baŋk/	*VC	*CDC & IDENT (voice)	MAX	*CDC	IDENT (voice)
a. [baŋg]	*!	*		*	*
b. → [baŋk]				*	
c. [baŋ]			*!		

1.3 Problem #3: [ŋ] vs. [ŋg] in prevocalic position

(28) The cluster [ŋg] occurs between vowels if the second one is not a schwa syllable. This generalization only holds in monomorphemes. The following examples only contain nonnative words because there are no native words of this structure (with the exception of names, see 29-30 below).

Tango	[taŋgo]	'tango'
Kongo	[kɔŋgo]	'Congo'
Ungarn	[uŋgarn]	'Hungary'
Singular	[zɪŋgula:ɐ]	'singular'
Singapur	[zɪŋgapu:ɐ]	'Singapore'
Angina	[aŋgi:na]	'angina'

(29) The velar nasal (and not [ŋg]) occurs between two vowels if the second vowel is a schwa syllable (i.e. [ə], a syllabic sonorant, or [ɐ]). Names show the same generalization.

a. Mangel	[maŋəl]/[maŋl]	‘lack’
Angel	[aŋəl]/ [aŋl]	‘fishing rod’
Inge	[ɪŋə]	‘personal name’
Ingeborg	[ɪŋəbɔrk]	‘personal name’
Göttingen	[gœtɪŋən]/[gœtɪŋ]	‘city name’
b. Dünger	[dʏŋɐ]	‘dung’

(30) Minimal triplet (all names) illustrating the contrast between [ŋ] before schwa and [ŋg] before a full vowel:

a. Inge	[ɪŋə]
b. Inga	[ɪŋga]
Ingo	[ɪŋgo]

(31) The ungrammaticality of [ŋg] before a schwa syllable is a significant difference between German and English:

	<i>English</i>	<i>German</i>
Single	[ŋg]	[ŋ]
Finger	[ŋg]	[ŋ]
Hunger	[ŋg]	[ŋ]

(32) [ŋk] occurs intervocalically before schwa syllables (in a) and before full vowels (in b). [mb nd] and [mp nt] occur in both contexts as well (see c and d).

a. Onkel	[ɔŋkəl]	‘uncle’
b. Inka	[ɪŋka]	‘Inca’
c. Bombe	[bɔmbə]	‘bomb’
Ende	[ɛndə]	‘end’
Kombination	[kɔmbinatsjɔ:n]	‘combination’
Endivie	[ɛdi:vjə]	‘endive’
d. Lampe	[lampə]	‘lamp’
Ente	[ɛntə]	‘duck’
empirisch	[ɛmpiriʃ]	‘empirical’
Anti-	[anti]	‘anti-’

(33) Summary of environments for German [ŋ] and [ŋg] before vowels:

	[ŋ]	[ŋg]
a. before schwa	yes	no
b. before full V	no	yes

1.3.1 A rule-based approach

(34) Examples of surface and underlying representations:

a. Ding	/dɪŋg/	[dɪŋ]	‘thing’
b. krank	/kʀʌŋk/	[kʀʌŋk]	‘sick’
c. Tango	/tʌŋgə/	[tʌŋgo]	‘tango’
d. Zunge	/tsʊŋgə/	[tsʊŋə]	‘tongue’

Note: The symbol /ə/ represents a skeletal position (i.e. X) underspecified for segmental features; hence, it cannot be syllabified as a nucleus and /g/ can delete because it is syllable-final. The features for schwa are supplied by the Schwa-Default rule, which is ordered after g-Deletion. See Hall (1992), who advocates this approach.

(35) Derivations of the velar nasal in word-final position (*Ding*), before /k/ (*krank*) and before a syllable-initial /g/ (*Tango*):

	/dɪŋg/	/kʀʌŋk/	/tʌŋgə/
1. Syllab.	.dɪŋg.	.kʀʌŋk.	.tʌŋ.gə.
2. NPA	.dɪŋg.	.kʀʌŋk.	.tʌŋ.gə.
3. g-Del	.dɪŋ.	-----	-----
4. Final Devoicing	-----	-----	-----
	[dɪŋ]	[kʀʌŋk]	[tʌŋgo]

- (36) Derivation of a word in which the velar nasal is followed by schwa (*Zunge*) compared with a phonologically similar word, in which g-Deletion does not apply (*Bombe*):

	/tsungə/	/bɔnbə/
1. Syllabification	tsung.ə	bɔnb.ə
2. NPA	tsuŋg.ə	bɔmb.ə
3. g-Del	tsuŋ.ə	-----
4. Schwa-Default	tsuŋ.ə	bɔmb.ə
5. Syllabification	tsu.ŋə	bɔm.bə
6. Final Devoicing	-----	-----
	[tsu.ŋə]	[bɔm.bə]

Note: Schwa-Default triggers Syllabification, which applies before Final Devoicing.

1.3.2 An OT approach

- (37) Constraints according to Féry (2003):

- MAX (N, D): Penalizes deletion of a nasal or a dorsal segment
- ONSET_{σ(μ)}: Penalizes ambisyllabic structure? (not formalized)
- *ŋg: No ŋg
- ONSET_{σ(non-μ)}: Penalizes semisyllables (i.e. non-moraic syllables)

- (38) Given the ranking MAX (N, D), ONSET_{σ(μ)} » * ŋg a word like *Tango* surfaces as [taŋ.go], regardless of the input. Here the input is /taŋo/.

/taŋo/	MAX (N, D)	ONSET _{σ(μ)}	* ŋg	ONSET _{σ(non-μ)}
a. → [taŋ.go]			*	
b. [taŋo]		*!		
c. [taŋo]	*!			

- (39) Given the ranking MAX (N, D), * ɲɡ » ONSET_{σ (non-μ)} a word like *Zunge* surfaces as [tsuŋə]. Here the input /tsuŋə/ is assumed.

/tsuŋə/	MAX (N, D)	ONSET _{σ (μ)}	* ɲɡ	ONSET _{σ (non-μ)}
a. → [tsuŋə]				*
b. [tsuŋ.gə]			*!	
c. [tsu.gə]	*!			

- (40) How can [tsuŋə] in (39) can be selected given the input /tsuŋə/?

/tsuŋə/	MAX (N, D)	ONSET _{σ (μ)}	* ɲɡ	ONSET _{σ (non-μ)}
a. [tsuŋə]	*!			*
b. ← [tsuŋ.gə]			*	
c. [tsu.gə]	*!			

1.3.3 A stratal OT approach

- (41) Two problems an OT approach must deal with:
- How do we get rid of [tsuŋ.gə] while selecting [taŋ.go]?
 - How do we get rid of [tsuŋ.gə] while selecting [bɔm.bə]?

Possible answers: There is a derivational stage in which schwa is underspecified, as in the rule-based approach described in 1.3.1. The derivational stage in which underspecified schwas are optimal would correspond to the lexical level and the level in which schwa is specified would be the postlexical level.

- (42)
- | <i>Example</i> | <i>Lexical output</i> | <i>Postlexical output</i> |
|----------------|-----------------------|---------------------------|
| a. Tango | [taŋ.go] | [taŋ.go] |
| b. Bank | [baŋk] | [baŋk] |
| c. Ding | [dɪŋ] | [dɪŋ] |
| d. Zunge | [tsuŋ.ə] | [tsuŋə] |
| e. Bombe | [bɔmb.ə] | [bɔm.bə] |
| f. Hund | [hʊnd] | [hʊnt] |

(43) Nine constraints referred to below:

- a. *VC: No voiced obstruents in the coda
- b. IDENT-VC: The input and output agree in the feature [voice]
- c. *CODA-ŋg: No [ŋg] in the coda
- d. *SCHWA: Schwa (i.e. the features making up the segment [ə]) is ungrammatical. (see Raffelsiefen 1995)
- e. FEATURE: All segments have to be specified for features
- f. *_o[ŋ]: The velar nasal is not permitted syllable-initially
- g. ONSET: The syllable has an onset
- h. DEP-C: No epenthesis of a consonant
- i. MAX-C: No deletion of a consonant

(44) The ranking *VC, MAX-C, DEP-C » IDENT-VC is necessary for Final Devoicing. It will be shown below that this is the postlexical ranking:

/hʊnd/	*VC	MAX-C	DEP-C	IDENT-VC
a. [hʊnd]	*!			
b. [hʊn]		*!		
c. [hʊn.dV]			*!	
d. → [hʊnt]				*

(45) The ranking IDENT-VC, MAX-C, DEP-C » *VC will be shown to hold in the lexical ranking:

/hʊnd/	IDENT-VC	MAX-C	DEP-C	*VC
a. → [hʊnd]				*
b. [hʊn]		*!		
c. [hʊnt]	*!			
d. [hʊn.dV]			*!	

- (46) Given the high ranking constraint *SCHWA no candidate with [ə] can be selected in the lexical component. This is illustrated with the following tableau. Additional candidates and constraints will be considered below.

<u>/tsuŋə/ ~ /tsuŋə/</u>	*SCHWA	DEP-C	FEATURE
a. → [tsuŋ.ə]			*
b. [tsuŋ.ə]	*!		
c. [tsuŋ.gə]	*!	*	

- (47) For words like [dɪŋ] the following rankings select the correct output:

<u>/dɪŋg/</u>	*CODA-ŋg	IDENT-VC	MAX-C	DEP-C	*VC
a. [dɪŋg]	*!				*
b. [dɪŋk]		*!			
c. → [dɪŋ]			*!		

<u>/dɪŋ/</u>	*CODA-ŋg	IDENT-VC	MAX-C	DEP-C	*VC
d. [dɪŋg]	*!			*	*
e. [dɪŋk]				*!	
f. → [dɪŋ]					

- (48) In the following tableaux (representing the lexical rankings) only candidates will be considered which have an underspecified schwa. Two tableaux for *Zunge* are presented here. In the first the input without a /g/ is assumed and in the second one there is a /g/ in the input.

<u>/tsuŋə/ ~ /tsuŋə/</u>	*CODA-ŋg	IDENT-VC	MAX-C	DEP-C	*VC
a. → [tsuŋ.ə]					
b. [tsuŋg.ə]	*!			*	*
c. [tsuŋk.ə]				*!	

<u>/tsuŋgə/ ~ /tsuŋgə/</u>	*CODA-ŋg	IDENT-VC	MAX-C	DEP-C	*VC
d. → [tsuŋ.ə]			*		
e. [tsuŋg.ə]	*!				*
f. [tsuŋk.ə]		*!			

(49) For words ending in /ŋk/ the same rankings select the correct output:

/baŋk/	*CODA-ŋg	IDENT-vc	MAX-C	DEP-C	*VC
a. [baŋg]	*!	*			*
b. → [baŋk]					
c. [baŋ]			*!		

(50) For words like *Bombe* the same rankings select the correct output:

/bɔmbə/ ~ /bɔmbə/	*CODA-ŋg	IDENT-vc	MAX-C	DEP-C	*VC
a. → [bɔmb.ə]					*
b. [bɔmp.ə]		*!			
c. [bɔmə]			*!		

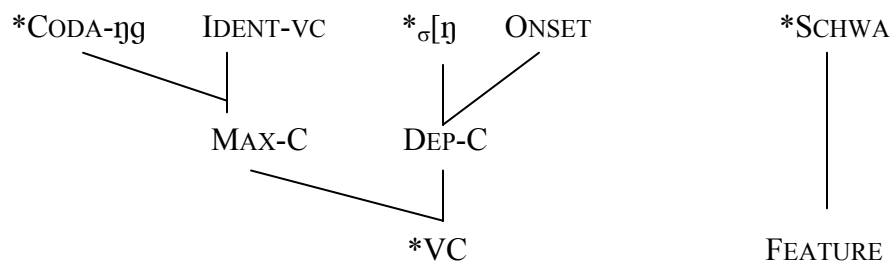
(51) For words like *Tango* the same rankings select the correct output given the input /taŋgo/:

/taŋgo/	*CODA-ŋg	IDENT-vc	MAX-C	DEP-C	*VC
a. → [taŋ.go]					
b. [taŋ.o]			*!		
c. [ta.ŋo]			*!		

(52) Given the input /taŋo/ the analysis requires that the two constraints ONSET and *_σ[ŋ] outrank DEP-C:

/taŋo/	*CODA-ŋg	IDENT-vc	MAX-C	* _σ [ŋ]	ONSET	DEP-C	*VC
a. → [taŋ.go]						*	
b. [taŋ.o]					*!		
c. [ta.ŋo]				*!			

(53) Summary of lexical rankings:



- (54) The ranking *VC, MAX-C, DEP-C » IDENT-VC is necessary for Final Devoicing (see 44). This holds postlexically:

/hʊnd/	*VC	MAX-C	DEP-C	IDENT-VC
a. [hʊnd]	*!			
b. [hʊn]		*!		
c. [hʊn.dV]			*!	
d. → [hʊnt]				*

- (55) Postlexically the constraint *SCHWA is outranked by FEATURE. This ensures that candidates surface with schwa fully specified. Neither constraint is given in the tableaux below. For *Zunge* the input is /tsʊŋə/, which is the output of the lexical evaluation:

/tsʊŋ.ə/	*CODA-ŋg	*VC	MAX-C	ONSET	DEP-C	IDENT VC	* _σ [ŋ]
a. [tsʊŋ.ə]				*!			
b. → [tsʊ.ŋə]							*
c. [tsʊŋ.gə]					*!		
d. [tsʊŋ.kə]					*!		

Note: ONSET outranks DEP-C to account for the fact that glottal stop is epenthesized to repair onsetless syllables; e.g. *aus* [aus] ‘out’ (see Alber 2001).

- (56) For words ending in /ŋk/ the same rankings select the correct output:

/baŋk/	*CODA-ŋg	*VC	MAX-C	ONSET	DEP-C	IDENT VC	* _σ [ŋ]
a. [baŋg]	*!	*				*	
b. → [baŋk]							
c. [baŋ]			*!				

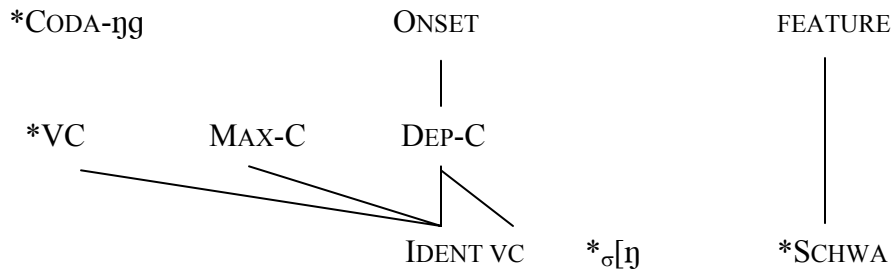
- (57) For words like *Bombe* the same rankings select the correct output. Note that the input is /bɔmb.ə/, which is the output of the lexical evaluation in (50).

/bɔmb.ə/	*CODA-ŋg	*VC	MAX-C	ONSET	DEP-C	IDENT VC	* _σ [ŋ]
a. → [bɔm.bə]							
b. [bɔm.pə]						*!	
c. [bɔ.mə]			*!				

- (58) For words like *Tango* the same rankings select the correct output. Recall from (51-52) that the input here is /taŋ.go/.

/taŋ.go/	*CODA-ŋg	*VC	MAX-C	ONSET	DEP-C	IDENT VC	* _σ [ɪ]
a. → [taŋ.go]							
b. [taŋ.o]			*!	*			
c. [ta.ŋo]			*!				*

- (59) Summary of postlexical rankings:



1.4 Problem #4: [ŋg] vs. [ŋ] in morphologically complex words

- (60) [ŋg] does not surface (but [ŋ] does) before a suffix. This generalization is illustrated below. Note that the suffix can be either vowel-initial (i.e. full vowel or schwa) or consonant-initial. The generalization holds for derivational suffixes (in a) and inflectional suffixes (in b). The suffixes below are highly productive.

- a. Derivational suffixes:

Spreng-ung	[ʃpɾɛŋʊŋ]	‘explosion’
Jüng-ling	[jʏŋlɪŋ]	‘youth’
läng-lich	[lɛŋlɪç]	‘longish’
Säng-er	[zɛŋɐ]	‘singer’

- b. Inflectional suffixes:

sing-e	[zɪŋə]	‘sing (1 sg)’
sing-st	[zɪŋst]	‘sing (2 sg.)’

- (61) [ŋg] surfaces (but [ŋ] does not) before a ‘level 1’ suffix. The suffixes below are not productive. Note that the suffixes attach to bound roots. By contrast, the suffixes in (60) attach to stems, which are marked for a lexical category

tang-ier-en	[tʌŋgi:RƏn]	‘be tangent to’
Tang-ens	[tʌŋgɛns]	‘tangent’
Adstring-ens	[atstrɪŋgɛns]	‘astringent’
fung-ier-en	[fʊŋgi:RƏn]	‘act as’
laryng-al	[lʌrɪŋgɑ:l]	‘laryngeal’
Laryng-itis	[lʌrɪŋgi:tɪs]	‘laryngitis’
angl-o	[ʌŋɡlo]	‘anglo’
angl-isier-en	[ʌŋɡlizi:RƏn]	‘anglicize’

- (62) The following examples illustrate alternations between [g] and zero. It is possible that this list is exhaustive. Note that these examples involve a single morpheme (i.e. ‘phthong’).

Diphthong	[dɪftʌŋ]	‘diphthong’
diphthong-ieren	[dɪftʌŋgi:RƏn]	‘diphthongize’
Monophthong	[mɒnɔftʌŋ]	‘monophthong’
monophthong-ieren	[mɒnɔftʌŋgi:RƏn]	‘monophthongize’

- (63) Summary of environments:

	[ŋ]	[ŋg]
a. before ‘level 1’ suffix	no	yes
b. before ‘level 2’ suffix	yes	no

1.4.1 A rule-based analysis

- (64) Derivation of two words in which the rules must apply cyclically (see Hall 1989 for German and Borowsky 1990 for a similar treatment of English). The first word (*Sprengung*) has a level 2 suffix and the second word (*laryng-al*) a level 1 suffix:

	/ʃprɛŋg/	/laRYŋg-a:l/
Level 1:		
1. Syllabification	.ʃprɛŋg.	.la.RYŋ.g-a:l.
2. NPA	.ʃprɛŋg.	.la.RYŋ.g-a:l.
3. g-Del	.ʃprɛŋ.	-----
Level 2:		
1. <i>-ung</i> affixation	.ʃprɛŋ. - ŋg	-----
2. Syllabification	.ʃprɛ.ŋ - ŋg.	
3. NPA	.ʃprɛ.ŋ - ŋg.	-----
4. g-Del	.ʃprɛ.ŋ - ŋ.	-----
	[.ʃprɛ.ŋŋ.]	[.la.RYŋ.gai.]

Note: There cannot be a ‘root’ cycle of level 1, otherwise the /g/ in *laryngeal* would incorrectly delete.

1.4.2 An OT approach with Paradigm Uniformity

- (65) Consider once again the lexical rankings for *Tango* from (51-52):

	/taŋgo/	*CODA-ŋg	IDENT-VC	MAX-C	DEP-C	*VC
a.	→ [taŋ.go]					
b.	[taŋ.o]			*!		
c.	[ta.ŋo]			*!		

	/taŋo/	*CODA-ŋg	IDENT-VC	MAX-C	* _σ [ŋ]	ONSET	DEP-C	*VC
d.	→ [taŋ.go]						*	
e.	[taŋ.o]					*!		
f.	[ta.ŋo]				*!			

- (66) Problem: These rankings incorrectly predict the retention of the word-internal /g/ in words like *Sprengung* in (60):

	/ʃpɾɛŋ-ʊŋ/	*CODA-ŋg	IDENT-VC	MAX-C	* _σ [ŋ]	ONSET	DEP-C	*VC
a.	←[ʃpɾɛŋ.gʊŋ]						*	
c.	[ʃpɾɛŋ.ʊŋ]					*!		
d.	[ʃpɾɛ.ŋʊŋ]				*!			

	/ʃpɾɛŋg-ʊŋ/	*CODA-ŋg	IDENT-VC	MAX-C	* _σ [ŋ]	ONSET	DEP-C	*VC
e.	← [ʃpɾɛŋ.gʊŋ]							
g.	[ʃpɾɛŋ.ʊŋ]			*!		*		
h.	[ʃpɾɛ.ŋʊŋ]			*!	*			

- (67) The following two examples (representative of 60) show that the respective stems show no allomorphy. Put differently, the stems in these paradigms are uniform. Note that the paradigms include not only the inflectional forms, but also derivational forms with the same stems.

	‘spreng’ paradigm:	‘sing’ paradigm:
deriv. Form	Spreng-ung	Säng-er
1 sg	spreng-e	sing-e
2 sg	spreng-st	sing-st
3 sg	spreng-t	sing-t
1 pl	spreng-en	sing-en
2 pl	spreng-t	sing-t
3 pl	spreng-en	sing-en
imperative	spreng	sing
preterite	spreng-te	sang
ppart.	ge-spreng-t	ge-sung-en

- (68) Four simplified paradigms for the example *Spreng-ung*:

- [ʃpɾɛŋgʊŋ ~ ʃpɾɛŋ...] normal application
- [ʃpɾɛŋgʊŋ ~ ʃpɾɛŋg...] underapplication candidate
- [ʃpɾɛŋʊŋ ~ ʃpɾɛŋg...] ‘backwards’ application
- [ʃpɾɛŋʊŋ ~ ʃpɾɛŋ...] overapplication candidate

- (69) A general output-output constraint :

O-O-SEG : A segment in the output form of a stem has a correspondent in all instances of that stem.

(70) Rankings work with PU constraint:

/ʃpɾɛŋ/	*CODA-ŋg	IDENT-VC	O-O-SEG	MAX-C	* _σ [ŋ]	ONSET	DEP-C	*VC
a. [ʃpɾɛŋgʊŋ ~ ʃpɾɛŋ]			*!				*	
b. [ʃpɾɛŋgʊŋ ~ ʃpɾɛŋg]	*!						*	*
c. [ʃpɾɛŋʊŋ ~ ʃpɾɛŋg]	*!		*		*		*	*
d. → [ʃpɾɛŋʊŋ ~ ʃpɾɛŋ]					*			

/ʃpɾɛŋg/	*CODA-ŋg	IDENT-VC	O-O-SEG	MAX-C	* _σ [ŋ]	ONSET	DEP-C	*VC
e. [ʃpɾɛŋgʊŋ ~ ʃpɾɛŋ]			*!	*				
f. [ʃpɾɛŋgʊŋ ~ ʃpɾɛŋg]	*!							*
g. [ʃpɾɛŋʊŋ ~ ʃpɾɛŋg]	*!		*	*	*			*
h. → [ʃpɾɛŋʊŋ ~ ʃpɾɛŋ]				**	*			

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