

Zero morphology and constraint interaction: subtraction and epenthesis in German dialects

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1. Introduction¹

This paper investigates what looks like a case of subtractive plural morphology in Hessian German, illustrated in (1).

(1)	Singular	Plural	
	hond̥	hon	‘dog’
	dɔŋ	dɔ:	‘day’

We argue that subtractive pluralization is best understood as a response to a number of conflicting constraints on phonological and morphological well-formedness in Hessian. Crucially, we show that each of these constraints is operative in Standard German as well, where no subtractive morphology is found. We propose that these two dialects (Hessian and Standard) differ not in terms of the rules they have or even in the constraints they have; rather, that they differ only as to the relative ranking of constraints. We assume the framework of Optimality Theory (Prince & Smolensky 1993), according to which the phonologies of distinct languages differ only as to the ranking of a universal set of violable constraints. We take mutually intelligible dialects to be the ideal place to test OT since the effects of ranking are best seen where there is a large amount of shared phonology and morphology.

Since much of the following discussion will be aimed at showing that the plurals in (1) are *not* subtractive, we define what we mean by this term, as follows:

(2) *Subtractive morphology:*

a morphological category is signalled by deletion of underlying material

A genuine case of subtractive morphology can be found in Tohono O’odham (Zepeda 1983), a native American language spoken in southern Arizona: perfective verbs are formed by deleting the final light syllable of the verb stem. The phenomenon has received a lot of attention and generated a number of processual analyses (Hale 1965; Mathiot 1973; Martin 1988; Lombardi & McCarthy 1991; Weeda 1992; Hill & Zepeda 1992) and at least one non-processual analysis (Golston 1995). We will not be concerned with Tohono O’odham here, except to show that Hessian subtractive pluralization is *not* subtractive in the same way.

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The paper is organized as follows. We begin with the basic facts of Hessian and Standard German plural morphology (§2). We then uncover an important phonological generalization about subtractive plurals in Hessian (§3). This allows us to formalize what appears to be subtractive pluralization as a phonologically conditioned case of zero marking (§4). Finally, we show that the analysis generalizes naturally to Standard German and reduces the number of arbitrary noun classes, treating the plural suffix $-\emptyset$ as conditioned zero marking as well (§5). We end with a brief conclusion (§6).

2. German Plural Morphology

We begin with a brief overview of Standard and Hessian plural morphology, the main focus of our work here. Our sources for Hessian are Alles (1907/08), Haas (1988) and Frau Lina Kölsch, a native speaker from the area. (Alles 1907/8 is a broad study of noun plurals in a number of upper Hessian villages; Haas 1988 is an in-depth study of noun plurals in Ebsdorf, a village near Marburg.) For the facts of Standard German we follow Wiese (1996b: §5.3) and references therein. Leaving aside distinctive vowel-fronting (umlaut) for the moment, Standard German has five ways of marking a plural noun, including four suffixes and zero-marking:

(3) Standard German

	Singular	Plural	gloss
-r	kɪnt	kɪn.d-ər	‘child’
-n	fʁaʊ̯	fʁaʊ̯-ən	‘brood’
-ə	ʃu:	ʃu:-ə	‘shoe’
-s	aʊ̯to	aʊ̯to-s	‘car’
∅	va:gən	va:gən	‘car’

The zero plural is restricted to masculine and neuter nouns.² All Standard plurals end in a stressless, sonorant-final syllable; this restricts zero marking to polysyllabic sonorant-final stems like $va:gən$ ‘car’, $lœfəl$ ‘spoon’ and $mʊtər$ ‘mother’.³

Hessian has a similar plural system, but with some important differences. It has lost the $-s$ plural and seems to have added the subtractive plural discussed briefly above:

² With two exceptions: $mʊtər$ ‘mother’ and $tœxtər$ ‘daughter,’ both feminine.

³ We are not concerned here with precise qualities of the segments involved; the prosodically conditioned allomorphies of the plural suffixes involving schwa; or the $-s$ plural. The latter is special in several ways. It applies to relatively few common nouns, but is regarded as the default plural because of its wide range of application when no other (lexically specified) plural suffix is available; it is not restricted in its occurrence within the phonological and/or morphological space of German pluralization; and it has very differently morphophonological properties. (For discussion see Bornschein & Butt 1987, Janda 1990, Clahsen et al. 1995, Marcus et al. 1995.)

(4) Hessian

	Singular	Plural	gloss
-r	mɛ:ɖ	mɛ:ɖ-ər	‘market’
-n	hɔr	hɔ(r)-n	‘hair’
-ə	pʌn	pʌn-ə	‘pan’
∅	ʃirm	ʃirm	‘umbrella’
Subtr	hond	hon	‘dog’

The ə-suffix in Hessian is not generally cognate with the ə-suffix in Standard German, which has been lost in Hessian. Most ə-suffixes in Hessian are cognate with Standard -ən suffixes and come from the same source via a loss of final -n throughout much of the Hessian vocabulary.

In both dialects, certain plurals are also marked by means of a fronted vowel (umlaut). Standard German has fronting with -r, -ə and ∅:

(5) Vowel Fronting (Standard)

Singular	Plural		
vʌlt	vɛld-ɾ	‘forest’	-ɾ
hant	hɛnd-ə	‘hand’	-ə
apfl	ɛpfl	‘apple’	∅

Hessian allows fronting with all types of plural, except -n:

(6) Vowel Fronting

dux	diç-ər	‘cloth’	-ər
dɔrm	dɛrm-ə	‘gut’	-ə
bɑ:m	bɛ:m	‘tree’	∅
grond	grin	‘ground’	subtractive

We follow Wiese (1996a, 1996b: § 7.1) in treating umlaut as governed by an independent phonological rule of fronting and will not discuss the phonology of umlauting further.

‘Subtractive’ plural morphology in Hessian is completely unexpected given normal German (and general Germanic) affixation. Standard German and other Germanic languages draw the line at zero-affixation and never express morphology subtractively; the apparent subtraction in Hessian is thus highly marked for a Germanic language. This is not to say that Hessian is alone in having apparent subtractive plurals: similar cases can be found in the German dialect of the Saar area and in Limburgian Dutch (Ben Hermans, p.c.). The case from Hessian is particularly well-documented, however, and shows that subtraction is merely a surface effect of purely non-subtractive morphology. We expect that other apparent cases of subtraction in Germanic will yield to a similar analysis.

3. Hessian plural morphology

Here we take a closer look at Hessian plural morphology. Cases of *-ər*, *-n* and *-ə* plurals are given in (7) - (9). (Data from Haas 1988 unless otherwise indicated.)

(7) *-er*

bɔ:əɖ	bɛ:əɖ-ər	‘beard’	fəs	fɛs-ər	‘barrel’
dux	diç-ər	‘cloth’	haʊs	hɔʊs-ər	‘house’
fɛɫɖ	fɛɫd-ər	‘field’	mɛ:ɖ	mɛ:ɖ-ər	‘market’
ʃaɫɖ	ʃaɫr-ər	‘log’	hemb	hembə-ər	‘shirt’

(8) *-n*

bawər	bawə-n	‘farmer’	gɔ:wəl	gɔ:wə-n	‘fork’
fɔɫər	fɔɫə-n	‘fire’	kɔɔtofəl	kɔɔtofə-n	‘potato’

(9) *-e*

altɔ:r	altɛ:r-ə	‘altar’	kaɖs	kaɖs-ə	‘cat’
braʊɖ	brɔɫr-ə	‘fiancée’	pən	pən-ə	‘pan’
dɔrm	dɛrm-ə	‘gut’	halm	halm-ə	‘stalk’

The data in (8) require some comment: Hessian does not allow liquid + n sequences, offending liquids are underparsed yielding forms like *gɔ:wə-n* ‘forks’ from *gɔ:wəl*.

Turning now to the apparent cases of subtractive morphology, we present the full set of data from three sources: Alles (1907-08, italicized)⁴, Haas (1988) and our own data from Frau Lina Kölsch (K), a native of the area.⁵ From the range of sources and the sheer number of examples we conclude that the phenomenon is a stable one Hessian:

⁴ We transliterate Alles’ data as follows:

Alles	IPA			
ah	a:	Hahd	[ha:d]	‘hand’
ä	ɛ	Häng	[hɛŋ]	‘hands’
ea	eə	Keand	[keənd]	‘child’
ng	ŋ	Häng	[hɛŋ]	‘hands’

When <h> alternates with <k> it is clearly a fricative [h]: “Vokal + k wechselt mit Vokal + spirantischem Hauch oder bloß mit Vokal’ (Alles 1907:350).

⁵ Schirmunski (1962, 417) lists the following as well, but does not cite source or dialect. It is likely that his source is Alles 1907/8.

(10) Subtractive Plurals

ha:d	hen	'hand'	keənd	keən	'child'
ha:nd	hɛn	'hand' (K)	kɪnd	kɪn	'child' (K)
hand	hɛŋ	'hand'	kiend	kieŋ	'child'
ʃtant	ʃtɛŋ	'situation'	brand	bɾɛn	'fire'
vand	vɛŋ	'wall'	hond	hon	'dog'
va:d	ven	'wall'	hənd	hɔn	'dog' (K)
va:nd	vɛn	'wall' (K)	hond	hon	'dog'
ʃlond	ʃlin	'throat'	grond	grɪn	'ground'
pond	pon	'pound'	ʃdɑ:d	sɔɛn	'stall'
ɛnd	ɛn	'end'	greind	grɛŋ	'scab'
faind	fain	'enemy'	va:ld	vɛl	'forest'
froind	froin	'friend'	viend	vien	'wind'
mu:d	mi:n	'month'	pe:ənd	pɛn	'shoe nail'
drohk	dre	'trough'	straŋk	strɛŋ	'rope'
forhaŋk	forhɛŋ	'curtain'	ri:ŋk	riŋ	'ring'
rauxfank	rauxfɛŋ	'chimney flue'	ʃpruŋk	ʃpriŋ	'jump'
gaŋk	gɛŋ	'walk'	bɛrk	bɛr	'mountain'
ʃlɔək	ʃla	'hit'	krehk	kre	'war'
ʃuk	ʃu	'shoe'	doək	doə	'day'
ʃuk	ʃu:	'shoe' (K)	dɔg	dɔ:	'day'
fluk	fli	'flea'	gɑ:g	gãɪŋ	'walk'
blowk	blɔi	'plow'	krog	kre	'jug'
blok	ble	'plow'	tsvihk	tsvi	'twig'
vɛk	vɛ	'way'	ʃtɛk	ʃtɛ	'path'

It is important to realize that the final k's in (10) are all etymologically g's, as comparison with Standard German makes clear. Also, /g/ and /k/ behave differently in Hessian, as shown by alternations such as the following:

(11)	vek	vejə	'way'	/g/
	flek	flegə	'patch'	/k/

ga:ŋk	gɛŋ	'walk'	hond	hon	'dog'
va:ld	vɛl	'forest'	bɛrk	bɛr	'mountain'
va:nd	vɛŋ	'wall'	doŋk	doŋ	'day'
ʃuk	ʃu:	'shoe'	ri:ŋk	riŋ	'ring'

Schirmunski's brief discussion has been the source of some discussion of subtractive morphology in recent theories; in particular, Wurzel (1984) argues, on the basis of these examples, that morphology must be processual.

(10) makes it clear that subtractive pluralization in Hessian is phonologically conditioned, as follows:

(12) Subtraction if the stem ends in

a. *ld, nd, ŋg, Rg*

b. *Vg*

What (12) tells us is that subtractive pluralization is really a phonologically conditioned realization of something else. It is predictable, not distinctive and thus does not (and could not) signal, as a morphological marker, the category plural.⁶

When we look at Ø-marked plurals, we see what that something else is. Despite a large number of sonorant- (13) and obstruent-final Ø-marked plurals (14) in Hessian (Ø-marked plurals account for about a third, 200/651, of the plurals in Haas' extensive corpus) there are no cases of Ø-marked stems ending in *nd* and only a handful of cases ending in *ŋg* or *Vg* (see below).

(13) Ø-marked sonorant final plurals (partial list)

<i>hø:mər</i>	<i>hø:mər</i>	'hammer'	<i>agər</i>	<i>agər</i>	'field'
<i>ʃnur</i>	<i>ʃnır</i>	'string'	<i>jø:r</i>	<i>jø:r</i>	'year'
<i>hər</i>	<i>hər</i>	'fold, pen'	<i>keil</i>	<i>keil</i>	'wedge'
<i>fø:gəl</i>	<i>fe:jil</i>	'bird'	<i>bigil</i>	<i>bigil</i>	'pimple'
<i>ʃnø:wəl</i>	<i>ʃnø:wil</i>	'snout'	<i>frəkl</i>	<i>frəkl</i>	'suckling pig'
<i>əbəl</i>	<i>əbil</i>	'apple'	<i>dəkl</i>	<i>dəkl</i>	'lid'
<i>bə:m</i>	<i>be:m</i>	'tree'	<i>agsdhəlm</i>	<i>agsdhəlm</i>	'axe handle'
<i>torm</i>	<i>term</i>	'tower'	<i>ʃirm</i>	<i>ʃirm</i>	'umbrella'
<i>bam</i>	<i>bam</i>	'tree'	<i>dan</i>	<i>dan</i>	'fir'
<i>ran</i>	<i>ran</i>	'ridge'	<i>bun</i>	<i>bun</i>	'bean'
<i>ʃtaⁿ</i>	<i>ʃtaⁿ</i>	'stone'	<i>tən</i>	<i>tən</i>	'threshing-floor'

(14) Ø-marked obstruent final plurals (complete list)

<i>ʃtomp</i>	<i>ʃtimp</i>	'stump'	<i>somp</i>	<i>simp</i>	'marsh'
<i>bomb</i>	<i>bemb</i>	'crash'	<i>ʃdromb</i>	<i>ʃdremb</i>	'sock'
<i>komb</i>	<i>kemb</i>	'drain'	<i>gø:ns</i>	<i>gø:ns</i>	'goose'
<i>bəlç</i>	<i>bəlç</i>	'husk'	<i>mündwəlf</i>	<i>mündwəlf</i>	'mole'
<i>fəəg</i>	<i>fırg</i>	'furrow'	<i>kərɓ</i>	<i>kerɓ</i>	'basket'
<i>last</i>	<i>ləst</i>	'load'	<i>fəʊsɔ</i>	<i>fəʊsɔ</i>	'fist'
<i>lasɔ</i>	<i>lesɔ</i>	'bale'	<i>brost</i>	<i>brəst</i>	'breast'
<i>akst</i>	<i>əkst</i>	'axe'	<i>faust</i>	<i>fəʊst</i>	'fist'

⁶ We are aware of a single counterexample to (12): *laib* 'loaf' should not undergo subtractive pluralization, but does (*lai*) in two villages.

blaḍs	blēḍs	‘place’	fūḍs	fīḍs	‘fart’
fogs	fegs	‘fox’	nɔəxt	nɛxt	‘night’
groft	grift	‘vault’	he:fḍ	he:fḍ	‘edge of a vest’
loft	left	‘air’	lofḍ	lofḍ	‘wind’
vorʃt	virʃt	‘sausage’	voʃḍ	voʃḍ	‘sausage’
retç	retç	‘radish’	fedç	fedç	‘wing’
krɔḅç	krɛḅç	‘crop’			
ho:b	he:f	‘manor’	breib	brɛib	‘letter’
hu:b	hu:b	‘hoof’	riḅ	riḅ	‘rib’
gnɔḅ	gnɛḅ	‘button’	leḅ	leḅ	‘loaf’
ʃḍriḅ	ʃḍriḅ	‘stalk’	ʃtoət	ʃtɛt	‘city’
dro:ḍ	dre:ḍ	‘wire’	tredḍ	tredḍ	‘doorstep’
braut	brɔit	‘fiancée’	lɛd	lɛd	‘burial’
nɔt	nɛt	‘seam’	be:t	be:t	‘bed’
arvet	arvet	‘work’	haut	hɔit	‘skin’
ʃtoək	ʃteək	‘stork’	ʃtɛk	ʃtɛk	‘footbridge’
vaɫg	vaɫg	‘bun’	sag	saɫg	‘sack’
bɔg	bɛg	‘ram’	bɑ:g	bãɫŋg	‘bank’
arves	ɛrves	‘pea’	fos	fɛs	‘foot’
nos	nes	‘lice egg’	nos	nes	‘nut’
flos	fles	‘river’	maʊs	mɔis	‘mouse’
ʃos	ʃɛs	‘lap’	laʊs	lɔis	‘louse’
ʃtos	ʃtes	‘push’	nos	nes	‘nut’
kis	kis	‘rake’	foʊs	foɪs	‘foot’
ke:s	ke:s	‘cheese’	gli:s	gli:s	‘potato dumpling’
ʃo:f	ʃo:f	‘sheep’	re:f	re:f	‘tire’
fre:ʃ	fre:ʃ	‘frog’	deʃ	deʃ	‘table’
feʃ	feʃ	‘fish’	foʃ	feʃ	‘fish’
bʊʃ	bɪʃ	‘bush’	fʊʃ	fɪʃ	‘fish’
bux	bix	‘stomach’	flox	flex	‘curse’
ʃtrux	ʃtrix	‘bush’	ʃlux	ʃlix	‘hose’
brox	brex	‘fracture’	ho:x	he:ç	‘hook’

Alles’ transcription hides the fact that the words for ‘bun,’ ‘sack,’ ‘ram’ and ‘bank’ end in [k], as evidenced by their Standard German cognates: *Wecken, Sack, Bock, Bank*.

We see then that subtraction and Ø-marking are in complementary distribution in Hessian. Subtraction occurs in the environment given in (11), Ø-marking in the complementary environment:

(15) Ø-marking if the stem does not end in

- a. ld, nd, ŋg, Rg
- b. Vg

Before turning to a formal analysis of (12) and (15), we need to treat what appear to be counterexamples to (15). There are some cases of etymological [g] that do not delete; these pose a serious threat to the generalization in (15):

(16) Ø-marked stems in (etymological) Vg

plug	plig	‘plow’	vɛk	vɛk	‘way’
flɔk	flɪk	‘flea’	ʃloək	ʃlɛk	‘hit’
doək	doək	‘day’	kɾɪk	kɾɪk	‘war’
trok	trek	‘trough’	kɾɔk	kɾɪk	‘jug’
kroək	krek	‘collar’			

We believe that these data have been reanalyzed in certain dialects as k-final stems; that is, we think that Alles’ transcription here does accurately reflect the phonemic facts. These k-final stems do not undergo subtraction because they do not meet either of the requirements in (12). This conjecture is supported by the following observation: for each of these ex hypothesi re-analyzed stems with constant *-k*, the inherited form exists elsewhere in Hessian (17).

(17) Subtraction in stems in etymological vowel + g

blok	ble	‘plow’	vɛk	vɛ	‘way’
kɾɪk	kɾɪk	‘war’	ʃloək	ʃla	‘hit’
doək	doək	‘day’	krog	kre	‘jug’
drohk	dre	‘trough’			

The only form for which we have no such double is ‘collar’. The variation between the forms in (16) and (17) follows no discernible geographical pattern. The reanalysis of /g/ to /k/ seems to have been made on an item-by-item basis.

How then are we to understand (12) and (15)? First we must note that voiceless stops are never deleted in Hessian: the only stops that undergo deletion are /d/ and /g/, while /b/, sonorants, voiceless segments and fricatives are never deleted.⁷ On the other hand, [d] and [g] delete after homorganic sonorants, and [g] deletes after any vowel.

⁷ There are two counterexamples to this claim that fricatives do not delete, *flu:x* ~ *fli*: ‘flea(s)’ and

4. Analysis

Our analysis has two parts, one about phonological features and their organization (4.1), the other about constraints and constraint interaction (4.2). The latter is cast in terms of Optimality Theory (Prince & Smolensky 1993, McCarthy & Prince 1993a,b).

4.1 Distinctive features of Hessian

We assume the following (partial set of) underspecified features for Hessian.

(18) Some distinctive features of Hessian

	Vowels	b	p	d	t	g	k	s	n	l
SONORANT	+								+	+
NASAL									+	
CONT								+		
SPREAD GLOTTIS			+		+		+	+		
LABIAL		+	+							
CORONAL				+	+			+	+	+
DORSAL	+					+	+			

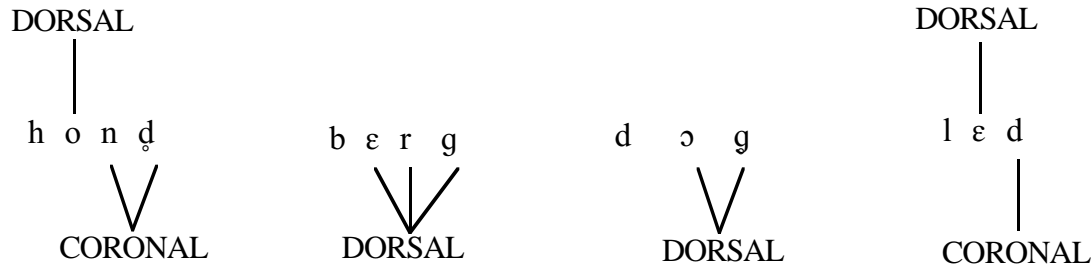
The crucial claims for our analysis are (i) that all vowels are made with the tongue body and are thus distinctively DORSAL, (ii) that of the major place features for consonants only palatals, velars and uvulars are DORSAL and (iii) that the relevant laryngeal distinction for obstruents in Hessian is SPREAD GLOTTIS (aspiration) rather than VOICE, the feature most often used for Standard German.

Evidence for (iii) is as follows. It has long been observed that the Standard German distinction of voiced vs. voiceless is not phonetically true of Hessian. Haas (1978), for instance, treats [p t k] as geminates and [b d g] as simple consonants. We feel that this analysis is phonetically unmotivated (as does Haas 1988:37) but it correctly singles out the voiceless stops as the marked case, something our analysis reflects.

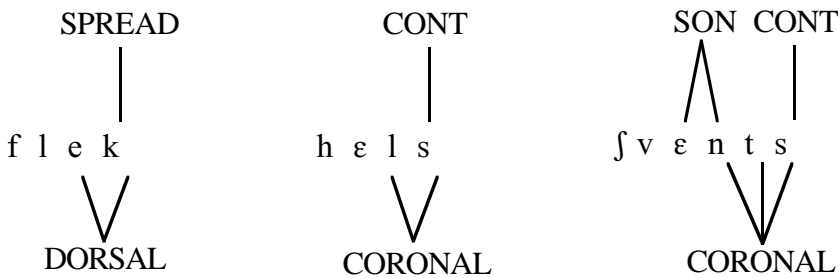
We assume that adjacent identical features within a morpheme are shared (Steriade 1982), resulting in structures like (19) - (20).

$\int_{\text{Ux}} \sim \int_{\text{Oy}}$ ‘shoe(s).’ Both are unique in our data in that they derive from Middle High German stems in *ch*. There is a good deal of variation for these two words within Hessian and the final consonant is deleted in all forms of the word elsewhere in Germanic (Standard German, English etc.).

(19) Place features



(20) Laryngeal and manner features



One ingredient of our analysis should now be clear: subtractive plurals never entail the loss of a distinctive feature. In just those cases where a segment is deleted, the distinctive features which identified it are shared with the preceding segment: *hond*, *berg*, *dog*.

The second ingredient of our analysis rests on the observation that the output of subtraction in Hessian invariably ends in a sonorant, as inspection of (10) above will verify. This is not an isolated fact about Hessian. As Wiese (1996b) points out, the following is surface true for all plural nouns (leaving aside *-s* plurals) in Standard German:

(21) A plural noun ends in an unstressed sonorant-final syllable (ə, l, r, n)

A number of factors conspire to enforce (21) in Standard German. First, the suffixes *-ə*, *-ər* and *-(ə)n* all fit (21). Second, zero-marking may only occur with nouns which already end in a sonorant-final schwa syllable (plurals like *tɪʃ* are impossible). Finally schwa epenthesis occurs with monosyllabic stems, *fʁaʊ-ən* ‘women’ (**fʁaʊ-n*) but not with comparable disyllabic stems, *ga:bəl-n* ‘forks’, (**ga:bəl-ən*). In all of these cases, exactly one (neither more nor less) schwa syllable is found.⁸

⁸ The *-s* suffix behaves very differently here: plural nouns suffixed with *-s* never display a final schwa syllable. That is, monosyllabic nouns are not extended by schwa, if they receive a suffix *-s*: *Clown-s*, but not **Clown-es*.

4.2 Constraints and constraint interaction

The generalization in (21) has two parts, which we treat as well-formedness constraints on morphologically defined categories. The first requires inflected words to end in a stressless syllable; the second requires them to end in a sonorant.

Why should plurals (and in fact most inflected words in German: see Neef 1996, Raffelsiefen 1995) end in a schwa syllable? We argue that this is an effect of NON-FINALITY, as argued for in Latin and Hindi (McCarthy & Prince 1993a), a constraint against word-final stress:

(22) NON-FINALITY Inflected words do not end in a stressed syllable.

A final schwa syllable creates a prosodic structure in which the stressed syllable is not final.

The second part of (21) is more puzzling, but attested robustly in Ancient Greek, where all words must end in a sonorant (or [s], see Steriade 1982 for discussion). We formalize it as in (23):

(23) SON]PL Plurals end in a sonorant.

In Hessian we see the need for splitting (21) into two parts: only the SON]PL part of (21) plays any role in the phonology. The only relevant difference between Hessian and Standard German, we will argue, lies in the ranking of SON]PL and NON-FINALITY relative to other constraints. (We return to NON-FINALITY in Standard German in §5; it plays no crucial role in Hessian).

NON-FINALITY and SON]PL are not, strictly speaking, language-particular constraints. As we have seen, both are attested at phonological word edge in other languages (Hindi, Latin, Ancient Greek). What is different about the German constraints is only that the edges of a restricted set of morphological categories (inflected words) are subject to them. Formally the constraints in (22) and (23) are members of a family of constraints on Alignment (McCarthy & Prince 1993b) that require morphological and phonological edges to coincide. The primitives of both constraints (sonorant, stressed syllable, plural, inflected word) are part of universal grammar, as is the form of the constraint, ALIGN (Cat1, Edge1, Cat2, Edge 2).

The generalizations may be captured in the following way. Some stems take affixes, the shape of which (-ən and -əR) allow them to pass SON]PL straightforwardly. Sonorant-final stems already end in a sonorant satisfying SON]PL trivially:

(24) Stems ending in schwa syllable don't need a suffix

fɪrm	fɪrm	'umbrella'	keil	keil	'wedge'
ran	ran	'ridge'	jo:r	jo:r	'year'

Zero-marked stems ending in an obstruent lose that obstruent so as not to violate SON]PL:

(25) Stems ending in an obstruent lose it

hond	hon	‘dog’
dɔg	dɔ:	‘day’

But deletion of distinctive features is not tolerated. Zero-marked stems that end in an obstruent retain the obstruent in defiance of SON]PL if loss of the obstruent would mean loss of any of the distinctive fetures mentioned in (18).

The final ingredients in our analysis of Hessian involve well-known constraints in Optimality Theory. FILL is a ban on epenthetic vowels (Prince & Smolensky 1993):

(26) FILL Epenthesis is banned

PARSE forces various types of underlying information to appear on the surface. We are concerned here with two variants of PARSE, one for features and one for root-nodes (segments).

(27) PARSE-FEATURE Underlying features are realized on the surface

(28) PARSE-SEG Underlying segments are realized on the surface

The low ranking of PARSE-SEG in Hessian should be obvious: it is violated constantly in subtractive plurals like *hɔn<d>*, where the angled brackets indicate unparsed (deleted) material. Although it plays no decisive role in Hessian (as the following tableaux make clear), it does have an important role to play in Standard German, as will be seen below.

Our account of subtractive pluralization is then essentially this: Hessian plurals end in sonorants unless this involves epenthesis or underparsing of features. This means that FILL and PARSE-FEATURE must be ranked above SON]PL. The fact that segments are sometimes deleted in order to respect SON]PL means that PARSE-SEG must be ranked below it. All of this may be expressed in tableaux in which higher ranked constraints are given to the left of lower ranked constraints, as follows:

(29) Underparsing of *d* after a coronal sonorant

	PARSE FEAT	FILL	SON]PL	PARSE SEG
☞ hon<d>				*
hond			*!	
hond[E]		*!		
ho<nd>	*!			**

The first candidate respects all but the lowest ranked constraints and wins. The second candidate, identical to the bare stem, ends in an obstruent in fatal violation of SON]PL. (This provides the evidence for

ranking SON]PL above PARSE-SEG: the opposite ranking wrongly predicts **hond* and no ranking creates a tie.) The third is out because it has an epenthetic vowel (E) and the fourth because it has an unparsed place feature (the shared feature CORONAL, see (19) above).

Turning now to cases where the final obstruent is not homorganic with the preceding segment we see that PARSE-SEG forces violation of SON]PL.

(30) No underparsing of *d* after a non-coronal segment

	PARSE FEAT	FILL	SON]PL	PARSE SEG
☞ led			*!	
led[E]		*!		
lε<d>	*!			*

The first candidate violates only SON]PL and wins. The second violates FILL, with its epenthetic vowel, and the third violates PARSE-FEAT because of the unparsed place feature (CORONAL, see (19) above).

Similarly for stems that end in fricatives and voiceless stops. The former are parsed, in violation of SON]PL, in order to respect PARSE-FEAT. The latter are parsed in order to respect PARSE-FEAT as well, due to their distinctive SPREAD GLOTTIS specification. The tableaux for such forms are identical to (30) and will not be repeated here.

Finally, there are those stems that end in sonorants. For them the best solution is to add nothing and parse everything:

(31) No underparsing of final sonorants

	PARSE FEAT	FILL	SON]PL	PARSE SEG
☞ firm				
firm[E]		*!		
fir<m>	*!			*
fi<rm>	*!*			**

We see then that there is no morphologically distinctive process of truncation in Hessian. The driving force behind subtractive pluralization is the requirement that plurals end in sonorants, not that they have deleted segments. Even this requirement, however, bows to PARSE-FEAT and to FILL, requirements that maximize the similarity between input and output forms. Imagine there were a truncation process 'delete a word-final obstruent' that was blocked by PARSE-FEAT. Nothing would prevent it from turning a word like *brest* 'breast' into *bres<t >*, since no feature would go unparsed (t is featurally a subset of s). Our analysis, on the other hand, rules out such a candidate by (low-ranked) PARSE-SEG, since *brest* and

bres<t> tie with respect to all other constraints, in particular SON]PL. The point is that Hessian wants to have sonorant-final plurals (*not* subtractive plurals): deleting the final stop in brest does not lead to this result.

5. Standard German plural morphology

The framework we assume here, Optimality Theory, claims that the phonologies of different languages or dialects differ only in terms of their constraint ranking. Here we will be concerned with why Standard German lacks any sign of ‘subtractive’ morphology, despite the fact that it too has the constraint SON]PL.

We begin by noticing that in almost all cases where Hessian deletes an obstruent to satisfy NON-FINALITY, Standard German adds a schwa:

(32) <i>Hessian subtractive</i>		<i>Standard -ə</i>		
<u>Singular</u>	<u>Plural</u>	<u>Singular</u>	<u>Plural</u>	
bɛrk	bɛr	berk	berg-ə	‘mountain’
dɔg	dɔ:	ta:k	ta:g-ə	‘day’
ga:ŋk	gɛŋ	gaŋ	gɛŋ-ə	‘walk’
ha:nt	hɛn	hant	hɛnd-ə	‘hand’
hɔnd	hɔn	hɔnt	hɔnd-ə	‘dog’
mɔnd	mi:n	mo:nat	mo:nat-ə	‘month’
ri:ŋk	riŋ	rɪŋ	rɪŋ-ə	‘ring’
ʃdand	sɔɛn	ʃtant	ʃtɛnd-ə	‘stall’
vand	vɛn	vant	vɛnd-ə	‘wall’

From this we conclude that FILL is less highly valued in Standard German than in Hessian and that the plurals of both sets in (32) are zero-marked.

As the following tableau shows, reranking FILL below SON]PL and PARSE in Standard German yields the correct forms.

(33) Standard German epenthesis

	PARSE FEAT	SON]PL	PARSE SEG	FILL
↳ hun.d[E]				*
hun<d>			*!*	
hund		*!		
hu<nd>	*!		***	

The first candidate in (33) violates FILL with its epenthetic vowel. But the second violates higher-ranked PARSE-SEG, the third higher-ranked SON]PL and the fourth PARSE-FEAT (the place feature CORONAL).

The relevant parts of Standard and Hessian phonology, then differ only in the relative ranking of FILL:

(34) Comparative constraint ranking

Hessian PARSE-FEAT >> FILL >> SON]PL >> PARSE-SEG
 Standard German PARSE-FEAT >> SON]PL >> PARSE-SEG >> FILL

Both dialects value the parsing of distinctive features above all else: PARSE-FEAT is undominated and never violated.⁹ Both also require plurals to end in sonorants and require all features to be parsed. But Hessian ranks FILL above SON]PL and PARSE-SEG, making subtraction (hɔn ‘dogs’) and obstruent-final plurals (dɛʃ ‘tables’) better options than epenthesis (*hɔnd-ə, *dɛʃ-ə). Standard German, on the other hand, ranks FILL below SON]PL and PARSE-SEG, making epenthesis (hʊnd-ə ‘dogs’, tɪʃ-ə ‘tables’) a better option than obstruent-final plurals (*dɛʃ) or subtraction (*hʊn).

Before concluding, we would like to treat one final important aspect of German plural morphology. As mentioned earlier, zero-plurals of monosyllabic stems in German are impossible. Alongside the zero-marked disyllables in (35) plural forms like *val, *ror, *zin, *ham are ill-formed.

(35) Zero-marked disyllabic stems

lœfɫ lœfɫ 'spoon'
 mɛsɾ mɛsɾ 'knife'

The constraint that rules *val, etc. out is NON-FINALITY, discussed above and shown at work below with a made-up stem vor:

(36) Sonorant final monosyllabic plurals are ill-formed

	PARSE FEAT	NON-FINALITY	SON]PL	PARSE SEG	FILL
vor		*!			
☞ vor[E]					*
vo<ɪ>	*!			*!	

The ranking of NON-FINALITY here is crucial only insofar as it must dominate FILL; otherwise epenthesis would be avoided and sonorant-final monosyllables would (incorrectly) make well-formed plurals.

We conclude that there is no need for a final -ə suffix in Standard German. Rather, ə-final plurals in Standard German are epenthetic, analogous to subtractive plurals in Hessian: they are phonologically conditioned variants of Ø-marking. The basic evidence for this claim is provided by the fact that neither a monosyllabic word nor a word ending in a schwa syllable followed by an additional schwa is a possible

⁹ Final Devoicing in German is an obvious exception, but one which does not affect any of the claims made here. An analysis of Final Devoicing in the present framework would require a constraint against syllable-final voiced obstruents to outrank PARSE-FEAT.

plural noun. Furthermore, we know independently that schwa is the epenthetic vowel in German (Giegerich 1987, Wiese 1988, Hall 1992, Noske 1993); the suffixes *-er* and *-(e)n* could not be epenthetic since they add unpredictable material. What drives the phonological conditioning in both languages is the constraint SON]PL. The difference between the two languages resides in whether they violate PARSE (Hessian) or FILL (Standard German) to achieve sonorant final plurals.

This allows us to simplify the account of German plural morphology. With only a few exceptions, feminines take an *-n* suffix, a lexically marked class of non-feminines takes an *-er* suffix, another class takes an *-s* suffix (see footnote 3 for references), and the rest are morphologically \emptyset -marked. We thus do away with an arbitrary class needed in previous analyses of Standard German: schwa plurals are not a separate inflectional class.

6. Conclusion

By way of conclusion we would like to briefly consider what a rule-based account of the Hessian data we have studied would look like. We can see two possibilities, one with only rules, the other with both rules and constraints. A purely rule-based approach would require a rule that deleted voiced stops after homorganic sonorants and voiced velar stops after vowels. This is an unenlightening disjunction of environments and completely misses the important generalization that all so-called subtractive plurals end in sonorants. This analysis would thus entirely miss the parallel with Standard German plurals, which also end in sonorants.

Similarly with a rules plus constraints approach. The constraints would be reasonable enough, of course, but the deletion rule (Delete a final obstruent in the plural) would have no motivation whatsoever. This rule would be specific to Hessian and the parallel with Standard German would be lost.

It is only on the surface of things that Hessian seems to have a subtractive process of pluralization. We have shown, however, that this apparent deletion process is in complementary distribution with zero marked plurals. This observation allows for an analysis in which subtraction is merely the result of respecting other constraints in the grammar. Crucially, the other constraints involved (SON]PL and FILL) are found elsewhere in German. The relevant difference between the phonology of Hessian and Standard German is reduced to the ranking of the constraint against epenthesis: it dominates two constraints in Hessian that dominate it in Standard German.

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