Perceptually Driven Allomorphy: The Swedish Non-Neuter Singular Definite Article*

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1. Introduction

The Swedish non-neuter definite article has two allomorphs, [n] and [en], whose distribution cannot be reduced to stem phonotactics. Rather, distribution is driven by perceptual salience, determined by constraint rankings projected from a perceptual map (Steriade 2001). Minimality and sonority sequencing fail to account for the pattern.

2. Distribution of allomorphs

Consider the allomorphs' distribution. After vowels, [n] surfaces:

(1)

SG.=STEM	*	NON-N. SG. DEF.	GLOSS
[byː]	*[ˈbyːen]	[ˈbyːn]	'village'
[frʉː]	*[ˈfrʉːen]	[ˈfrʉːn]	'wife'

The preference of [n] over [en] postvocalically is not motivated by phonotactics. The neuter singular definite article has the allomorphs [t] and [et]. In standard Swedish, the allomorph [et], not [t], surfaces after stressed vowels:

(2)

SG.=STEM	*	N. SG. DEF.	GLOSS
[blyː]	*[blyːt]	[ˈblyːet]	'lead'
[kʉː]	*[kʉːt]	[ˈkʉːet]	'letter Q'

The UR /n/ is also suggested by lateral-final stems with penultimate stress:[1]

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(3)

SG.=STEM	*	NON-N. SG. DEF.	GLOSS
[ˈsyk:el]	*[ˈsyk:elen]	[ˈsyk:eln]	‘bicycle’
[ˈkonsʉl]	*[ˈkonsʉlen]	[ˈkonsʉln]	‘consul’

I depart from earlier accounts (Teleman 1969, Eliasson 1972, Hellberg 1974) which have assumed /en/ as the underlying representation, in addition to morpheme-specific syncope rules. I will assume that /n/ is the UR.

Unsurprisingly, epenthesis applies after stem-final obstruents.

(4)

SG.=STEM	NON-N. SG. DEF.	*	GLOSS
[gru:p]	[ˈgru:pen]	*[ˈgru:pn]	‘hole’
[i:s]	[ˈi:sen]	*[ˈi:sn]	‘ice’

This is banal, since the obstruent-n clusters would be phonotactically deviant in Swedish. More interestingly, the allomorph [en] appears after a stem-final nasal.

(5)

SG.=STEM	NON-N. SG. DEF.	*	GLOSS
[strøm:]	[ˈstrøm:en]	*[strøm:n]	‘current’
[riŋ:]	[ˈriŋ:en]	*[riŋ:n]	‘ring’

This is no minimality effect: it applies to polysyllabic forms, independent of their stress or morphological structure.

(6)

SG.=STEM	NON-N. SG. DEF.	*	GLOSS
[ˈpilgrim]	[ˈpilgrimen]	*[ˈpilgrimn]	‘pilgrim’
[ˈvɛl:iŋ]	[ˈvɛl:iŋen]	*[ˈvɛl:iŋn]	‘porridge’
[ˈʉŋ: + ˌdum:]	[ˈʉŋ: + ˌdum:en]	*[ˈʉŋ: + ˌdum:n]	‘young’ + ‘n-form.’
[ˈɛlsk + liŋ:]	[ˈɛlsk + liŋ:en]	*[ˈɛlsk + liŋ:n]	‘love’ + ‘dim.’

Epenthesis is is not due to stem phonotactics: [m:n] and [ŋ:n] are licit codas:

(7)

STEM=SG.	GLOSS
[hym:n]	‘hymn’
[vaŋ:n]	‘wagon’

The following minimal pairs contrast the grammaticality of tautomorphemic word-final [m:n] and [ŋ:n] with the ungrammaticality of heteromorphemic [m: + n] and [ŋ: + n]:

[1] Two exceptions are [ˈhim:el] ‘heaven’, which surfaces as [ˈhim:eln], [ˈhim:len] or [ˈhim:elen]; and [ˈfjɛ:ril] ‘butterfly’ which surfaces as [ˈfjɛ:rilen].

(8)	monomorpheme	[søm:n]			‘sleep’
	but:	[søm:]	→	[ˈsøm:en]	‘seam, def’
				*[søm:n]	
	monomorpheme	[sɛŋ:n]			‘legend’
	but:	[sɛŋ:]	→	[ˈsɛŋ:en]	‘bed, def’
				*[sɛŋ:n]	

In stems ending in [l] that are stressed on the final syllable, the allomorph [en] surfaces. This is true for monosyllabic stems, polysyllabic stems, and both singleton and geminate [l]:

(9)

STEM	*	NON-N. SG. DEF.	GLOSS
[vɑ:l]	*[vɑ:ln]	[ˈvɑ:len]	‘whale’
[val:]	*[val:n]	[ˈval:en]	‘rampart’
[korˈprɑ:l]	*[korˈprɑ:ln]	[korˈprɑ:len]	‘corporal’
[meˈtal:]	*[meˈtal:n]	[meˈtal:en]	‘metal’

Just as epenthesis after nasal-final stems is independent of stem phonotactics, the epenthesis after lateral-final stems is independent of stem phonotactics. The coda cluster [ln] is licit in monomorphemes, as the lexical item [mo:ln] ‘cloud’ illustrates. The following minimal pair shows conclusively that stem phonotactics cannot capture the allomorphic pattern at hand:

(10)	monomorpheme	[ɑ:ln]			‘el’
	but:	[ɑ:l]	→	[ɑ:len]	‘alder, def’
				*[ɑ:ln]	

So, phonotactics does not drive [e]-epenthesis in the non-neuter definite morpheme.

3 Perceptually driven allomorphy

Epenthesis of [e] before the article /n/ after sonorants [l m ŋ] is driven by perceptual salience. Since the suffix /n/ carries the functional load of being a morpheme, it is under stricter perceptibility requirements than non-morphemic /n/. The epenthesis of [e] renders more salient the distinction between the definite member of the noun’s paradigm from the (unaffixed) non-definite stem.

Kiparsky (1982:87) notes the functional nature of ‘*distinctness conditions*, which... state that there is a tendency for semantically relevant information to be retained in surface structure.’ Along the same lines, Crosswhite 1999 formulates the constraint

ANTI-IDENTITY to maintain paradigmatic distinctness. Informally, ANTI-IDENTITY states that two tautoparadigmatic forms must be segmentally non-identical.

I will borrow Kiparsky's and Crosswhite's insights regarding paradigmatic distinctiveness. However, I will consider distinctiveness a gradient—not categorical—notion. From a functional perspective, we should expect different members of a paradigm to not only be phonologically distinct; they should be perceptually distinct to a non-trivial degree. An overly subtle perceptually distinction would be functionally worthless.

Take the Swedish stem /søm:/ 'seam'. The non-definite form has a null suffix, so it surfaces as [søm:]. Theoretically, the definite form might surface with either [n] or [en]; that is, [søm: + n] or [søm: + en]. While the former is phonologically distinct from the non-definite form, they are nevertheless somewhat confusable. The mechanism that chooses the allomorph [en] is a mechanism that minimizes confusability in paradigms.

Even the most robust phonetic distinction—say [s] versus [a]—can be rendered imperceptible in a sufficiently noisy ambiance: a given morphemic exponence inevitably features some level of perceptual fragility. Consider *NONDIST MORPH as a family of constraints, where any sound/context combination incurs a violation, since any sound/context combination is, to some degree, perceptually fragile:

(11) ***NONDIST MORPH—a family of constraints**
For tautoparadigmatic morphemes M_i and M_j, $M_i \neq M_j$, with respective phonetic exponence m_i and m_j, exponence m_i at context K incurs a violation *NONDIST MORPH (m_i,m_j / K).

Following Flemming 2004 and Steriade 2001, the relative fragility of a morpheme in various contexts is projected from the P-map to the grammar. The ranking of the various *NONDIST MORPH constraints depends on the relative confusability of the morphemic exponence w.r.t. other tautoparadigmatic exponences.

(12) **P-map-to-ranking projection of *NONDIST MORPH**
For contexts K_a and K_b, $K_a \neq K_b$,
and tautoparadigmatic morphemic exponences m_i and m_j, $m_i \neq m_j$,
If $\Delta\ (m_i,m_j)\ /K_a < \Delta\ (m_i,m_j)\ /\ K_b$,
then *NONDIST MORPH (m_i,m_j / K_a) $\gg$ *NONDIST MORPH (m_i,m_j / K_b).

Greater similarity of exponence results in a more highly ranked *NONDIST MORPH constraint.

4. Cues for [n]

Vowel epenthesis facilitates perceptibility of [n] after nasal-final stems, since the sound [n] is more salient after a vowel than after a nasal. Three kinds of information must be retrieved for the sound [n] to be salient. The listener must retrieve (a) the segmental status of the gesture, (b) the coronal place of articulation, and (c) the nasal manner of articulation. Wright 2004 and Raphael 2007 provide overviews of perceptual cues of various sounds, including [n]. I will argue that the cues for [n] are easier to retrieve after [e] than after a nasal.

To identify segmental status of the gesture, the key is signal modulation, according to Kawasaki 1982 and Ohala 1992, summarized in Wright 2004. Modulation of both spectral shape and amplitude facilitate segmental parsing.

Place cues, according to Wright (2004:37) 'are found in the brief transitional period between a consonant and an adjacent segment....' The crucial information is in the second and third formant, which 'provide the listener with cues to the place of articulation of consonants with oral constrictions....' (Wright 2004:38, citing Malécot 1956; also, Raphael 2007:196).

As far as manner is concerned, nasality is cued by the nasal murmur itself. Also, nasalization on the preceding sound 'provides look-ahead cues to the nasal manner' (Wright 2004:39; Ali, Gallager, Goldstein & Daniloff 1971, Hawkins & Stevens 1985).

So, we have clear notions of why the sound [n] is more salient in postvocalic position than in postnasal position. The vowel and the nasal have modulated spectral shape and amplitudes facilitating segmentation. The vowel-nasal transition provides clear formant transitions, cuing coronal place. The vowel carries some nasalization, cuing nasal manner.

In contrast, the sound [n] after a nasal is highly non-salient. First, the signal modulation between the [m] and [n] is minimal, since the sounds are similar in spectral shape and amplitude, impeding segmental parsing. Second, a [m]-[n] transition provides weak formant transitions to signal place. Third, the nasalization on the vowel is triggered by the stem-final nasal, not the suffix, so there is no informative look-ahead cue of nasalization to facilitate the perception of the suffix.

These facts suggest the following P-map fragment:

(13)

Context Morphemes	N_#	V_#
n/∅	n/∅	n/∅

The morphemes /n/ and ∅ are less distinct in the context N_#; the small distinction is represented by means of the small font. They are more distinct in the context V_#.

The difference between morphemes /n/ and ∅ in context N_# is smaller than their difference in context V_#. This generates, according to the P-map-to-ranking projection in (12), the ranking *NONDIST MORPH (n,∅/N_#) ≫ *NONDIST MORPH (n,∅/V_#). Epenthesis in [m]-final stems is generated by DEP-V's being ranked lower than *NONDIST MORPH (n,∅/N_#):

(14)

/søm: + n/	*NONDIST MORPH (n,∅/N__#)	DEP-V	*NONDIST MORPH (n,∅/V__#)
a. søm:n	*!		
b. > søm:en		*	*

On the other hand, the epenthetic form is harmonically bounded by the non-epenthetic form in the case of vowel-final stems:

(15)

/by: + n/	*NONDIST MORPH (n,∅/N__#)	DEP-V	*NONDIST MORPH (n,∅/V__#)
a. > by: n			*
b. by:en		*!	*

So, no epenthesis takes place after vowel-final stems.

Crucially, the *NONDIST MORPH constraints only apply to morphemes, not phonemes. It is for this reason that it does not apply to the [n] in the monomorpheme /søm:n/ 'sleep'. The relevant markedness constraint—call it *PHONOTACTIC (n/N_#)—is crucially ranked lower than DEP-V such that the epenthetic candidate is dispreferred:

(16)

/søm:n/	*NONDIST MORPH (n,∅/N__#)	DEP-V	*NONDIST MORPH (n,∅/V__#)	*PHONO-TACTIC (n/N__#)
a. > søm:n				*
b. søm:en		*		

5. Why no epenthesis after lateral-final[2] with penultimate stress?

Lateral-final stems behave schizophrenically, sometimes following the epenthesis pattern of nasal-final stems and sometimes following the non-epenthesis pattern of vowel-final stems. Lateral-final stems with penultimate stress do not trigger epenthesis. Recall the definite forms [ˈsykːel+n] 'bicycle' and [ˈkonsʉl+n] 'consul' in (3) above. These are reminiscent of vowel-final stems with penultimate stress, which do not trigger epenthesis:

(17)

SG.=STEM	*	NON-N. SG. DEF.	GLOSS
[ˈblomːa]	*[ˈblomːaen]	[ˈblomːan]	'flower'
[ˈtodːy]	*[ˈtodːyen]	[ˈtodːyn]	'toddy'

Nasal-final words with penultimate stress, in contrast, do trigger epenthesis; recall [ˈpilgrim+en] 'pilgrim, def' and [ˈvɛlːiŋ + en] 'porridge, def' in (6) above. A lateral-final stem with penultimate stress patterns like vowel-final stems, not like nasal-final ones.

Lateral-final stems with final stress, however, pattern like nasal-final stems, and unlike vowel-final stems; they associate with the [en] allomorph. Recall [ˈvɑːl+en] 'whale, def' and [ˈvalː+en] 'rampart', as well as [korˈprɑːlen] 'corporal, def' and [meˈtalːen] 'metal, def' from (9) above. This is much like epenthesis after nasal-final stems like [ˈpilgrim+en] 'pilgrim, def' and [ˈvɛlːiŋ + en] 'porridge, def' in (6) above; it contrasts with the lack of epenthesis in vowel-final words with final stress, like [ˈbyː+n]'village, def' and [ˈfrʉː+n] 'wife, def' in (1) above.[3]

Summarizing, lateral-final stems pattern like vowel-final stems when they have penultimate stress, but they pattern like nasal-final stems when they have final stress. Lateral-final stems pattern like something intermediate between nasal-final stems and vowel-final stems precisely because the perceptibility of [n] in postlateral position before a word-boundary—(L_#)—is intermediate between the perceptibility of [n] in contexts N_# and V_#.

Recall Wright's observations about the cues for the sound fragment [n]. To facilitate segmentation, Wright refers to signal modulation. In his discussion of acoustic analysis of sounds, Ladefoged (2000:185) notes that the spectra of nasals and laterals are distinct. However, the amplitudes of nasals and laterals are similar (Ladefoged 2000:182). So, modulation of spectral shape may facilitate segmentation somewhat, while amplitude modulation is presumably a poor cue.

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[2] The patterns described apply to r-final stems as well. I set them aside, however, since there is a confound in this case: [r] followed by [n] coalesces into a postalveolar nasal. This introduces complications beyond the scope of the present paper.

[3] Some lexical exceptions exist. See Teleman 1969 for discussion.

A preceding [l], being coronal, will not provide transitional place information about a following coronal, since no place transition takes place. However, it seems likely that the lack of transition is interpreted as maintenance of coronal place.

Wright observes that anticipatory nasalization on the segment before /n/ cues the nasal feature. Since the lateral can carry some anticipatory nasalization, but presumably not as much as a vowel, nasal manner will be cued; but less saliently than in the postvocalic position.

The intermediate status of cue-strength of [n] in context L_# compared to contexts N_# and V_# implies an intermediate status of confusability of distinct tautoparadigmatic morphemic exponences [n] and ∅. The following P-map fragment captures this:

(18)

Context / Morphemes	N_#	L_#	V_#
n/∅	n/∅	n/∅	n/∅

By the P-map-to-ranking projection in (12), the P-map in (18) generates the ranking *NONDIST MORPH (n,∅/N_#) ≫ *NONDIST MORPH (n,∅/L_#) ≫ *NONDIST MORPH (n,∅/V_#). We know already that DEP-V is ranked lower than *NONDIST MORPH (n,∅/N__#). Also, the epenthesis of [e] after lateral-final stressed syllables suggests *NONDIST MORPH (n,∅/L_#) ≫ DEP-V, as in the following tableau:

(19)

/ˈɑːl + n/	*NONDIST MORPH (n,∅/N_#)	*NONDIST MORPH (n,∅/L_#)	DEP-V	*NONDIST MORPH (n,∅/V_#)
a. (ˈɑːln)		*!		
b. > (ˈɑːlen)			*	

Now, consider the [l]-final stems with penultimate stress. Recall that these fail to trigger epenthesis. The constraints that we have posited generate the incorrect output; the ranking *NONDIST MORPH (n,∅/L__#) ≫ DEP-V inevitably favors an output with epenthetic [e]:

(20)

/ˈkonsʉl + n/	*NONDIST MORPH (n,∅/N_#)	*NONDIST MORPH (n,∅/L_#)	DEP-V	*NONDIST MORPH (n,∅/V_#)
a. > ˈkonsʉln		*		
b. 💣 ˈkonsʉlen			*	

Some constraint is active, which disfavors candidate (b). If this constraint—call it C—is ranked above *NONDIST MORPH (n,∅/L__#), the correct output would be generated.

(21)

/ˈkonsʉl + n/	*NONDIST MORPH (n,∅/N_#)	C	*NONDIST MORPH (n,∅/L_#)	DEP-V	*NONDIST MORPH (n,∅/V_#)
a. > ˈkonsʉln			*		
b. ˈkonsʉlen		*!		*	*

The following section will propose such a constraint.

6. A prosodic constraint

Prosodically, candidate (b) in tableau (21) is a trisyllabic sequence with initial stress [ˈσ σ σ], and the canonical foot in Swedish is a bisyllabic trochee [(ˈσ σ)] (Riad 1992). Assuming that the trisyllabic sequence with initial stress involves an unparsed final syllable [(ˈσ σ) σ], we can naturally derive the non-optimality of candidate (b) from a constraint against unfooted syllables. Call it PARSE-σ. This is the constraint alluded to above—constraint C—which disprefers the candidate [ˈkonsʉlen], leaving [ˈkonsʉln] to be the optimal candidate:[4]

(22)

/ˈkonsʉl + n/	*NONDIST MORPH (n,∅/N_#)	PARSE-σ	*NONDIST MORPH (n,∅/L_#)	DEP-V	*NONDIST MORPH (n,∅/V_#)
a. > (ˈkonsʉln)			*		
b. (ˈkonsʉl)en		*!		*	*

[4] One might consider the candidate [ˈkonslen], where the stem vowel is deleted. This would satisfy both PARSE-σ and *NonDist Morph (n/L__#). While the plural morpheme /ar/ triggers syncope in the stem, the non-neuter definite article does not. For example, the definite singular [morgonen] is dactylic, while the plural [ˈmorgnar] is trochaic, due to syncope. This is presumably a level-ordering effect.

PARSE-σ must be ranked lower than *NONDIST MORPH (n,∅/N__#), to generate trisyllabic outputs when the non-neuter article associates with an [m]-final trochee stem:

(23)

/ˈpilgrim+n/	*NONDIST MORPH (n,∅/N_#)	PARSE-σ	*NONDIST MORPH (n,∅/L_#)	DEP-V	*NONDIST MORPH (n,∅/V_#)
a. (ˈpilgrimn)	*!				
b. > (ˈpilgrim)en		*		*	*

7 Alternative accounts

Having rejected stem phonotactics as the source of the allomorphic pattern under discussion, we will presently reject minimality and sonority sequencing.

First, take minimality. Suppose that [e]-epenthesis were motivated by constraints on foot structure. Recall that the default foot in Swedish is trochaic (Riad 1992); assume minimality requires at least a bisyllabic trochee in derived forms. This could explain [e]-epenthesis in the case of affixation to monosyllabic stems: forms like *[ɑːl+n] 'el, def' and *[søm:+n] 'seam, def' are monosyllabic, and therefore subminimal. The [e]-epenthesis in these forms would satisfy minimality, since [ɑːl+en] and [søm:+en] are bisyllabic trochees. However, the minimality account fails to account for [e]-epenthesis after nasal-final trochees: the result of epenthesis is a marked trisyllabic structure, as we saw in forms such as [ˈpilgrim+en] 'member, def' and [ˈvɛlːiŋ+en] 'porridge,def'. Furthermore, minimality predicts that all derived forms should be at least bisyllabic trochees. This is not the case, as revealed by suffixes such as the participle /d/, supine /t/, and neuter /t/. The participle and supine of [døm:] 'judge' are [døm:+d] and [døm:+t], without epenthesis. Similarly, the neuter of [lɑːm] 'lame' is [lɑːm+t], without epenthesis.

Second, suppose sonority sequencing drives epenthesis after lateral-final stems and nasal-final stems; perhaps the suffix /n/ is too close to the lateral and nasals in the sonority scale. This approach cannot work. The participle, supine, and neuter suffixes surface unchanged after sounds of identical sonority, e.g., [tigː+d] 'beg, participle', 'extinguish', [slɛkː+t] 'extinguish, supine', and [çɛkː+t] 'stylish, neuter'. So minimum sonority distance does not drive epenthesis in Swedish.

8. Extensions

It is tempting to extend *NONDIST MORPH to other cases of allomorphy. Perhaps the most famous case of allomorphy is the English past tense –d suffix; the key puzzle is the mechanism of schwa epenthesis. While Bakovic 2005 accounts for epenthesis in English past-tense allomorphy by means of the highly ranked constraints NoGem (which rules out geminates) and Agree (voi) (which rules out clusters like [td] in SR), schwa-epenthesis in English can be formalized to apply in contexts /t_d/ and /d_d/ without reference to NoGem. Note that [e]-epenthesis in Swedish applies between nasals without a ban on nasal geminates: words like [lamː] 'lamb', [spanː] 'bucket', and [soŋː] 'song' are impeccable Swedish monomorphs. For English, consider the confusability of morphemes /d/ 'past' and ∅ 'simple present'. They are maximally confusable in contexts d_# and t_#, where the cues for the sound [d] are the weakest. So, *NonDist Morph (d, ∅/d_#), *NonDist Morph (d, ∅/t_#) ≫ *NonDist Morph (d, ∅/X_#), where X is any sound of English other than [d] or [t]. An interleaved Dep-V generates the epenthetic pattern: *NonDist Morph (d, ∅/d_#), *NonDist Morph (d, ∅/t_#) ≫ Dep-V ≫ *NonDist Morph (d, ∅/X_#). A similar account, *mutatis mutandis,* can be given for the epenthesis pattern of the plural s-morpheme.

To conclude, I will note that the epenthesis in the Swedish definite article paradigm is an instantiation of The Emergence of the Unmarked (TETU; McCarthy & Prince 2004) in a Derived Environment (Kiparsky 1982, Lubowicz 2004). I conjecture that other TETU-effects and Derived Environment-effects can be reanalyzed in terms of *NonDist Morph. Also, the present account requires primary phonetic content in the phonological formalism. So, it is a counterexample to Evolutionary Phonology (Blevins 2004).

9. Summary

Allomorphy is directly computed from the perceptual map; it is not mediated by phonotactics. The Swedish non-neuter definite article provides empirical evidence. Alternative mechanisms such as phonotactics, minimality, and sonority sequencing fail to account for the Swedish data. Perceptually driven allomorphy can also capture schwa-epenthesis triggered by the English past tense –d suffix and plural –s suffix.

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