

*A diachronic account of phonological unnaturalness**

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Norwegian retroflexion exhibits some phonetic properties that do not seem to ‘make sense’. In Standard East Norwegian, an alveolar /r/ causes a following alveolar coronal to become postalveolar, and in the Frogner and Arendal dialects of Norwegian, the same postalveolarisation process is triggered by a uvular /ʁ/. Comparative analyses of Norwegian dialects reveal that these properties are the results of historical changes and phonological diffusion across dialects. Theories attempting to analyse Norwegian retroflexion as phonetically ‘natural’ can neither fully account for these properties of Norwegian retroflexion nor capture the typological generalisations found across Norwegian dialects.

1 Introduction: natural and unnatural phonology

Phonological interactions typically ‘make sense’ phonetically, meaning that there is a clearly discernible synchronic phonetic motivation behind them. Such interactions are generally called ‘natural’. One question which has occupied phonologists for many years is why there is a strong tendency for phonological processes to be natural. One common approach has been to appeal to what I will call the ‘diachronic model’ of phonology. This model posits that synchronic phonological alternations are most typically the result of sound changes in earlier stages of the language. Sound changes tend themselves to be phonetically motivated, because most of them originate from misperception of the acoustic signal and from errors due to the inherent physiological limitations of the human articulatory and perceptual systems. Since these explanations make direct reference to the nature of acoustics, articulation and perception, it follows that the resulting synchronic processes will be motivated by phonetic properties

* Parts of this work were presented at BLS 37, the 85th Annual Meeting of the LSA and the MIT Phonology Circle. I am grateful to the audience at these events for their comments and feedback. Earlier versions of this paper have also greatly benefited from comments and criticism from Adam Albright, Michael Becker, the editors of *Phonology* and three anonymous reviewers. I wish to thank Arne Torp for conducting the recording session with the speaker of the Frogner dialect on my behalf, and, finally, I am grateful to the dialect speakers consulted in this paper for letting me probe and record their phonological production.

(see e.g. Ohala 1971, 1972, 1974). In this way, it is not necessary to appeal to 'grammar' in order to explain why natural processes are so common. As a result, most proponents of the diachronic model see no need to assign any special value to natural processes inside grammar itself (see e.g. Barnes 2006: 2).

Phonetically motivated sound changes do not, however, necessarily lead to synchronically natural interactions. As is particularly well known in the case of 'telescoping', a series of chronologically ordered natural sound changes sometimes happens to give an 'unnatural' alternation, i.e. one which lacks any synchronic phonetic motivation (Kenstowicz & Kisseberth 1977: 64f). Nor are synchronic alternations always the result of phonetically motivated sound changes, as they sometimes arise from factors such as morphophonological analogy and language contact. In these cases, too, then, the resulting alternation might be synchronically 'unnatural' (Buckley 2000, Garrett & Blevins 2009). What such unnatural processes have in common, however, is that they all have a discernible historical explanation. Within the diachronic model, the same applies to natural processes: they, too, have a discernible historical explanation. In sum, then, there is no principled distinction between natural and unnatural interactions in the diachronic model.

According to a very different approach, natural interactions are assumed to be favoured by the cognitive system. I will call this approach 'naturalness theory'. In this theory, it is typically said that natural interactions are more 'highly valued' by the grammar (e.g. Schane 1973: 115ff, Keating 1985: 129), or that there is a 'bias' in favour of such interactions (e.g. Wilson 2006: 947), but it is often not clear or made explicit what this means in practice. According to a very strict interpretation of naturalness theory, unnatural processes simply cannot exist in a synchronic grammar. If they were to arise historically, they would lose productivity and become lexicalised or morphologised (Hooper 1976: 90, 133f). In other words, the grammar would by design be incapable of expressing or learning unnatural phonology. Another and perhaps more reasonable claim is that unnatural processes should be harder to learn than natural processes (e.g. Schane *et al.* 1974–75). If this were the case, we would expect unnatural interactions to be in a steady decline in languages across the world, since language learners should have difficulties acquiring them. Several phonologists have pointed out that no such tendency can be found (Buckley 2000: 24, Barnes 2006: 221). More importantly, the idea that unnatural interactions are harder to learn finds little support in the many learning experiments designed to test this (cf. Jusczyk *et al.* 2003, Pycha *et al.* 2003, Saffran & Thiessen 2003, Seidl & Buckley 2005, Pycha *et al.* 2006, Kuo 2009, Skoruppa & Peperkamp 2011). Presumably for these reasons, another approach within naturalness theory has been to claim that unnatural processes are not necessarily harder to learn (Wilson 2006: 947). Instead, the difference between naturalness and unnaturalness is manifested primarily in the design of the grammar, such that natural processes are innate, whereas unnatural processes need to be learned (Donegan &

Stampe 1979: 143f, Hayes 1999: 270).¹ One obvious problem with this approach is that two distinct mechanisms are posited for what is essentially one task – learning the phonology of the ambient language.²

The diachronic model posits that synchronic alternations, whether they are natural or unnatural, look the way they do because of history, with no need for a ‘naturalness bias’. Naturalness theory, on the other hand, suggests that synchronically natural alternations exist primarily due to a cognitive bias for naturalness. In contrast, synchronically *unnatural* alternations are said to be caused by quirks of history (Donegan & Stampe 1979: 127f, Hayes 1999: 269, Kawahara 2008). In this way, naturalness theory posits two distinct explanations for the origin of synchronic alternations. Taken together, there is a clear difference between the diachronic model and naturalness theory. The diachronic model claims that phonological alternations are the result of history, and need to be learned. Naturalness theory claims that phonologically natural alternations stem from an innate cognitive bias and need only be ‘internally induced’, whereas phonologically unnatural alternations are the result of history and need to be learned. Put differently, naturalness theory simply refers to the diachronic model in order to account for unnatural processes. A methodological issue that arises in this connection is that every time a diachronic account needs to be added to the naturalness theory in order to explain the presence of unnatural processes encountered in the data, the naturalness theory will look more and more like the diachronic model itself, in which no principled distinction is made between natural and unnatural processes (Mielke 2008: 6f). In short, adding diachronic accounts to the naturalness theory makes it look more like the diachronic model. Since there are no alternative ways of explaining unnatural phonology than with diachronic accounts, it has always been an important endeavour for supporters of the diachronic model to document unnatural processes in languages. The larger the number of such unnatural interactions there can be found in languages around the world, the stronger their argument against naturalness theory will be (for examples of such unnatural processes, see Blevins 2004: 67ff, 2008).

This paper continues this tradition by highlighting an unnatural process which has not been mentioned in this debate yet: Norwegian retroflexion. In Standard East Norwegian, an alveolar /r/ causes a following alveolar /t d n s/ to become postalveolar, without any obvious source for the postalveolar articulation. In other dialects, the same change is triggered by a uvular /ʁ/, after which the change from an alveolar to a postalveolar seems even more mysterious.

Since unnatural processes need to be explained with reference to their historical origin, I adopt the diachronic model in accounting for the

¹ In Hayes’ terminology, natural processes are ‘induced from internal phonetic experience’, whereas unnatural processes are ‘induced from external language data’.

² For similar critical remarks along these lines, cf. Hale (2000: 252), Baroni (2001: 175f) and Mielke (2008: 82).

properties of Norwegian retroflexion that seem phonetically unmotivated from a synchronic perspective. A comparative and historical analysis shows that in Standard East Norwegian, alveolar /t d n s/ originally assimilated to the apical alveolar /r/ to become apical alveolar [t̪ d̪ n̪ s̪], and assimilated to the apical postalveolar /ɾ/ to become apical postalveolar [t̪̠ d̪̠ n̪̠ s̪̠]. Apical alveolar [t̪ d̪ n̪ s̪] and apical postalveolar [t̪̠ d̪̠ n̪̠ s̪̠] later merged as postalveolars. After this merger, alveolar /t d n s/ seemingly ‘assimilate’ to alveolar /r/ to become postalveolar [t̪̠ d̪̠ n̪̠ s̪̠].

In the Frogner dialect of Norwegian, the alveolar /r/ underwent a sound change to uvular /ʁ/, but retroflexion nevertheless remained. The outcome of this change is that the alveolar /t d n s/ ‘assimilate’ to a uvular /ʁ/ to become postalveolar [t̪̠ d̪̠ n̪̠ s̪̠]. Finally, the original non-retroflexing dialect of Arendal with uvular /ʁ/ has adopted the retroflexion process from neighbouring dialects, where retroflexion is triggered by /r/, made possible by the consistent correspondence of /ʁ/ and /r/ across these dialects. The result is that the Arendal dialect now exhibits a process in which the uvular /ʁ/ causes a following alveolar coronal to become postalveolar. In both the Frogner and Arendal dialects, no synchronic phonetic motivation exists for having a uvular /ʁ/ trigger postalveolarisation. In both cases, however, the process originates in the older retroflexion process triggered by /r/, which still exists in Standard East Norwegian today.

This paper is organised as follows. §2 introduces retroflexion in Standard East Norwegian and shows that it has no synchronic articulatory motivation. §2.1 provides a diachronic account of this retroflexion process. §3 shows that there is a productive retroflexion process in the uvular /ʁ/-dialect of Frogner, and that this process, too, cannot be articulatorily motivated. §3.1 explains how this situation has arisen from historical changes in the phonology of this dialect. §4 demonstrates that retroflexion is active also in the uvular /ʁ/-dialect of Arendal, and §4.1 shows how it has emerged as a result of language contact. §5 argues that retroflexion in Norwegian cannot be analysed as a natural process with a perceptual motivation, and §6 argues against a proposal that retroflexion in Standard East Norwegian was unnatural from the outset (i.e. that it has not become unnatural as a result of later historical changes). §7 concludes the paper.

2 Retroflexion in Standard East Norwegian

Retroflexion in Standard East Norwegian involves the three sets of sounds in (1).^{3,4}

³ By ‘Standard East Norwegian’ is meant the fairly uniform variant of East Norwegian spoken in urbanised areas in East Norway. Apart from minor regional differences, this standard reflects the expanding city dialect of Oslo (cf. Bull 1980: 14), which is described in Larsen (1907).

⁴ The articulatory properties of the segments in (1) are most carefully described by Storm (1884) and Endresen (1991). For articulatory studies of the same segments, see Moen *et al.* (2003), Simonsen & Moen (2004), Knutsen (2006), Simonsen *et al.* (2008), Moen & Simonsen (2011) and Stausland Johnsen (in press). In accordance

- (1) a. trigger /r/ apical alveolar tap
 b. target /t d n s/ laminal alveolar coronal
 c. output [t d ŋ s] apical postalveolar coronal ('retroflex')

When the alveolar tap /r/ is followed by a morpheme beginning with an alveolar coronal /t d n s/, the alveolar coronal becomes a retroflex, and the /r/ deletes (first described by Brekke 1881: 18ff, Storm 1884: 96f and Western 1889: 275; cf. Kristoffersen 2000: 96f for a recent treatment).

- (2) a. /ny:/ 'new' + /-t/ NEUT → [nyt]
 /tɑ:/ 'take (INF)' + /-də/ 'it' → [tɑ:də]
 /tɑ:/ 'take (INF)' + /-n/ 'him' → [tɑ:n]
 /tɑ:/ 'take (INF)' + /-sæ/ REFL → [tɑ:sæ]
 b. /bɑ:r/ 'bare' + /-t/ NEUT → [bɑ:t]
 /tɑ:r/ 'take (PRES)' + /-də/ 'it' → [tɑ:də]
 /tɑ:r/ 'take (PRES)' + /-n/ 'him' → [tɑ:n]
 /tɑ:r/ 'take (PRES)' + /-sæ/ REFL → [tɑ:sæ]

This process is traditionally described as a synchronic articulatory assimilation or articulatory merger of /r/ and /t d n s/ (Borgstrøm 1958: 46, Hovdhaugen 1969: 146f, Kristoffersen 1980: 72, Eliasson 1986: 277ff, Bradley 2007: 965f).

- (3) *The 'retroflex rule'* (Hovdhaugen 1969)

$$\begin{bmatrix} -\text{syll} \\ +\text{son} \\ -\text{nas} \\ -\text{ant} \end{bmatrix} + \begin{bmatrix} -\text{syll} \\ +\text{ant} \\ +\text{cor} \end{bmatrix} \rightarrow \emptyset + [-\text{ant}]$$

e.g. /r/ + /t/ → ∅ + [t]

In (3), the [−anterior] feature of /r/ causes an immediately following [+anterior] coronal to become [−anterior], in the style of a typical progressive place assimilation. This solution, however, is not descriptively correct, since both the trigger /r/ and the targets /t d n s/ are [+anterior] (alveolars), whereas the output is [−anterior] (postalveolar) (Endresen 1974: 73). Focusing on the place specification of these segments, the process needs to be described as in (4).

- (4) alveolar + alveolar → postalveolar

with the articulatory definition set by the *IPA handbook* (1999: 8), apical postalveolars are traditionally called 'retroflexes' in the literature on Norwegian phonology (cf. Borgstrøm 1958: 30, 45f, Hovdhaugen 1969: 146f, Vanvik 1972: 137ff, Endresen 1974, Næs 1979: 68f, Eliasson 1986: 277ff, Kristoffersen 2000, Simonsen *et al.* 2008, Stausland Johnsen 2012), a tradition I will follow in this paper. Apical postalveolars are typically called 'cacuminals' in Norwegian dialectology, in the tradition initiated by Storm (1884: 94).

The somewhat puzzling aspect of retroflexion in Standard East Norwegian is that a sequence of two alveolars results in a postalveolar segment. There is, however, a relatively straightforward historical account for this property, which is given in §2.1.

2.1 A diachronic account of retroflexion in Standard East Norwegian

Standard East Norwegian also has an apical postalveolar flap /ɾ/⁵ (Larsen 1907: 70, 75), which contrasts both with the tap /r/ and with the laterals /l/ and /l̥/.⁶

(5) /kʰɛ:r/	‘cure’	/kʰɛ:l/	‘cool’	/kʰɛ:ɾ/	‘bump’
/stø:r/	‘sturgeon’	/stø:l/	‘shieling’	/stø:ɾ/	‘sore’
/hɑ:r/	‘have (PRES)’	/hɑ:l/	‘haul (IMP)’	/hɑ:ɾ/	‘hard’
/kɑ:r/	‘man’	/jɑ:l/	‘earl’	/ɑ:ɾ/	‘ard’
/bu:r/	‘live (PRES)’	/bu:l/	‘anabolic steroids’	/bu:ɾ/	‘hive’

The flap /ɾ/ triggers the same process as the tap /r/ does (Storm 1884: 101ff, Larsen 1907: 76, Næs 1979: 69). In other words, when the postalveolar flap /ɾ/ is followed by a morpheme beginning with an alveolar coronal /t d n s/, the alveolar coronal becomes a retroflex, and the /ɾ/ deletes (cf. Kristoffersen 2000: 96f).

(6) /gʷɛ:ɾ/	‘yellow’	+ /-t/	NEUT	→	[gʷɛ:t]
/stæ:ɾ/	‘steal (IMP)’	+ /din/	‘your’	→	[stæ:dʒin]
/stæ:ɾ/	‘steal (IMP)’	+ /-n/	‘him’	→	[stæ:n]
/stø:ɾ/	‘sore’	+ /sɔm/	‘as’	→	[stø:sɔm]

Unlike the postalveolarisation process triggered by /r/ in (4), this process is a typical place assimilation.

(7) postalveolar + alveolar → postalveolar

⁵ For articulatory studies of /ɾ/, see Moen *et al.* (2003) and Knutsen (2006).

⁶ The traditional upper class Dano-Norwegian sociolect in Oslo has no regular occurrence of the postalveolar flap /ɾ/ (Western 1889: 272). In its place it has either a lateral (/stø:l/ ‘shieling’, ‘sore’) or a tap (/hɑ:r/ ‘have (PRES)’, ‘hard’). The regular presence or absence of the flap is Larsen’s primary criterion for distinguishing the Dano-Norwegian sociolect from the city dialect (1907: 26). As would be expected, speakers of Dano-Norwegian have borrowed words with ‘vulgar’ meanings from the city dialect, and these words are used in the appropriate social settings. Some of these words have the flap /ɾ/ (cf. Jahr 1981: 335f), hence it is not entirely absent in Dano-Norwegian (Western 1889: 272, Larsen 1907: 31). Conversely, speakers of the city dialect have also borrowed words from the Dano-Norwegian sociolect. In certain social settings, then, these speakers might use words without the flap where the corresponding forms in the city dialect have it. In conclusion, variation between flaps and non-flaps in Oslo speech is due to lexical borrowings whose use is socially determined (Faarlund 1974: 2f, Papazian 1977: 29f, 36ff). Attempts to derive the flap /ɾ/ phonologically from underlying /r/ and /l/ (Kristoffersen 2000: 91ff) have little to recommend them, since it is lexically unpredictable which forms can or cannot have the flap, as exemplified in (5).

From the evidence in Standard East Norwegian alone, it is reasonable to assume that the two postalveolarisation processes in (2) and (6) are not independent of each other. Comparative evidence from other eastern dialects immediately confirms this assumption.

As first noted by Storm (1884: 98, 100), the alveolar /r/ and the postalveolar /r̥/ trigger two distinct processes in many eastern and northern dialects of Norwegian.⁷

- (8) a. apical alveolar + laminal alveolar → apical alveolar
 /r/ /t d n s/ /t̥ d̥ n̥ s̥/
 b. apical postalveolar + laminal alveolar → apical postalveolar
 /r̥/ /t d n s/ /t̥ d̥ n̥ s̥/

In these dialects, the apical alveolar /r/ causes a following laminal alveolar coronal to become an apical alveolar coronal, and the apical postalveolar /r̥/ causes a following laminal alveolar coronal to become an apical postalveolar coronal, as seen in (8). Unlike Standard East Norwegian, the processes in these dialects can be straightforwardly understood as phonetically motivated assimilations, in which the laminal alveolar coronal takes on the place of articulation of the immediately preceding rhotic segment, which itself deletes.

Given the wide presence of eastern and northern dialects with these phonetically motivated assimilations, it is a natural assumption that all eastern dialects of Norwegian once behaved as in (8), and that some of these dialects, among them Standard East Norwegian, later merged the apical alveolar [t̥ d̥ n̥ s̥] with the apical postalveolar [t̥ d̥ n̥ s̥] (cf. Hoff 1949: 56f, 1978: 156f). This merger has also been observed in real time in many eastern dialects (Larsen 1908: 11f, 243f, Midtsian 1951: 212f, Dalen 1970: 151, Iversen 1976: 67ff, Skjekkeland 1980: 41, Killingbergtrø 1981: 25, Haugen 1982: 41, Sandøy 1982: 11, Jenstad 1985: 98, Donali 1988: 46).⁸

⁷ Primary descriptions of these processes in such dialects can be found in Reitan (1906: 36ff), Riksheim (1921: 47ff), Mo (1922: 9), Rypdal (1929: 8, 37), Skånland (1933: 68ff), Sørli (1943: 50ff), Midtsian (1951: 13f, 212ff), Olssen (1958: 55ff), Stemshaug (1968: 419f), Dalen (1970: 151, 1985: 122ff), Holten (1974: 66f), Engen (1975: 95ff, 1977: 9f), Bjerkeset (1976: 171ff), Hovdenak (1978: 34f), Mathisen (1979: 39f), Killingbergtrø (1981: 24f), Haugen (1982: 40f), Sandøy (1982: 10), Hanssen (1985: 21f), Jenstad (1985: 87f, 97f), Donali (1988: 46f) and Brekke (2000: 39f).

⁸ One could entertain the possibility that the dialects in (8) originally had postalveolarisation triggered by both /r/ and /r̥/, as in Standard East Norwegian ((2) and (6)), and that the postalveolarisation triggered by the alveolar /r/ later changed into a process by which the apical alveolar /r/ caused a following coronal to become apical alveolar (8), since this would be a more 'natural' interaction. But there are good reasons to reject this possibility. The dialects in (8) also distinguish between apical alveolar /t̥ d̥ n̥ s̥/ and apical postalveolar /t̥ d̥ n̥ s̥/ in morpheme-internal position according to etymological origin, with /t̥ d̥ n̥ s̥/ from original /r̥C/ clusters and /t̥ d̥ n̥ s̥/ from original /r̥C/ clusters: cf. /fɔ̥s̥/ 'waterfall' and /çɛ:ɲa/ 'kernel' < Old Norwegian (ON) *fors* ([r̥s]) and *kjarne* ([r̥n]) vs. /hæ̥s̥/ 'neck' and /s̥jje:ɲa/ 'difference' < ON *hals* ([r̥s]) and *skilnaðr* ([r̥n]) (examples from the Vefsn dialect; Riksheim 1921: 30, 34, 48, 50). Since there are no synchronic alternations in

The typical cause of phonological merger is when the categories are perceptually so similar that listeners can no longer reliably distinguish them from one another. Under this scenario, the merger originates with the listener failing to recognise the distinction intended by the speaker. The perceptual distinction between apical alveolar [t̥ d̥ n̥ s̥] and apical postalveolar [t̥ d̥ n̥ s̥] is fairly small, and there is an observed tendency for listeners with such a contrast to asymmetrically misperceive apical alveolars as apical postalveolars (Anderson 1997). The contrast between apical alveolars and apical postalveolars is therefore more likely to merge as apical postalveolars than as apical alveolars, since apical alveolars are more often misperceived as apical postalveolars than the other way around. Norwegian fits this expectation perfectly, since the vast majority of Norwegian dialects that merge apical alveolars and apical postalveolars merge them as apical postalveolar [t̥ d̥ n̥ s̥] (see §5 for exceptions).

Retroflexion in Standard East Norwegian is therefore a textbook example of ‘rule telescoping’, as succinctly explained by Kenstowicz & Kisseberth (1977: 64):

It often happens that the intermediate steps in a series of historical changes are lost ... in a synchronic grammar of the resulting language. If a language changes As to Bs in the environment X at a certain point in history, and then later changes Bs to Cs, the result may be that some As will alternate with Cs synchronically. If the intermediate stage of B cannot be motivated in a synchronic description, there will have to be a rule taking As directly to Cs. Such a rule can be said to have ‘telescoped’ ... the two historical changes, A > B and B > C. Although each of the historical steps may be phonetically motivated, the telescoped rule will not necessarily be.

In the history of Standard East Norwegian, Kenstowicz & Kisseberth’s environment X is the tap /r/, A the laminal alveolar /t d n s/, B the apical alveolar [t̥ d̥ n̥ s̥] and C the apical postalveolar [t̥ d̥ n̥ s̥].

(9) <i>History</i>	<i>Synchrony</i>
XA /rt/	XA /rt/
B [t̥]	
C [t̥]	C [t̥]

In the left column of (9), the apical /r/ (X) takes a following alveolar /t/ (A) to an apical alveolar [t̥] (B), which later merges with the apical postalveolar [t̥] (C). Synchronically, as seen in the right column, the apical /r/ (X) takes an alveolar /t/ (A) directly to an apical postalveolar [t̥] (C), since speakers have no evidence of the historically intermediate apical alveolar [t̥] (B).

morpheme-internal position, this would mean that speakers were somehow able to correctly split the postalveolar /t̥ d̥ n̥ s̥/ into alveolars and postalveolars based only on their historical origins – which is highly unlikely, if not impossible (the same point is made in Endresen 1974: 75).

According to the scenario described so far, /r/ can cause a following alveolar /t d n s/ to become a postalveolar [t̠ d̠ ŋ̠ s̠] only if the language already had postalveolar [t̠ d̠ ŋ̠ s̠] as the result of assimilations with the postalveolar flap /ɾ/. This makes the prediction that /r/ does not trigger postalveolarisation in dialects which do not have the flap /ɾ/ in their inventory. This prediction is borne out.

The postalveolar flap /ɾ/ is an innovation in East Norwegian (Storm 1884: 106f). It is absent in North Norwegian (Storm 1884: 106, Larsen 1897: 20), the Dano-Norwegian sociolect in Oslo (Western 1889: 272, Larsen 1907: 26) and Risør (Hødnebo 2005: 32ff, 102), yet these are all dialects where the tap /r/ changes a following alveolar /t d n s/. As predicted, in these dialects /r/ assimilates with a following alveolar /t d n s/ to an apical alveolar [t̟ d̟ ŋ̟ s̟], and *not* to apical postalveolar [t̠ d̠ ŋ̠ s̠], as in Standard East Norwegian (see Brekke 1881: 18f, Western 1889: 271f, Larsen 1907: 72, Alnæs 1910: xii–xiii, Iversen 1913: 8, 67f, Christiansen 1933: 165ff, Ingebrigtsen 1942: 7f, Tømmerås 1964: 0f, 15ff, Paulsen 1971: 87ff, Hatlebrekke 1976: 41ff, 1981: 13, Elstad 1982: 73f, Martinussen 1984: 16f, 20f, Hødnebo 2005: 37, 108).

(10) apical alveolar + laminal alveolar → apical alveolar
 /r/ /t d n s/ /t̟ d̟ ŋ̟ s̟/

3 Retroflexion in the Frogner dialect

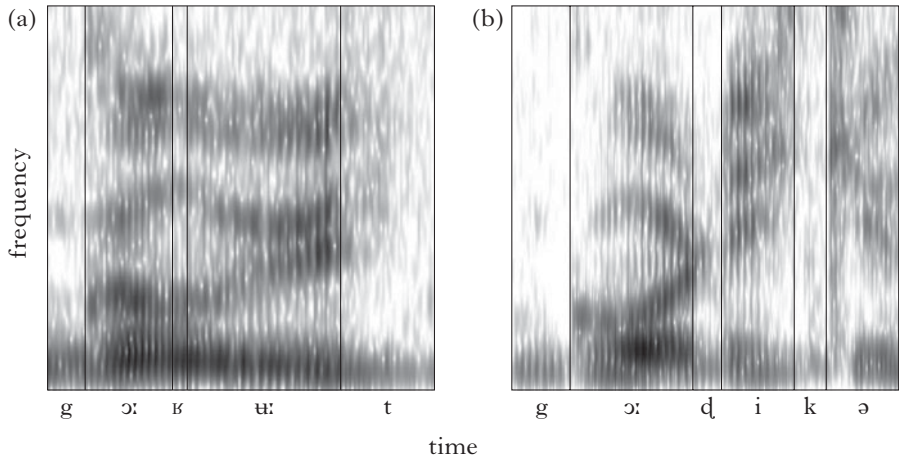
Some dialects of Norwegian have a dorsal uvular /ɣ/ instead of the tap /r/ (Aasen 1848: 21, 1864: 25). It has repeatedly been claimed that retroflexion cannot exist in such dialects, since the articulatory properties of the uvular /ɣ/ would render the retroflexion process unnatural and phonetically implausible (Torp 1983: 73f, Eliasson 1986: 291, Sandøy 1993: 142). As will be shown in this and following sections, such ‘unnatural’ retroflexion does in fact exist in dialects with a uvular /ɣ/. The unnatural character of /ɣ/-retroflexion lies in the fact that there is no clear relation between the articulatory properties of the trigger /ɣ/ and the structural change applied to the target /t d n s/.

(11) *The ‘retroflex rule’ in a /ɣ/-dialect* (Kristoffersen 1980: 73)

$$\begin{bmatrix} +\text{son} \\ +\text{back} \\ +\text{high} \\ -\text{nas} \end{bmatrix} + \begin{bmatrix} +\text{ant} \\ +\text{cor} \\ -\text{back} \end{bmatrix} \rightarrow \emptyset + [-\text{ant}]$$

e.g. /ɣ/ + /t/ → ∅ + [t̠]

In (11), the [+anterior] (alveolar) feature of /t d n s/ changes to [−anterior] (postalveolar) in the position after /ɣ/, but there does not seem to be any phonetic link between this change from [+anterior] to [−anterior] and the feature values of the dorsal uvular /ɣ/.

*Figure 1*

Spectrograms of recordings of the forms in (12), produced by Arne Næss, a speaker of the Frogner dialect, in a 1964 interview.

(a) [gɔ:ɸæt] 'go out'; (b) [gɔ:ɸikə] 'if it's not possible'.

One of these Norwegian /ɸ/-dialects is the Frogner dialect of Oslo (Torp 1994: 292).⁹ Both Larsen (1907: 28) and Torp (1994: 292) briefly mention that the Frogner dialect has retroflex segments in its inventory, and this opens up the possibility that the dialect also has the retroflexion process in (11). The dialect is now relatively rare, so an acoustic analysis was performed of a recorded 1964 interview with a particularly well-known speaker of the Frogner dialect, the late philosopher Arne Næss (1912–2009).¹⁰ Many instances of retroflexion can be identified in this interview, exemplified in the spectrograms in Fig. 1 for the forms in (12).

(12) /gɔ:ɸ/ 'go (PRES)' + /æt/ 'out' → [gɔ:ɸæt]
 /gɔ:ɸ/ 'go (PRES)' + /də ikə/ 'it' + NEG → [gɔ:ɸikə]

In the spectrogram in Fig. 1a, the final uvular /ɸ/ of /gɔ:ɸ/ surfaces before the initial vowel of the morpheme /æt/. The formant trajectories leading into /ɸ/ show the characteristic rising third formant associated with the uvular /ɸ/ (Lindau 1985: 164f). In the spectrogram in Fig. 1b, the final uvular /ɸ/ of /gɔ:ɸ/ has been deleted before the alveolar consonant of

⁹ The Frogner dialect is a variant of the Dano-Norwegian sociolect in (West) Oslo. It is typically associated with the district of Frogner (cf. Torp 1994: 292), although it might be more correct to associate the use of the uvular /ɸ/ in the Dano-Norwegian sociolect with certain upper class families rather than a specific district (cf. Brekke 1881: 17, Larsen 1907: 27, Papazian 1977: 25, 2002: 122). This characteristic feature is absent in the city dialect of Oslo (Papazian 1977: 25).

¹⁰ Retrieved from <http://www.youtube.com/watch?v=5m5tTww2-IM> (October 2012).

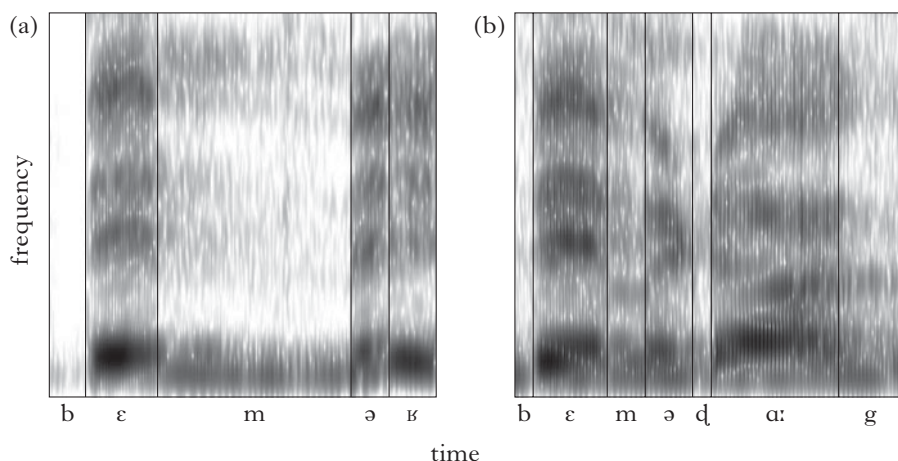


Figure 2

Spectrograms of recordings of a speaker of the Frogner dialect, born in the 1930s. (a) [bɛmɐʁ] (nonce); (b) [bɛmɐdɑ:g] (nonce + 'day').

the morpheme /də/, and the alveolar /d/ surfaces as a retroflex [d]. This consonant is not only clearly identified as a retroflex [d] by native speakers of Standard East Norwegian, but the formant trajectories leading into [d] also show the characteristic falling third formant indicative of retroflex consonants (Stevens & Blumstein 1975: 219f, Hamilton 1996: 47f). In sum, there is clear evidence that this speaker of the Frogner dialect exhibits retroflexion of alveolars triggered by /ʁ/.

A recording session with another speaker of the Frogner dialect, born in the 1930s, was also conducted.¹¹ This speaker productively applied retroflexion to nonce formations, thereby confirming that /ʁ/-retroflexion is an active phonological process in the Frogner dialect.

- (13) /bɛmɐʁ/ (nonce) + /dɑ:g/ 'day' → [bɛmɐdɑ:g]
 /bɛmɐʁ/ (nonce) + /sɑ:k/ 'case' → [bɛmɐsɑ:k]
 /bɛmɐʁ/ (nonce) + /stɛ:n/ 'stone' → [bɛmɐstɛ:n]
 /sɔmɐʁ/ 'summer' + /sko:/ (nonce) → [sɔmɐʂko:]

An acoustic illustration of /ʁ/-retroflexion for this speaker is given in Fig. 2, showing the same acoustic characteristics of /ʁ/ and retroflex [d] as explained above in connection with Fig. 1.

The acoustic and phonological evidence from speakers of the Frogner dialect show that the dorsal uvular /ʁ/ triggers retroflexion in this dialect, despite the unnatural character of such a process. As will be shown in §3.1,

¹¹ This person speaks a typical Dano-Norwegian sociolect with a uvular /ʁ/, and reports that other members of her nuclear family also use /ʁ/. To the extent that it is possible to determine with any accuracy who a genuine speaker of the Frogner dialect would be, this speaker seems to qualify.

retroflexion in the Frogner dialect originally behaved in a more ‘natural’ manner, and the modern unnatural interaction between the uvular /ɤ/ and retroflexion is the result of a recent sound change in the language.

3.1 A diachronic account of retroflexion in the Frogner dialect

Retroflexion is a very old process in East Norwegian, dating back as far as the 14th century (Seip 1955: 177, 289). The Frogner dialect in Oslo is an East Norwegian dialect, and with the exception of /ɤ/ shares all its features with the Dano-Norwegian sociolect of Oslo (Torp 1994: 292). It is safe to assume, therefore, that retroflexion in the Frogner dialect is as old as it is elsewhere in Oslo and East Norwegian.¹²

Uvular /ɤ/, on the other hand, cannot be very old in the Frogner dialect. It was brought to this region by immigrant families from South Norway and Denmark, where /ɤ/ is used in the place of /ɾ/ (Larsen 1907: 27), and the uvular /ɤ/ is itself a recent innovation for /ɾ/ in South Norway and Denmark, dating back no further than the middle of the 18th century (Nielsen 1950). Retroflexion must therefore have existed in Oslo long before /ɾ/ was replaced by a uvular /ɤ/ in the Frogner dialect. So when /ɤ/ was introduced into the dialect, the retroflexion process already existed by which /ɾ/ triggered retroflexion of a following alveolar. The change of /ɾ/ to /ɤ/ apparently had no influence on this retroflexion process – it simply remained, now triggered by /ɤ/.

Retroflexion in the Frogner dialect is therefore another instance of rule telescoping (cf. §2.1), only this time it is the trigger /ɾ/ that underwent an independent sound change. Using the example from (12), this is illustrated in (14).

(14) a. *History*

Earlier Frogner	[gɔ:ɾ]	[gɔ:ɾdə]
/ɾ/-retroflexion		[gɔ:ɖə]
uvularisation	[gɔ:ɤ]	

b. *Synchrony*

/ɤ/-retroflexion	[gɔ:ɤ]	[gɔ:ɖə]
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/ɾ/-retroflexion was introduced into the language at a very early stage, leading to alternations such as [gɔ:ɾ] ~ [gɔ:ɖə]. Only much later was the alveolar tap /ɾ/ uvularised to /ɤ/, which in the modern Frogner dialect

¹² Judging from the spectrograms in Figs 1 and 2, as well as from my native perception, the two speakers in §3 produce apical postalveolars (‘retroflexes’) rather than apical alveolars, the latter being the traditional articulation described in phonetic studies of the Dano-Norwegian sociolect at the end of the 19th and beginning of the 20th century (see §2.1 for references). This finding agrees with Larsen’s discovery that younger speakers of the Dano-Norwegian sociolect had adopted the postalveolar articulation from the city dialect (1907: 26). As this recent change is irrelevant with respect to the origin of /ɤ/-retroflexion, I will make no further note of it, but simply refer to the process as ‘retroflexion’.

leads to alternations such as [gɔ:ɪ] ~ [gɔ:ɪdə], which are phonetically unmotivated from a synchronic perspective.

4 Retroflexion in the Arendal dialect

The town of Risør mentioned at the end of §2.1 is located in the eastern part of South Norway, and has /ɾ/ as its only rhotic segment (Hødnebo 2005: 37f, 102). About 25 kilometres further south-west along the coast lies the town of Tvedestrand, and another 25 kilometres south-west is the town of Arendal. Both the Tvedestrand and Arendal dialects have a uvular /ɸ/ as their only rhotic segment (Larsen 1891: 225, Voss 1940: 72).¹³ Moen (2001: 69f) finds that retroflexion across word boundaries is prevalent in today's Tvedestrand dialect, and Kristoffersen observed as long ago as 1977 that retroflexion across morpheme boundaries occurred to some degree among young speakers of the Arendal dialect (1980: 119ff, 147). In order to confirm Kristoffersen's finding that retroflexion occurs as far south-west as Arendal, a recording session was conducted with a native speaker of the Arendal dialect, born in 1982. As seen in (15), this speaker applied retroflexion in both real and nonce words, thus confirming that young speakers of the Arendal dialect have retroflexion triggered by uvular /ɸ/.

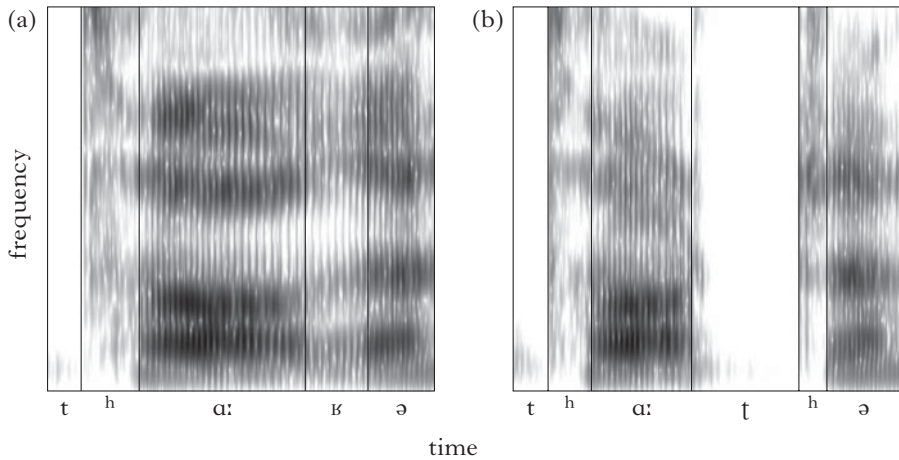
- (15) /hø:ɸ/ 'hear' + /-tə/ PRET → [høtə]
 /tɑ:ɸ/ (nonce) + /-tə/ PRET → [tɑ:tə]
 /stu:ɸ/ 'big' + /-t/ NEUT → [stu:t]
 /skɑ:ɸ/ (nonce) + /-t/ NEUT → [skɑ:t]
 /fɑ:ɸ/ 'father' + /-s/ POSS → [fɑ:s]
 /pʌ:ɸ/ (nonce) + /-s/ POSS → [pʌ:s]

An acoustic illustration of /ɸ/-retroflexion for this speaker for the forms in (16) is given in Fig. 3, and shows the same acoustic characteristics of /ɸ/ and retroflex [t] as explained in §3.

- (16) /tɑ:ɸ/ (nonce) + /-ə/ INF → [tɑ:ɸə]
 /tɑ:ɸ/ (nonce) + /-tə/ PRET → [tɑ:tə]

The next section will show that retroflexion has gradually spread from eastern /ɾ/-dialects into the /ɸ/-dialects of South Norwegian, undeterred by the fact that this spreading crossed the /ɾ/-/ɸ/ isogloss.

¹³ In Risør, Tvedestrand and Arendal, the coronals /t d n s/ are produced as laminal alveolars, as in East Norwegian. Holen (1929: 30), Voss (1940: 72) and Hødnebo (2005: 37) all say that these coronals are articulated 'as elsewhere in Norwegian', Vintermyr (1983: 42) says that they are articulated as in Standard East Norwegian, and Holen (1929: 30), Kristoffersen (1980: 73) and Vintermyr (1983: 43) call them 'dental', the traditional term for laminal alveolars in Norwegian dialectology (cf. Storm 1884: 80ff, Endresen 1985: 71ff). West of Arendal, however, these coronals are produced as apical alveolars (Larsen 1891: 230f, Torp 1986: 39).

*Figure 3*

Spectrograms of recordings of the forms in (16), produced by a speaker of the Arendal dialect, born in 1982. Aspiration is indicated.

(a) [tɑ:ɸə] (nonce + INF); (b) [tɑ:ɾə] (nonce + PRET).

4.1 A diachronic account of retroflexion in the Arendal dialect

As explained in §3.1, the uvular /ɸ/ is an innovation for /ɾ/ in South Norway. The isogloss between the innovated /ɸ/ and the original /ɾ/ is only a few kilometres east of Tvedestrand, i.e. around 30 kilometres east of Arendal (Larsen 1891: 225, Holen 1929: 17, Foldvik 1988: 61). Since /ɸ/ is an innovation for /ɾ/, the forms with /ɾ/ in the nearby dialects to the east have /ɸ/ in the Arendal dialect.

Retroflexion and retroflex segments are traditionally not features of the Arendal dialect (Voss 1940), nor is /ɾ/-retroflexion a traditional feature in the neighbouring /ɾ/-dialects east of Tvedestrand and Arendal (Larsen 1891: 227, Holen 1929: 30, Hødnebo 2005: 37, 110, Torp 2005: 34f). Over the years, however, it has been reported that retroflex segments (Vintermyr 1983: 45f, Torp 1994: 294, Winje 1994: 18, Moen 2001: 69, Nyjordet 2006: 115) and the retroflexion process (Kristoffersen 1980: 72, Moen 2001: 69f, 111ff, Torp 2005: 34f) have advanced into these dialects from East Norwegian, a finding confirmed for the Arendal dialect in §4 above.

In other words, retroflex segments and the retroflexion process spread westwards from East Norwegian into the /ɾ/-dialects east of Arendal, and eventually also into the /ɸ/-dialects of Tvedestrand and Arendal, despite the fact that /ɸ/-retroflexion is an unnatural process. The westward spread of these features is primarily conditioned by sociolinguistic factors, as Standard East Norwegian is the prestige and normative language in Norway. The spread of retroflexion into Tvedestrand and Arendal shows that this diffusion process is not sensitive to the fact that /ɸ/ is an unnatural

trigger of retroflexion, thereby providing empirical support for Hale's claim that phonological diffusion is only constrained by sociolinguistic conditions (2007: 39).

As mentioned above, since /ʁ/ is an innovation for /r/ in South Norwegian, the forms with /r/ in the nearby dialects to the east have /ʁ/ in the Arendal dialect. The fact that speakers of the Tvedestrand dialect and the Arendal dialect adopted /r/-retroflexion as /ʁ/-retroflexion indicates that these speakers treat /r/ and /ʁ/ as the same phonological segment, despite the fact that they are phonetically quite different from each other. This is not surprising, considering that /r/ and /ʁ/ have the same lexical and phonological distribution across these dialects, but it is surprising if we take the traditional view that there is a direct link from the phonetic properties of a segment to its phonological representation (Postal 1968: 53ff, Hale *et al.* 2007: 647ff). The spread of retroflexion into these dialects can therefore be taken as support for a theory in which phonological segments are abstract entities devoid of phonetic content, and where the link between phonological representations and their phonetic realisations is constructed during language learning (cf. Dolbey & Hansson 1999: 66f, Barnes 2006: 10, Mielke 2008: 98f). Under the latter view, two segments that are phonetically distinct can still be treated as the same phonological segment by speakers, as long as they behave phonologically as one and the same entity.

5 Naturalness accounts of Norwegian retroflexion

The previous sections have argued that retroflexion as it is manifested in Standard East Norwegian, the Frogner dialect and the Arendal dialect is 'unnatural' in that it lacks a synchronic phonetic motivation. Yet it is not uncommon to see that phonological processes which some phonologists classify as 'unnatural' are later reanalysed as 'natural' by others (cf. Schane 1972: 216 *vs.* Johnson 1973; Blevins 1997: 229ff *vs.* Uffmann 2007; Hyman 2001 *vs.* Solé *et al.* 2010), particularly in that phonological processes which seem unmotivated from an articulatory point of view can be analysed as having a perceptual motivation instead. It should be clear that the retroflexion processes discussed in the previous sections have no synchronic articulatory motivation, as the postalveolar articulation in the surface form seems to appear out of nowhere. Some studies have therefore tried to analyse these retroflexion processes as being perceptually motivated instead. This section will briefly review these accounts and point out some of the problems associated with them.

5.1 Perceptual contrast

The merger of apical alveolars with apical postalveolars into postalveolars in many eastern dialects of Norwegian seems to indicate that apical alveolars in some sense are 'weak' (Steblyn-Kamenskij 1965: 26) or

‘marked’ (Endresen 1974: 76) in relation to apical postalveolars. Flemming (2003: 353ff) analyses this pattern as perceptually conditioned, suggesting that retroflexion is motivated by the need to enhance the distinctiveness of the contrast between apical and laminal coronals. In other words, the contrast between a laminal alveolar /t/ and an apical alveolar /t̟/ is less distinct than the contrast between a laminal alveolar /t/ and an apical postalveolar /t̟/, so in a language where apicality is contrastive in coronals, it will prefer apical postalveolars over apical alveolars. In Flemming’s Optimality Theory analysis, this preference is formalised with a constraint APICAL→RETROFLEX, which is defined as ‘contrastively [apical] coronals must be [–anterior]’ (2003: 354). There are, however, four problems with this analysis.

The first problem, shared with most accounts within naturalness theory, is that the specific assumptions made to explain the pattern are redundant. The fact that naturalness theory was created to explain is that most phonological processes are phonetically motivated. But since it is possible to explain this fact without assuming a cognitive bias for naturalness, there is no need to introduce such an assumption into phonological theory at all (Blevins 2004: 5ff). In the case of Norwegian retroflexion, perceptual experiments have shown that there is an asymmetric misperception of apical alveolars as postalveolars (see §2.1). There is therefore no need to add a stipulation that grammars prefer apical coronals to be postalveolar, since this tendency can be explained without reference to the grammar. Although it is possible that grammars redundantly restate facts from outside the grammar (cf. Flemming 2001: 26, Kiparsky 2008: 25), this possibility should be entertained only when the evidence points in that direction. In the case of retroflexion, I know of no such evidence.

Another question is how to account for languages that do not abide by the principle that contrastively apical coronals should be postalveolar. According to Endresen (1974: 76), such languages do not seem to exist, which is therefore taken as support for a grammatical preference for the contrast /t/–/t̟/ over the contrast /t/–/t̟̟/. But as shown in §2.1 above, such languages abound, even within Norway. In terms of a formal Optimality Theory analysis, this pattern can be described with the use of faithfulness constraints protecting the specification of the alveolar articulation in the input, but this completely misses the typological generalisation that these dialects are exactly those dialects without a postalveolar flap /ɾ/ in their inventory, a fact which has nothing to do with faithfulness to the input. One could in turn describe this observation with the use of a universally present markedness constraint against apical postalveolars (Flemming 2002: 43f, 2003: 354), which prevents both /ɾ/ and other retroflexes from surfacing in these dialects,¹⁴ but this would still miss the typological

¹⁴ Note in this case that a learner of such a dialect cannot construct a markedness constraint against retroflexes based on language input, since retroflexes are missing altogether in the inventory. This analysis forces therefore the assumption that all markedness constraints are universally present in all languages users, independent

generalisation that postalveolarisation triggered by an alveolar /ɾ/ depends on the prior existence of a postalveolar /ɽ/. In Standard East Norwegian and other eastern dialects, Flemming's constraint APICAL→RETROFLEX needs to be ranked above a markedness constraint against retroflexes, in order to capture the fact that retroflex outputs surface from alveolar inputs. The same ranking would allow for the many Norwegian dialects with an alveolar /ɾ/ as their only rhotic segment to also derive retroflexes, yet such dialects are curiously absent (see §2.1), and there is nothing within this framework to capture this typological fact.

The third issue is that Flemming's analysis effectively bars the possibility of a language with an inventory of laminal alveolars, apical alveolars and apical postalveolars, and at the same time merges the apicals as apical alveolars. This prediction could be a good thing if it were true, as Endresen (1974: 76) claims, that 'there are no dialects where the neutralisation product is an alveolar'. But this is not the case. Again, even within the boundaries of Norway, there are dialects that do just that. One is the dialect of Vang in Valdres. In contrast with the other dialects in the Valdres region (and Standard East Norwegian), the laminal alveolars /t d n s/ in the Vang dialect become apical alveolars when preceded by both an apical alveolar /ɾ/ and an apical postalveolar /ɽ/, with deletion of /ɾ/ and /ɽ/ (Beito 1958: 248, 252f).

- (17) /gɑ:ɾ/ 'farm' + /-n/ DEF → [gɑ:ŋ]
 /dɑ:ɽ/ 'valley' + /-n/ DEF → [dɑ:ŋ]

A markedness constraint against retroflexes will not do the trick here, since this dialect exhibits retroflexes in non-derived environments (/dɑ:ɽ/ 'valley') and in derived environments for both native words (/ɛŋgrɑ/, /gambɾe/; plural forms of /ɛŋjil/ 'angel', /gɑ:mal/ 'old') and loanwords (/stɛmpɾɑ/; plural form of /stɛmpil/ 'stamp') (Beito 1958). Nor will it suffice to resort to faithfulness constraints preserving the alveolar articulation in input forms such as the definite marker /-n/ in (17) above, because the merger of apical alveolars and apical postalveolars into apical alveolars also took place in monomorphemes where the input segment was already postalveolar, as in */ɛ:ŋ/ → /ɛ:ŋ/ 'ell', */my:ŋɑɾ/ → /my:ŋɑɾ/ 'miller', */œdøɾ/ → /œdøɾ/ 'alder' and */hɛs/ → /hɛs/ 'neck'.¹⁵ In the Froan dialect, this exact merger is currently taking place (Midtsian 1951:

of what the language they are trying to learn actually contains (cf. Prince & Smolensky 2004: 4, 7). This is a somewhat problematic notion, as it significantly increases the size of the grammar with no apparent gain in empirical coverage.

¹⁵ The modern forms are based on the phonetic transcriptions in the online Norwegian dialect synopsis *Målføresynopsisen*, which is a systematic overview of the phonetics, phonology and morphology of local dialects in all Norwegian counties, collected between 1950 and 1970 (Wetås 2011: 77). The modern forms given above are all specified as having the same point of articulation as [dɑ:ŋ] 'the valley' in (17). The reconstructed forms with postalveolars follow from the fact that all of these forms have apical postalveolars in dialects where apical alveolars and apical postalveolars are kept distinct (cf. e.g. Reitan 1906: 40).

212f, Bye 1979: 28), and Bye is careful to note that this also applies to monomorphemes with underlying postalveolars: /boðə/ → /boðə/ ‘boil’.¹⁶ Within Flemming’s framework, this seems to require at the time of the merger between these categories a phonetically unmotivated constraint APICAL → ALVEOLAR (‘contrastively [apical] coronals must be [+anterior]’) outranking Flemming’s phonetically motivated constraint APICAL → RETROFLEX. Such a ranking is, however, not only in direct conflict with the primary claim in Flemming’s theory, which is that the constraint ranking invariably reflects the distinctiveness of the perceptual contrasts (cf. 2002: 26, 2004: 239), but also undermines the central premise of naturalness theory that the grammar favours natural interactions.¹⁷

Finally, Flemming’s account cannot explain retroflexion as it is manifested in the /ʁ/-dialects. In Standard East Norwegian, the problem is to explain why a sequence of an apical alveolar and a laminal alveolar would surface as an apical postalveolar (see §2). Flemming’s account is well suited to explain this articulatorily unmotivated property, as it points out that the articulatorily expected apical alveolar would not be sufficiently distinct from the laminal alveolar. In the /ʁ/-dialects, however, there is no motivation for the *apical* articulation in the retroflex output, since there is nothing apical in the input sequence. Some other explanation needs to be applied in order to make retroflexion in /ʁ/-dialects perceptually motivated. An attempt at providing such an explanation is addressed in the next section.

5.2 Perceptual assimilation

In §3 and §4, acoustic and phonological analyses of the Frogner and Arendal dialects showed that speakers productively apply retroflexion of

¹⁶ Note in the case of /da:ɾ/ ‘valley’ in (17) that the underlying sequence of an apical postalveolar followed by a laminal alveolar surfaces as an apical alveolar. Since it is possible to view this process as a synchronic articulatory assimilation, it is not ‘unnatural’. Nor is the merger of apical alveolars and apical postalveolars into apical alveolars in itself ‘unnatural’. The only point made here is that Flemming’s analysis of retroflexion processes predicts that such cases should not be possible. The diachronic account provided in §2.1, on the other hand, only predicts that merger of these two categories should more often yield postalveolars than alveolars, and this prediction is supported by the typological facts in Norwegian dialects, since the vast majority of dialects that merge these categories do indeed merge them as postalveolars. Since the processes in the Vang and Froan dialects discussed above are not ‘unnatural’, it lies outside the scope of this paper to go into further detail about their diachronic origins.

¹⁷ This conundrum is highly reminiscent of the debate surrounding voicing neutralisation of stops in postnasal position. Hayes (1999: 259, 271f) shows how there is a phonetic motivation for voiced and voiceless stops to neutralise as voiced stops in postnasal position, from which it follows that there is a constraint *NT preventing voiceless stops in that position, whereas a constraint *ND preventing voiced stops in that position would be unnatural. Yet there are languages which precisely neutralise stops to voiceless stops in postnasal position (Hyman 2001, Coetzee & Pretorius 2010, Solé *et al.* 2010). Within an Optimality Theory framework, then, it has been argued that it is necessary to posit a phonetically unmotivated constraint *ND outranking the phonetically motivated constraint *NT (Hyman 2001).

alveolar coronals after a uvular /ɤ/. Hamann (2003) suggests that /ɤ/-retroflexion is a phonetically motivated synchronic process, by which the low third formant (F3) of the uvular /ɤ/ is associated with the following coronal. Since retroflex coronals are characterised by a low F3, the association of a low F3 with a coronal leads to a surfacing retroflex (2003: 128, 174f). There are two problems with this analysis.

First, providing a motivation for the existence of a phonological process implies that this is the explanation for its origin. In other words, analysing retroflexion in /ɤ/-dialects as a synchronic perceptual assimilation implies that this is an internal development in these dialects. In doing so, this account therefore misses the generalisation that retroflexion in /ɤ/-dialects only exists when they are in direct contact with /r/-dialects with retroflexion. This generalisation is captured by the diachronic explanations in §3.1 and §4.1, where it is shown that in an /ɤ/-dialect retroflexion can either exist through a sound change in which a dialect within the /r/-retroflexion area becomes an /ɤ/-dialect or arise by phonological diffusion across neighbouring dialects.

More importantly, however, the uvular /ɤ/ is not characterised by a low F3, but by a *high* F3, a property found in other languages (Lindau 1985: 164f, Engstrand *et al.* 2007: 177), as well as in the Frogner and Arendal dialects (cf. the spectrograms in §3 and §4). Hamann's account can therefore not explain retroflexion in /ɤ/-dialects, since the property that is claimed to trigger the perceptual assimilation, the low F3 of the uvular /ɤ/, does not in fact exist.

6 Has retroflexion in Standard East Norwegian always been 'unnatural'?

In (8), it was illustrated how a range of eastern and northern dialects of Norwegian exhibit both an alveolarisation process triggered by the alveolar /r/ and a postalveolarisation process triggered by the postalveolar /ɾ/. It was further argued that all eastern dialects of Norwegian, including Standard East Norwegian, must once have behaved in the same way, with a later merger of apical alveolars and apical postalveolars into apical postalveolars. Since these (post)alveolarisation processes are not, and never have been, reflected in the writing system, there is no direct evidence that all eastern dialects of Norwegian once had these two distinct processes. Endresen (1974: 76) suggests, therefore, that Standard East Norwegian might have behaved as it does today from the outset, i.e. that the alveolar /r/ always triggered postalveolarisation. As will be explained in what follows, there are good reasons to reject this possibility.

The diachronic explanation provided in §2.1 points to the experimental finding that there is a tendency for apical alveolars and apical postalveolars to be asymmetrically misperceived as apical postalveolars. This finding provides a perceptual explanation for the historical merger of these two categories as apical postalveolars in Norwegian dialects, and this tendency

is further supported by the fact that many eastern dialects of Norwegian have been observed to merge these two categories in exactly this fashion in the last 100 years. From this diachronic explanation, postalveolarisation triggered by the alveolar /r/ presupposes the prior existence of a post-alveolarisation process triggered by the postalveolar /ɾ/. If, however, as Endresen suggests, /r/ always triggered postalveolarisation, then there is no such presupposition, since it would not be necessary for the /r/-postalveolarisation process to have come into existence from a previous merger with an already existing postalveolarisation process. Under this latter view, though, an important generalisation is missed: post-alveolarisation triggered by /r/ exists *only* in dialects with post-alveolarisation triggered by /ɾ/ (see the end of §2.1). This fact is reduced to a mere coincidence under this alternative view, as there is no necessary link between the two postalveolarisation processes. Under the diachronic merger theory, on the other hand, this generalisation is actually predicted to arise.

If it were the case that postalveolarisation triggered by /r/ did not come into existence from a merger of apical alveolars and apical postalveolars, then a perceptual explanation for /r/-postalveolarisation is lost (i.e. the asymmetric misperception of these two categories). As a result, this alternative view must provide another motivation for why the apical alveolar /r/ should cause a following alveolar to become apical postalveolar. The suggestion by Endresen (1974: 76), fleshed out in greater detail by Flemming (2003: 353ff), is that the grammar prefers apical coronals to be postalveolar. As reviewed in §5.1 above, this stipulation rules out dialects that seemingly ‘prefer’ apical coronals to be alveolar instead. As a result, the alternative motivation provided under this view is falsified. All in all, the alternative view that retroflexion in Standard East Norwegian has always been as it is today misses a crucial generalisation found across Norwegian dialects, and cannot offer a competing explanation that is coherent with facts from other dialects. In conclusion, it is more likely that retroflexion in Standard East Norwegian originates from a merger between apical alveolars and apical postalveolars, as suggested in §2.1.

7 Conclusion

The data reported in this paper shows that Norwegian retroflexion exhibits some phonetic properties that do not seem to be synchronically motivated. In Standard East Norwegian, an alveolar /r/ causes a following alveolar coronal to become postalveolar. There is no clear synchronic articulatory source for this postalveolar articulation, and attempts to analyse this process as the result of a universal perceptual preference for contrastively apical coronals to be postalveolar not only fail to capture important typological patterns of retroflexion in Norwegian dialects, but also incorrectly rule out dialects where contrastively apical coronals have an alveolar articulation. In the Frogner and Arendal dialects of Norwegian,

the postalveolarisation process is triggered by a uvular /ʋ/, a process which lacks any synchronic motivation, whether articulatorily or perceptually based. All of these retroflexion processes are shown to be productive and regular, and they are not limited to specific morphological categories – retroflexion applies whenever the phonotactic conditions are met. As such, it satisfies Blevins' criteria for being an 'extreme case' of unnaturalness (2008: 137).

The existence of unnatural phonology is important for the evaluation of two different approaches to phonology, dubbed 'naturalness theory' and 'the diachronic model' in this paper. According to the former, the phonetic motivation for a phonological process is encoded in the cognitive grammar as a 'naturalness bias', and natural phonology exists as a direct result of this synchronic bias. Under the diachronic model, on the other hand, phonetically motivated processes are seen as mere facts of history. Their original motivation does not need to be repeated in the synchronic grammar, and the 'naturalness' of such processes are posited to be irrelevant to the speaker and to the synchronic grammar. The diachronic model analyses unnatural processes in the same manner. They, too, are mere facts of history, whose original motivation and level of 'naturalness' are irrelevant to the synchronic grammar. For naturalness theory, however, unnatural processes pose a problem, since they cannot be explained with reference to the assumed bias for naturalness. In contrast with natural processes, these unnatural processes are explained as facts of history, and it is assumed that synchronic speakers acquire them differently from natural processes.

For a theory where a bias for naturalness is assumed, it therefore becomes necessary to operate with these two modes of explanation for synchronic patterns, as it can be demonstrated that both natural and unnatural phonology exist in synchronic grammars. Since naturalness theory is thus a more complicated model than the diachronic model, the burden of proof lies on the naturalness theory to justify the need for the assumption that the cognitive bias for naturalness exists, either by demonstrating with experiments that unnatural processes are in fact acquired differently from natural processes or by showing that no truly unnatural processes exist in spoken languages. A range of learning experiments have failed to find any evidence that speakers treat unnatural processes any differently from natural processes (see §1), and this paper has demonstrated that, at least in the case of Norwegian retroflexion, unnatural phonological interactions do exist. Unless future studies should show otherwise, it would be methodologically appropriate to conclude that the simpler model is a better model, and thus dispense with the assumption that synchronic grammars are biased in favour of natural phonology.

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