Consonant lenition in Danish

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Abstract:

In this thesis, I will account for coda lenition processes in Danish using local conjunction within optimality theory. These processes include deaspiration, stops becoming approximant and vocalization in syllable-final position. No such process occurs syllable-initially or intervocalically, nor does the following onset have any effect. I will show that these coda conditions, as well as lenition-caused sonority sequencing repairs, are best accounted for using a theory of positional markedness, restricting marked features from coda position. Positional markedness allows for a number of repair solutions, such as neutralization, epenthesis, deletion, etc. and I will show that this theory does not predict too many solutions but in fact predicts those repairs found in languages cross-linguistically.

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Introduction

Consonant lenition in Danish consists of a reduction of the plosives and approximants in 'weak' position. This development has set Danish apart from the other mainland Scandinavian languages, Norwegian and Swedish (Bandle, et al., 2002). In combination with other historical developments in Danish, it has become harder for Norwegians and Swedes to understand and is notoriously difficult for foreigners to learn (Grønnum 2003, Gooskens et al. 2006, Doetjes 2007).

The lenition processes in Danish are somewhat unique in that they are only triggered in syllable-final position. The 'strong' segments are not affected in intervocalic position, (lack of) stress or by a following onset. Lenition is responsible a three step chain shift in Danish from aspirated plosive to unaspirated plosive to sonorant. The aspirated plosives /p^h t^s k^h/ become [p t k] which, when underlying, become [p/ʊ̯, ð, ɪ̯/ʊ̯]. The underlying /p/ only lenites in certain native words and /k/ lenites according to the preceding vowel. This is briefly illustrated in (0.1) below.

(0.1) Lenition chain shifts:

a.	mikroskopi	[mik^{h}ʁoskoˈp^{h}iːˀ]	*microscopy*
	mikroskop	[mik^{h}ʁoˈskoːˀp]	*microscope*
	købe	[ˈk^{h}øːpə] / [ˈk^{h}øːʊ]	*to buy*
b.	demokrati	[demok^{h}ʁɑˈt^{s}iːˀ]	*democracy*
	demokrat	[demoˈk^{h}ʁɑːˀt]	*democrat*
	abbed/abbedisse	[ˈapeð]/ [apeˈtisə]	*abbot / abbess*
c.	lakere	[laˈk^{h}eːˀɐ]	*lacquer (v.)*
	lak	[ˈlɑk]	*lacquer (n.)*
	bage / bagt	[ˈpæːɪ] / [ˈpɑkt]	*to bake / baked (pp.)*

In Danish, [ð] is considered an approximant, not a fricative like the English or Icelandic /ð/ (see chapter one, section one). The approximants /j ʋ ʁ/ lenite to the non-approximant, non-syllabic vowels [ɪ̯ ʊ̯ ɐ̯] (see (2.8)). The approximants including [ð] all behave similarly after liquids and nasals with /j ʋ/ becoming fricatives /j̥ v/ after /l/ and /ð/ deleting after /l n ʁ/ (see (4.21)).

I propose that all these processes can be explained using positional markedness constraints within Optimality Theory (Prince & Smolensky, 1993). The *FEATURE (*F) constraints, prohibiting a certain feature, conjoined with NOCODA, prohibiting codas, account for the coda conditions in Danish, i.e. no [spread glottis] features, limited [approx] features and limited [stop] features. Conjoined IDENTITY constraints prevent 'over' leniting, lower-ranked *F constraints can account for the lack of lenition in strong position and MAX[F] constraints account for the repair of sonority sequencing (SSQ) violations caused by approximants after /l/.

There are also instances of overapplication of lenition (see chapter four, section three) in which some lenited segments seem to be in syllable-initial position. I propose that these can be accounted for using output-to-output correspondence (Kenstowicz 1996, Benua, 1997) without causing any problems for the analysis of normal application.

This thesis is organized as follows: Chapter one gives background information on the Danish language, lenition and how lenition has been dealt with by Danish phonologists. There is also a brief discussion of some previous analyses of lenition in general. Chapter two introduces the data relevant for Danish lenition with explanations for each process. Chapter three discusses lenition within optimality theory (OT). An explanation of OT and local conjunction (Green, 1993, Smolensky, 1993) is given as background information for the OT analysis in chapter four. I discuss coda conditions, derived environment effects and reasons for using positional markedness. Chapter four includes the OT analysis and explanations as well as a final constraint hierarchy. Chapter five discusses two other possible theories for lenition in OT, namely the effort-based approach (Kirchner, 1998) and Ternary Scales (Gnanadesikan, 1997), and explains why these theories are not optimal for Danish lenition. Chapter six is a discussion of the implications of my analysis and syllable-final lenition in other languages, namely Hausa, Quechua, Uyghur and Spanish. Chapter seven is an overall summary of the thesis.

Chapter One: Danish and lenition

1.1 Danish

This thesis concentrates solely on Standard Copenhagen Danish. Danish is the official language of Denmark spoken by approximately 5.4 million people and is the mother tongue of 94% of these inhabitants (Basbøll, 2005). Danish is a Germanic language and belongs to, more specifically, the North Germanic or Nordic languages subgroup (Bandle et al, 2002). As mentioned, speakers of Danish, Norwegian and Swedish are able to understand each other quite well (Basbøll, 2005) but, due to a number of phonological developments in the Middle Ages, Danish was set apart from the other Nordic languages, making spoken Danish more difficult for Norwegians and Swedes to understand (Bandle et al, 2002). These changes consisted of a number of reduction processes, including lenition, the topic of this thesis.

Another development was the 'stød', a laryngealization often described as creaky voice related to the word accents in Norwegian and Swedish (Basbøll, 2005). It is often transcribed as /ˀ/ which only falls on two morae, i.e. vowels and sonorant consonants (it has also been analyzed as a possible High-Low tone (Itô & Mester, 1997)). It does not have an effect on the lenition processes in Danish, so I will not go into any further discussion of this complicated process.

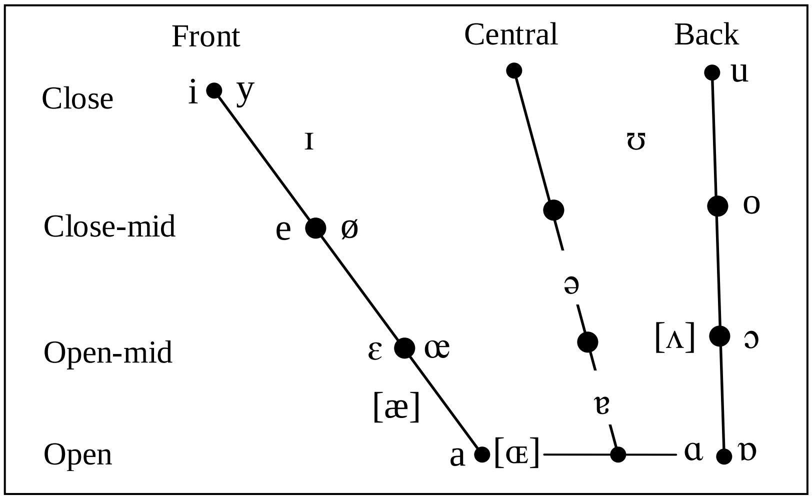
The surface segments in Danish are listed in (1.1) below.

(1.1) Surface segments (in IPA) (Basbøll, 2005):

a. Consonants

	Bilabial	Labiodental	Dental	Alveolar	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	pʰ p			tʰ t		kʰ k			
Nasal	m			n		ŋ			
Fricative		f (v)		s	ɕ (j̥)				h
Approximant		ʋ		ð	j			ʁ	
Lateral Approximant				l					

b. Vowels



As the first table shows, Danish plosives exhibit a laryngeal contrast, aspirated and unaspirated, but no voicing contrast. The /ð/ is considered an alveolar approximant in Danish and is *not* an obstruent like the /ð/ in English or Icelandic (Basbøll, 2005). It is often heard as /l/ by native English speakers. Also included in the approximant group are /ʋ/ and /ʁ/. The /ʁ/ is uvu-pharyngeal, tautosyllabic and *not* a trill (Basbøll, 2005:126, 130). Both /ʋ/ and /ʁ/ are described as "(fricative or) non-lateral approximant" (Basbøll, 2005:62). They both behave as approximants and their pronunciation seems to fall under the category as well (see discussion of features below). The [v] and [j] are in parentheses because they only occur after /l/ to avoid sonority sequencing problems (see (2.8)).

The second table shows the rich inventory of vowels. Danish has more phonemic distinctions in vowel quality than any other language (Basbøll, 2005). [æ] is only contrastive as a long vowel, otherwise it is a phoneme of /a/, and is only short in very limited contexts (Basbøll, 2005:49). Length is contrastive in Danish (though not illustrated in the table above) and all the vowels except for /a/ and /ʌ/ can occur as phonetically long or short. Vowel quality is also affected by r-coloring. When the vowel occurs in an r-context (before or after), it either raises or lowers to become more like /ʁ/. Further discussion on r-coloring and the quality of vowels in and out of r-contexts can be found in Basbøll (2005:50-52). It does not affect lenition processes but lenited /ʁ/, [ɐ̯], still affects preceding and following vowels.

The schwa in Danish is important to mention here because it *can* have an effect on lenition processes. While lenition in Danish was said to only take place in syllable-final position, it also occurs before schwas. However, schwa is the only vowel that triggers lenition. Consonants undergoing lenition are pronounced as syllable-initial before all other vowels, implicating that, before schwa, consonants are in fact in syllable-final position. This is because schwas are considered prosodically weak in Danish, as they are never stressed, do not lengthen and cannot have stød (Basbøll, 2005). Another important note is schwa-assimilation. Schwas will assimilate to the most sonorous adjacent segment, becoming segmentally identical, or delete completely if the adjacent segment is an obstruent (*masse* [mas]) (Basbøll, 2005:293). Schwas can remain in more distinct speech. This becomes relevant in the lenition of syllable-final /k/ before schwa and is discussed in more detail in chapter two.

Segmental features:

Lenition in Danish involves changes in segmental features. Therefore, in order to account for it, it is also important to discuss the relevant features for the segments mentioned above. In the tables in (1.2) below are the syllabic and non-syllabic segments and their features. The features are marked with a '+' when the feature is relevant for the corresponding segment. I use binary features following Basbøll (2005:167-68) with some slight adjustments to his tables with respect to feature names and '+' marks as discussed below.

(1.2) Features for Danish

a. Non-syllabic segments:

	/pʰ/	/tˢ/	/kʰ/	/p/	/t/	/k/	/f/	/s/	/h/	/ʋ/	/j/	/ʁ/	/m/	/n/	/ŋ/	/l/	/ð/	[ɐ̯]	[ɪ̯]	[ʊ̯]
so/ob	o	o	o	o	o	o	o	o	o	s	s	s	s	s	s	s	s	s	s	s
[stop]	+	+	+	+	+	+							+	+	+					
[lat]																+				
[voi]										+	+	+	+	+	+	+	+	+	+	+
[SG]	+	+	+				+	+	+											
[lab]	+			+			+			+			+							+
[cor]		+			+			+			+			+		+	+		+	
[dor]			+			+									+					+
[pha]												+						+		
[approx]										+	+	+					+			
[fro]											+								+	

b. Syllabic-segments:

	/i/	/e/	/ɛ/	[æ]	/a/	/ɑ/	/y/	/ø/	/œ/	[ɶ]	/u/	/o/	/ɔ/	[ʌ]	/ɒ/	/ə/	/ɐ/	[ɪ]	[ʊ]
so/ob	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s
[voi]	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
[lab]							+	+	+	+	+	+	+	+	+				+
[cor]	+	+					+	+										+	
[dor]											+	+	+						+
[pha]				+	+	+				+		+	+	+	+		+		
[approx]	+					+	+				+	+			+				
[fro]	+	+	+	+	+		+	+	+	+								+	

The main differences between these tables and the ones in Basbøll (2005) are the labels ([cor]) and dorsal ([dors]) and some changes to segment features with regards to approximant ([approx]).

Basbøll (2005) uses the term [velar] instead of [dorsal]. Basbøll (2005:129) also splits the [cor] group into two, [alveolar] and [palatal] to be more exact in his account of Danish phonology. It is, however, not necessary for the account of lenition and the feature [cor] is sufficient for our uses. The [pal] feature may be useful in the argument for labeling /j/ as [approx] because while it behaves as an approximant in lenition processes, its [pal] feature often combines with the previous segment in onset position: *tjene* [tɕɛ:nə] ‘to serve’, *sjæl* [ɕɛ:ˀl] ‘soul’. However, such occurrences do not affect lenition.

Regarding the feature [approx], I have added ‘+’ marks to this feature for the segments /ʋ/ and /ʁ/. They behave like /j/ in the lenition processes and belong in a group together (see (2.8)). /ʁ/ and /ʋ/ also behave as approximants in syllable-initial clusters, found in most combinations: *kvinde* ‘woman’, *tvinge* ‘to force’, *svinge* ‘to swing’, *træ* ‘tree’, *krans* ‘wreath’, *pres* ‘pressure’. The pronunciations are the same as when in syllable-initial position with perhaps spreading of voicelessness. I have also marked them as sonorant and not obstruent (as mentioned above, /ʁ/ is not a trill). I have also removed the ‘+’ for /l/ as an [approx] as it does not behave as the others in terms of lenition and does not seem to belong to that group. It is alone as a [lateral]. The segment /ð/ is also [+approx]. Though it does not behave like the group of /j ʋ ʁ/ as far as lenition processes go (since it is the segment lenited *to* not *from*), it does behave like them in sonority sequencing repairs after liquids and nasals (see (4.21)).

As for the vowel table, I leave it as it is in Basbøll (2005) with the new labels [cor] and [dors] and removing only those features which are not applicable, i.e. [stop], [lat], etc.

The important features for this analysis will be [STOP], spread glottis ([SG]), labial ([LAB]), [COR], [DORS], pharyngeal ([PHA]) and [APPROX]. As mentioned in the introduction, the processes include [SG] segments losing aspiration (see (2.2)), [STOP] segments becoming [son] segments (see (2.5) - (2.7)) and [approx] segments losing that feature (see (2.8)). Another possible feature to include would be [continuant] but since [STOP] feature captures the same processes that a [cont] feature would in Danish I leave it out, keeping the number of features to a minimum.

1.2 What is lenition?

Lenition is most often defined as a 'weakening' process (Bauer 1988, Kirchner 1998, Lavoie 2001, etc). This is more formally defined by Trask (1996:201):

> any phonological process in which a segment becomes either less strongly occluded or more sonorous, such as k>x, x>h, k>g. Often the term is extended to various other processes, […], which represent 'weakening' in some intuitive sense.

However, what is meant by weakening is still up for debate. One definition by Vennemann is as follows: "A segment X is said to be weaker than a segment Y if Y goes through an X stage on its way to zero" (cited in Hyman 1975: 165). Kirchner (1998:1) uses another definition, with regards to consonant lenition, "some reduction in constriction degree or duration".

Despite the lack of an exact definition, it is generally agreed that the following processes fall under the label 'lenition': degemination, flapping, spirantization, debuccalization, deletion, and voicing (Kirchner, 1998). Using Kirchner's definition as a basis, these processes can be defined as in (1.3) below.

(1.3) **Lenition processes** (Kirchner, 1998:1):

a. Degemination: reduction of a long consonant to a short one (tt → t)

b. Flapping: reduction of a stop to a flap (t → ɾ)

c. Spirantization: reduction of a stop (or affricate) to a fricative or approximant continuant (t → θ)

d. Debuccalization: reduction to a laryngeal consonant (t → ʔ)

e. Deletion: complete elision (t → ∅)

f. Voicing: (t → d)

The last process, voicing, is not a reduction in constriction but is included because it occurs in contexts, which overlap with lenition process and occurs in chain shifts with them (Kirchner, 1998). The processes listed above that are relevant for Danish are (a), (c) and one that is not listed, *deaspiration* (t^h → t). The Danish data is presented in more detail in chapter two below.

Lenition also tends to only occur in certain environments or 'weak' positions such as, intervocalically (V_V), word or syllable final (_#, _σ), before/after sonorants, and combinations of these (Kirchner, 1998). Escure (1977) proposed a hierarchy of weak positions starting from word/syllable-final positions to intervocalic-positions to word-initial positions. Thus, lenition is most likely to be found in the word-final positions and least likely in word-initial positions.

What constitutes 'strength' and how the terms 'weak' and 'strong' should be defined is part of the debate for defining lenition. Finding those definitions is not the purpose of this thesis and they are not important for the analysis as such. The term 'lenition' is convenient for explaining the unified process that is occurring in Danish, a process that matches those found in other languages analyzed using the same term. Thus, the terms 'lenition' and 'weakening' will be used in this thesis to describe the lenition processes occurring in Danish.

1.2.1 Lenition and Mutation

Lenition is a type of mutation. Consonant mutation is a process usually targeting initial or final segments of a lexical stem and usually triggered by morphosyntactic features of neighboring morphemes (Carlyle 1985, Pyatt 2003). Such processes are best known from Bantu languages (Hyman 1994, Zoll 1995), Mende (Cowper & Ric 1987, Tateishi 1990), Celtic languages (Chiosain 1991, Pyatt 2003), etc.

In Welsh, for example, there are three kinds of consonant mutation: lenition, spirantization and nasalization (Kula, 2005). The lenition mutations involve voicing or spirantization of stops, [m] becoming [v] and voicing voiceless laterals (Kula, 2005). The triggers for these mutations are now mostly lost but the context for lenition was intervocalic position within close syntactic units, the final segment of the first unit triggering lenition in the initial position of the second (Kula, 2005).

1.2.2. Lenition vs. consonant gradation

In the literature on Danish phonology, consonant gradation is the term used to describe the process of consonant 'weakening' in syllable-final position (Rischel, 1970, Molbæk Hansen, 1979, Basbøll 2005, etc). However, in other phonological literature concerning this topic the term 'lenition' is more widespread. Consonant gradation is most often used to describe processes such as degemination before closed syllables found in Uralic languages, such as Sami, Balto-Fennic languages and Eskimo (Bye, 2002:105). The processes seen in Danish, namely deaspiration, vocalization and changes in continuancy in syllable-final position, are also described in literature related to the term lenition in languages such as Celtic (Ni Chiosain 1991, Pyatt 2003), Spanish (Piñeros, 2001), and others. Therefore, as stated above, the term lenition will be used in this thesis to describe the processes occurring in Danish.

1.2.3. Previous analyses of lenition processes

In this section, I will briefly discuss two previous lenition analyses. I will show that these are not ideal for analyzing lenition processes due to flaws in the theoretical frameworks.

Rule-based approach:

The rule-based approach imposes restrictions on grammars through linearly ordered rewrite rules (Chomsky and Halle, 1968). Each rule applies one after the other, using the output of the previous rule as the input for the next rule. This is illustrated in (1.4) below using Spanish lenition. In this dialect of Spanish (North-central peninsular Spanish), voiced coda obstruents are spirantized and devoiced, while voiceless obstruents only spirantize when preceding a voiced consonant.

(1.4) Rule-based approach, Spanish lenition (Morris, 2000):

a. Voicing assimilation, spirantization and devoicing (voiced obstruents)

	/adxuntar/	/etθetera/	/etniko/
Assim:	d^t	--	t^d
Spir:	ð	--	$θ^ð$
Devoi:	θ	--	θ
	[aθ xuntar]	[et θetera]	[eθ niko]

It is crucial here that spirantization apply before devoicing since the rule ignores voiceless segments (etθetera). The superscripts with the assimilation rule indicate a voicing contour (Morris, 2000). It is crucial that assimilation only be partial because, for example /adxuntar/ would devoice to /atxuntar/ and spirantization would not be able to apply.

There are several problems with this rule-based approach. One is the arbitrariness of the rewrite rules. There is no way to formalize naturally occurring processes, such as lenition, as opposed to non-naturally occurring processes, both are treated the same (Harris, 1990).

Another problem is its inability to provide a unified account of processes across languages. For example, released stops neutralize differently in different languages (pre-pausally): French [+released], Korean [-released] and in English both are possible (Kirchner, 1998). However, this must be accounted for using three separate neutralization rules for each language, leaving us with no formal expression of cross-linguistic tendencies (Kirchner, 1998).

Lastly, the rule-based approach predicts unnatural grammars. For example, phonological rules assume voicing neutralization to be natural in any context (onset, coda, etc), predicting a possible grammar with neutralization in all contexts except codas, which is not what we find cross-linguistically (Kager, 1999).

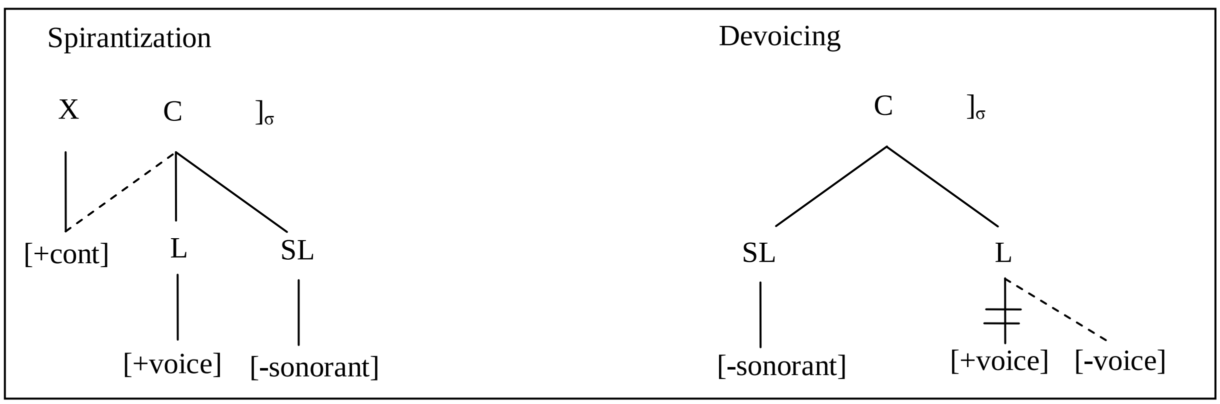
Autosegmental Phonology:

Autosegmental phonology (Goldsmith 1976) expresses phonological rules as operations on association lines, i.e. feature spreading. Spanish spirantization then may be accounted for with a rule spreading [continuant] from an adjacent segment. This is illustrated in (1.5) below.

(1.5) Spanish spirantization and devoicing in autosegmental phonology (Martínez-Gil 1991: 544; Harris 1984: 151):

a. Spirantization
Operation: Spreading
Direction: Left-to-right
Argument: [+continuant]
Target: C[-sonorant, +voice], coda

b. Devoicing (Hualde 1989: 36)
Operation: Insertion (with delinking)
Argument: [-voice]
Target: C[-sonorant, +voice], coda



These rules show that spirantization in Spanish involves the rightward spreading of the [+cont] feature to the voiced obstruent coda, while devoicing, in the same context, delinks the [+voice] feature and inserts a [-voice] feature (Morris, 2000).

Again, as in the first rule-based approach introduced, this theory cannot offer a unified account of lenition. Other types of lenition, such as degemination, the devoicing in coda position illustrated above and, as we will see in Danish, deaspiration, cannot be accounted for with feature spreading but must be accounted for with delinking. This theory also predicts that the spreading of [+cont], for example, can come from any segment with this feature, preceding or following, so that in intervocalic lenition, the role of the other vowel is unexplained (Kirchner, 1998).

As we will see in chapter three, optimality theory can deal with lenition in a unified manner, without running into the same problems as linear ordering rule-based approaches or feature spreading.

Chapter Two: The data

2.1 Explanation of transcriptions

The stops are transcribed as either aspirated or unaspirated, e.g. /pʰ/ or /p/. However, in Danish phonology it seems to be the norm that these are either transcribed in underlying form as /p/ and /b/ and in output form as [pʰ] and [b̥] or as plain [p] and [b] with a mention of aspiration and voicelessness (Rischel, 1970, Molbæk 1979, Basbøll 1980, Bauer 1983, Basbøll 2005, etc). This may be due to Danish spelling, which uses *b d g*, but either way the transcriptions refer to the same segments. I use the transcriptions /pʰ/ and /p/ because phonologically, the aspirated segments lenite to unaspirated segments. There is no change in voicing.

All transcriptions are from Basbøll (2005) unless otherwise noted.

2.2 The data

The stops in Danish /pʰ tˢ kʰ p t k/ and the approximants /j ʋ ʁ/ have different surface forms in 'strong' and 'weak' positions. In their 'weak' position, i.e. syllable-finally, these segments undergo a process of lenition: / pʰ tˢ kʰ / become [p t k], /p t k/ become [p/ʊ̯, ð, ʊ̯/ɪ̯] and /j ʋ ʁ/ become [ɪ̯ ʊ̯ ɐ̯]. This is illustrated in the data below.

(2.1) **/pʰ tˢ kʰ/ syllable initial = [pʰ tˢ kʰ]**

i.	mikrosko**p**i	[mikʰʁoskoˈ**pʰ**iːˀ]	*microscopy*
ii.	kapel	[kʰaˈ**pʰ**ɛlˀ]	*chapel*
iii.	demokra**t**i	[demokʰʁɑˈ**tˢ**iːˀ]	*democracy*
iv.	la**k**ere	[laˈ**kʰ**eːˀɐ]	*lacquer (v.)*

The examples in (2.1) show /pʰ tˢ kʰ/ realized as aspirated/affricated in 'strong', syllable-initial position. The aspirated /k/ in example (i) also shows that the syllable-initial position need not be stressed in order to be a 'strong' position (the first [kʰ] in mikroskopi).

(2.2) **/pʰ tˢ kʰ/ syllable final = [p t k]**

i.	mikrosko**p**	[mikʰʁoˈsk̲oːˀ**p**]	*microscope*
ii.	ka**p**ellan	[kʰa**p**əˈlæːˀn]	*curate*
iii.	demokra**t**	[demoˈkʰʁɑːˀ**t**]	*democrat*
iv.	la**k**	[ˈlɑ**k**]	*lacquer (n.)*

The examples in (2.2) show the same stops realized as deaspirated segments in 'weak', syllable-final position. Example (ii) also shows that lenition takes place before schwas. As mentioned in chapter one before, because schwas are often dropped, only appear in distinct speech, do not lengthen, do not take stød and constitute the only vowels that lenition occurs before, this position is considered syllable-final. Also for these reasons, schwa is considered to be a "weak" vowel in Danish, and does not act in the same way as other vowels (Basbøll, 2005).

(2.3) **/pʰ tˢ kʰ/ consonant clusters = [p t k]**

i.	s̲**t̲**eg	[ˈs**t**ɑɪ̯]	*roast (n.)*
ii.	s̲p̲il	[ˈs**p**el]	*play (n.)*
iii.	skov	[ˈs**k**ʌʊ̯]	*woods*

Finally, the examples in (2.3) show that /pʰ tˢ kʰ/ must appear in absolute syllable-initial position for aspiration/affrication to occur. When occurring after another segment in a cluster they are in a 'weak' position. The processes occurring here can be described as a change in the feature [SPREAD GLOTTIS], the aspirated segments being [+SG] and the non-aspirated segments [-SG].

(2.4) **/p t k/ syllable-initial = [p t k]**

i.	hydrofo**b**i	[hy.tʁo.fo.ˈ**p**iːˀ]	*hydrophobia*
ii.	abbe**d**isse	[a.pe.ˈ**t**i.sə]	*abbess*
iii.	strate**g**i	[stʁɑ.tˢe.ˈ**k**iːˀ]	*strategy*

The examples in (2.4) here show underlying /p t k/ realized as unaspirated in syllable-initial position. The realizations of these segments in syllable-final position are illustrated individually below.

(2.5) **/p/ syllable-final = [p], [ʊ̯]**

a.	hydrofo**b**	[hytʁoˈfo:ˀ**p**]	*hydrophobe*
b.	kø**b**e	[ˈkʰø:**p**ə] **/** [ˈkʰø:**ʊ**]	*to buy*
c.	ski**b**	[ˈski**p**] / [ˈski**ʊ̯**(ˀ)]	*ship*

In syllable-final position /p/ can always be realized as [p], but in some native words (ii, iii) it can optionally be realized as [ʊ/ʊ̯] depending on style (Basbøll, 2005:76). However, judgments seem to differ widely from person to person as to which native words have this option (personal communication with native Danish speakers). This will be discussed in more detail in chapter four.

(2.6) **/t/ syllable final = [ð]**

a.	abbe**d**	[ˈape**ð**]	*abbot*
b.	meto**d**e	[meˈtˢo:**ðə**] ~ [meˈtˢo:**ð̩**]	*method*

Underlying /t/ becomes /ð/ in syllable final position, except after /l ʁ n/ (see (4.21)).

As for underlying /k/ (illustrated in (2.7) below), lenition occurs according to the preceding segment. After front vowels /k/ is realized as [ɪ] or [ɪ̯]. Accordingly, after back vowels /k/ is realized as [ʊ] or [ʊ̯]. After other short vowels, front or back, /k/ is realized as [k]. The resulting [ɪ] / [ɪ̯] or [ʊ] / [ʊ̯] depends on the previous segment, a long vowel or short vowel respectively and schwa assimilation can also play a role. For example, depending on style and carefulness of speech *'bage'* can be realized as any of the following: distinct speech [pæ:ɪ̯ə], schwa assimilated [pæ:ɪ], or vowel shortening [pæɪ̯ɪ] (Basbøll, 2005:16). Since we are not dealing with distinct speech in this analysis and the schwa assimilated version is the most common pronunciation, I have chosen to use it in this analysis. We can, however, assume that [ɪ̯] is functioning as an onset or coda in these examples, while [ɪ] functions as the nucleus.

(2.7) **/k/ syllable final = [ɪ/ɪ̯, ʊ/ʊ̯, k]**

a. = **ɪ/ɪ̯** - front vowels

i.	bage	[ˈpæ:**ɪ**]	*to bake*→ (*pp.)* bagt [ˈpɑ**k**t]
ii.	bageri	[pæɪ̯ɐˈʁi:ˀ]	*bakery*
iii.	smage	[ˈsmæ:**ɪ]**	*to taste*→ *(pp.)* smagt [ˈsmɑ**kt**]
iv.	søge	[ˈsø:**ɪ]**	*to search*→ *(pp.)* søgt [ˈsø**kt**]

b. **ʊ/ʊ̯** - back vowels

i.	koge	[ˈkʰɔ:**ʊ**]	*to cook* → *(pp.)* kogt [ˈkʰʌ**kt**]
ii.	bagværk	[ˈpɑ**ʊ̯**ˌ.væɐ̯k]	*pastry*

c. **k** - short vowels

i.	mug	[ˈmɔk]	*mould*
ii.	dug	[ˈtuk]	*dew, steam*
iii.	ryg	[ˈʁœk]	*back (n.)*
iv.	rigtig	[ˈʁɛkti]	*right, correct*
v.	træagtig	[ˈtʁaˌɑkti]	*tree-like*

The processes occuring for /p t k/ seem to be a change in the feature [stop], [p t k] being [stop] and [ð] and the vowels being [sonorant]. No lenition in /k/ as shown in (c) occurs after some short vowels, which may be analyzed as having an underlying geminate /kk/. This is discussed further in chapter four.

The approximants /j ʋ ʁ/ also undergo lenition, surfacing as [j ʋ ʁ] syllable-initially and as [ɪ̯ ʊ̯ ɐ̯] syllable-finally, as illustrated in (2.8) below. However, [j̥ v] appear after /l/ (a.ii, a.v) and [j ʋ ʁ] can all appear in a non-initial position in consonant clusters (a.iii, a.vi, b.ii).

(2.8) Syllable-final lenition /j ʋ ʁ/

a. **/j, ʋ/ syllable-initial, after [l], and in consonant clusters = [j, ʋ]**

i.	hjul	[ˈjuːˀl]	*wheel*
ii.	elg	[ˈɛlˀj]	*elk*
iii.	fjern	[ˈfjæɐ̯ˀn]	*far*[1]
iv.	våd	[ˈʋɔðˀ]	*wet*
v.	ulv	[ˈulˀv]	*wolf*
vi.	sværd	[ˈsʋɛɐ̯ˀ]	*sword*

b. /ʁ/ syllable-initial, consonant clusters = [ʁ]

i.	ro	[ˈʁoːˀ]	*row*
ii.	tro	[ˈtˢʁoːˀ]	*to believe*

c. /j/ syllable-final = [ɪ̯][2]

i.	sag	[ˈsæɪ̯ˀ]	*case*
ii.	maj	[ˈmɑɪ̯]	*May*

d. /ʋ/ syllable-final = [ʊ̯]

i.	liv	[ˈliʊ̯ˀ]	*life*
ii.	hav	[ˈhɑʊ̯]	*sea*

e. /ʁ/ syllable-final = [ɐ̯]

i.	stor	[ˈstoɐ̯ˀ]	*big*
ii.	bær	[ˈpæɐ̯]	*berry*

The processes here can be described as change in the feature [APPROXIMANT] with [j ʋ ʁ] being [+APPROX] and the semi-vowels [ʊ̯ ɪ̯ ɐ̯] being [-APPROX].

---

[1] /j/ also becomes a fricative when preceded by /t/ ([tˢ]) or /s/ : tjene [ˈtɕɛːnə] 'serve, sjæl [ˈɕɛːˀl] 'soul'

[2] It is difficult to find alternating syllable-initial and syllable-final forms of the approximants due to schwa assimilation and overapplication. However, in careful speech the approximants can occur , as in [liʋ], and are acceptable pronunciations for some, though not in the standard Copenhagen dialect discussed in this thesis (Basbøll, 2005). Some optional pronunciations in borrowings, such as [mɑɪ̯(j)oˈnɛːsə] *mayonnaise*, may also suggest that this alternation is present. See Basbøll (2005) for more in-depth discussion.

Summary:

The underlying and lenited forms are illustrated in figure (1) below.

Figure 1.

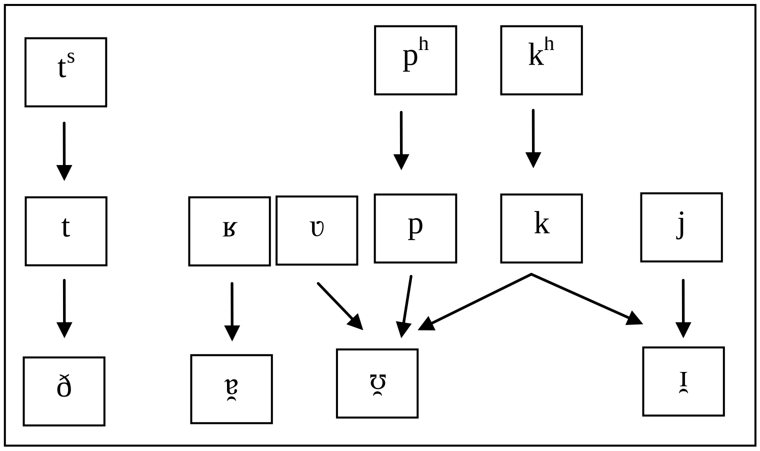


Figure 1 above illustrates the underlying and surface forms in ‘weak’ position in Danish. From this it is clear that some surface forms have two or more possible underlying forms: both /p^h/ and /p/ can surface as [p], /t^s/ and /t/ can both surface as [t], /k^h/ and /k/ both as [k], /p/, /k/, /ʋ/ all as [ʊ̯] and /k/ and /j/ both as [ɪ̯]. There are also a number of chain shifts taking place, as mentioned: t^h → t → ð and p^h → p → ʊ̯ and k^h → k → ʊ̯/ɪ̯. The /k/ in Danish actually makes lenition processes difficult to illustrate in a figure such as the one above. It shares output forms with /j/ /ʋ/ and /p/, otherwise unrelated segments, due to vowel assimilation. Ideally /j/ would be placed alongside the other approximants and /t^s/ with the stops but the figure serves only to illustrate the lenition processes in general.

Chapter Three: Theoretical framework and local conjunction

3.1 Optimality Theory

My analysis of Danish lenition will be done within the framework of Optimality Theory (OT) (Prince and Smolensky 1993). OT is based on different rankings of a universal set of violable constraints resulting in the cross-linguistic variation found in the world's languages. A GEN function *generates* an infinite number of output candidates based on an input. The EVAL function *evaluates* these output possibilities and chooses most optimal output based on the constraint hierarchy for that particular grammar. The candidates that violate the highest ranked constraints lose to those candidates that violate lower-ranked constraints, no matter how many of these violations have been incurred. Those candidates that violate the lower-ranked constraints fewest times win over those that violate them more often. If there is a tie, a lower-ranked constraint will choose the optimal candidate. Only the output forms are constrained, the inputs are unconstrained. This input-output mapping can be illustrated in the form of a tableau as shown in (3.1) below. An asterisk * represents a violation and an exclamation point ! represents a fatal violation that rules out that particular candidate. A solid line between constraint columns represents a crucial ranking between the constraints whereas a dotted line represents a non-crucial ranking, i.e. one that could be reversed without consequence for the optimal output. Shading shows that any violations in that particular place are irrelevant for the outcome. A ☞ marks the optimal candidate based on the constraint ranking.

(3.1) OT tableau example

input	Constraint 1	Constraint 2	Constraint 3
☞ Candidate 1			*
Candidate 2	*!		
Candidate 3		*!	

In this example Candidate 1 is the optimal output candidate because it does not violate the two highest ranked constraints, whereas its competitors do. The first two constraints cannot be ranked with respect to each other based on this tableau alone, as reversing them would not affect the outcome. The last constraint however must be ranked below the first two in order for Candidate

1 to win. Our constraint hierarchy would then look something like this: Constraint 1, Constraint 2 » Constraint 3.

There are two types of constraints in OT, faithfulness constraints and markedness constraints. Faithfulness constraints require that the output remain *faithful* or *identical* to the input while markedness constraints prefer certain output forms over others depending on some sort of configuration. An example of a faithfulness constraint would be something like DEP or MAX, the former disallows epenthesis while the latter disallows deletion. A markedness constraint would be something such as NOCODA, which disallows codas. If the markedness constraint were ranked above DEP and MAX, we might expect deletion or epenthesis violations as ways of avoiding NOCODA violations.

OT thus explains grammars in terms of violable, universal constraints, which can be ranked differently to result in cross-linguistic variation. See Prince & Smolensky (1993) for a more in depth discussion of Optimality Theory.

3.2 Local Conjunction

The theory within OT that I will use to account for lenition in Danish is local conjunction (Green, 1993, Smolensky, 1993). This theory works by combining individual constraints to construct more complex constraints. A definition is given below:

> *If C1 and C2 are constraints, and D is a representational domain type (e.g. segment, cluster, syllable, stem), then (C1 & C2)D, the local conjunction of C1 and C2 in D, is a constraint which is violated whenever there is a domain of type D in which both C1 and C2 are violated. It is used in situations where violations of C1 alone or of C2 alone do not eliminate a candidate, but violations of both constraints simultaneously do.*
> (Moreton & Smolensky, 2002:1).

Thus, in order for an output candidate to violate a local conjunction, **both** constraints have to be violated within the same domain. A candidate may violate **one** constraint or a candidate may even violate both constraints in different domains without violating the local conjunction. For example, using a local conjunction such as NOCODA&*[+voi, son] (Itô & Mester, 2002, see below) if we took a candidate such as *bip*, both NoCoda ([p]) and *[+voi,-son] ([b]) are violated but not in the same domain, one is in the coda and the other the onset. Thus, the local conjunction is not violated but such a candidate.

Moreton and Smolensky (2002) mention three constraint families, Dep, Max and markedness, and state that these three can only be violated at single level of representation: Dep by a surface segment without an underlying correspondent, Max by an underlying segment without a surface correspondent and markedness by forbidden surface configurations (Moreton & Smolensky, 2002:3). With this in mind they come with the table below, showing which conjunctions are and are not possible:

(3.2) Conjunctions yielding violable constraints in some domain (Moreton & Smolensky, 2002:3):

&	Markedness	Dep	Max
Max	X	X	√
Dep	√	√	
Markedness	√		

According to the table, a (Max & Markedness) conjunction is impossible, as is a (Max & Dep) conjunction, while all others are possible. The possible conjunctions are defended in Moreton & Smolensky (2002) to account for synchronic chain shifts. The Max conjunction and markedness conjunctions will be important for our purposes.

3.2.1 Positional faithfulness vs. positional markedness

Two approaches within local conjunction to account for coda and onset asymmetries in languages are positional faithfulness (Beckman 1995, 1998) and positional markedness (Zoll 1996, 1998). Positional faithfulness requires output segments in prominent positions to be faithful to the inputs. For example, IdentOns[sg] requires segments in onset position (a prominent, or strong, position) to maintain underlying [spread glottis] features. Ranking this constraint above *[sg] results in [spread glottis] features only occurring in onset position. Positional markedness, on the other hand, refers specifically to a weak position and states whether marked structure can occur in that position (Zoll, 1998). The analysis in chapter four falls under the positional markedness approach with conjunctions such as *[SG]&NOCODA. The marked structure is not allowed in coda position (a weak position).

Though the Danish data can be analyzed using either positional faithfulness or positional markedness, I choose the latter approach because I believe it has more explanatory power, is more relevant to the processes at hand and can better account for other languages as well. Danish lenition involves changes, taking place in the coda, to satisfy certain coda conditions in Danish. A universal coda markedness hierarchy was proposed (Prince & Smolensky 1993) due to observations in natural languages of processes that take place in coda position. The coda is a marked syllable position (hence the need for a NOCODA constraint) and thus what is found there is often restricted (see below on coda conditions) (Smolensky, 1993). The constraints for Danish coda conditions fit into this markedness hierarchy (see below) and explain exactly why Danish allows the segments it allows in one position but not another.

One of the main arguments for positional faithfulness is that it can determine the directionality of assimilation and restrict neutralization to weak positions, whereas positional markedness has to implement another device (Beckman, 1998). However, as Zoll (1998) points out, positional faithfulness fails to account for a language like Hamer that uses both progressive and regressive assimilation along with metathesis to repair ill-formed clusters, while positional markedness tackles this problem just fine (see Zoll (1998) for analyses). Zoll (1998) points out two problems with positional faithfulness listed in (3.3) below.

(3.3) Two problems with Positional faithfulness as a theory of licensing (Zoll, 1998:6)

a. Predicts that *derived* marked structure will be drawn to weak positions

$[\sigma_1]$ σ_2 σ_3 σ_4

Preserves identity here Allows change here

- Predicts therefore that derived marked structures should prefer to arise in weak positions

b. Does not subsume coda conditions when repairs don't uniformly neutralize marked structure

The first problem is illustrated by Zoll (1998) using Guugu Yimidhirr and its distribution of long vowels. Positional faithfulness fails in this analysis because it cannot block derived length (marked structure) in weak positions (Zoll, 1998:15). The second problem is illustrated using Hamer, in which positional faithfulness wrongly predicts regressive assimilation to be impossible (Zoll, 1998:22). (See Zoll (1998) for details of both analyses).

Thus I choose to use positional markedness in my analysis of Danish. Though this particular analysis can be analyzed using positional faithfulness constraints and does not serve as any proof against the approach as such, the positional markedness approach offers better explanatory power for Danish and has proven to be superior in other analyses, as well, as discussed by Zoll (1998).

3.2.2 Positional markedness and positional licensing

Zoll's (1998) analysis uses a positional licensing constraint, COINCIDE, to account for the above mentioned processes. This is a way of avoiding a negative constraint and the too-many-solutions problem (Blumenfeld, 2006). The constraint is formulated in (3.4) below.

(3.4) **COINCIDE** (heavy syllable, Head PWd): a heavy syllable belongs to the Head PWd (Zoll, 1996).

This constraint positively states that a heavy syllable must be in the head of the prosodic word, as opposed to stating that heavy syllables are banned elsewhere. Such a licensing constraint could also be stated to account for the Danish data, licensing features such as [sg] to onset position instead of banning them from coda position. This type of construction limits the number of possible reparations one would expect to find in natural languages for coda conditions such as those found in Danish and the same is true of positional faithfulness, described above. Avoiding featural contrasts, such as voicing, in the coda is claimed to only be done by neutralization, e.g. devoicing (Lombardi 2001, Steriade 2001, Blumenfeld 2006 ,etc). Thus, a constraint such as *[+VOI -SON]&NOCODA would not be an ideal constraint because its ranking relative to other constraints predicts that epenthesis, deletion, metathesis, etc, are possible solutions to avoiding voiced obstruent codas. As illustrated in the tableau below, the positively stated positional licensing constraint cannot predict epenthesis or deletion and thus solves the too-many-solutions problem. *LAR is violated by the voiced candidates.

(3.5) Epenthesis and deletion impossible with positional licensing (Lombardi, 2001:13)

/pig/	*LAR	MAXLAR	DEP	MAX
pig	*			
pik		*		
pigi	*		*	
pi		*		*

There is no possible ranking here that would allow the deletion or epenthesis candidate to win. *LAR is violated whether /g/ is an onset or a coda so epenthesis does not help there. Both [pik] and [pi] violate MAXLAR so the final MAX will give the win to [pik] no matter what. However, I argue, like Flynn (2007), that NOCODA conjunctions are in fact necessary because they predict the right amount of solutions, not too many. For example, the use of epenthesis to avoid aspirated or voiced codas can be found in both loanword and second language phonology (Iverson & Lee 2006, Flynn 2007[3]). In Korean, aspirated and voiced obstruents are restricted from coda position. Loanwords from English with a lax vowel followed by a final stop such as *kick* are borrowed as [kʰik˺] without epenthesis, whereas those with a tense vowel such as *week* are borrowed as [wikʰʉ] with epenthesis (Iverson & Lee, 2006). This can be explained by Kang (2003: 21) who reports that final stops in English are more often aspirated after a tense vowel than after a lax one, a contrast that is not permissible in coda position in Korean. Loanwords with voiced coda stops, such as *pad* are also regularly adapted with epenthesis [pʰɛdʉ] (Iverson & Lee, 2006:59). Also, Korean learners of English tend to avoid voiced coda stops with devoicing or epenthesis, *dog* [tok] or [to:gɯ] (Lee, 1992). Baković (2007) also argues that epenthesis and deletion are valid backups to assimilation processes, supporting the use of AGREE constraints, which have also been claimed to have too many solutions.

Given this evidence, and possibly more (see Fynn, 2007), it seems that *F&NOCODA conjunctions are in fact necessary constraints, predicting valid grammars of natural languages,

[3] Flynn 2007 also gives example of deletion, metathesis, resyllabification and nasalization as possible repairs for voiced coda prohibitions.

something positional licensing and positional faithfulness are unable to accomplish. In the next section I will briefly discuss the local conjunctions to be used in Danish and how they can be used to account for the data in the preceding chapter.

3.2.3 Local conjunctions in Danish

The types of conjunctions needed to explain the Danish data above are listed in (3.6) below.

(3.6) Local conjunctions for Danish lenition:

a. Markedness&Markedness (M&M)
b. Faithfulness&Faithfulness (F&F)
c. Faithfulness&Markedness (F&M)
d. MAX(F)&MAX-SEG

The first conjunction, M&M, is necessary to prevent marked segments in marked positions. For example, the constraint conjunction *[SG]&NOCODA will account for the lack of [spread glottis] segments in coda position (see Tableau IV below). Such *F&NOCODA constraints for Danish follow the coda markedness hierarchy, in which less sonorant segments make worse codas than more sonorous segments (Prince & Smolensky, 1993). This is illustrated in (3.7) below extended to include [spread glottis] segments, as is relevant for Danish (the segment represents the entire class of segments, i.e. t^s = all [spread glottis] stops).

(3.7) **Extended sonority-based coda markedness hierarchy** (Prince & Smolensky, 1993).**:**

*Coda-t^s » *Coda-t » *Coda-f » *Coda-n » *Coda-r » *Coda-w,j

I base these constraint types on other *F&NOCODA constraints that have been proposed in previous literature, such as *LAB&NOCODA (Smolensky 1993, Ito & Mester 1998). This constraint is based on coda markedness hierarchies, which illustrate that, cross-linguistically, labials tend to make bad codas while coronals, for example, make good codas: *[LAB]&NOCODA

» *[COR]&NOCODA (Smolensky 1993, Zoll 1998, Itô & Mester 2002, Morris 2002). M&M constraints are discussed in more detail in the section on coda conditions below (3.2.4).

The F&F conjunction, on the other hand, will prevent surface forms from being *too* unfaithful to the underlying forms. This type of constraint will prevent underlying forms from leniting too far in Danish, i.e. *t^s → ð, a form of Derived Environment Blocking ((DEB) see 3.2.5 below on Derived Environment Effects). Such a change is not only unfaithful in terms of [spread glottis] but also in terms of [stop]. Two faithfulness violations are worse than one (see Tableau IV below). Moreton and Smolensky (2002) have also used F&F constraints for the same purpose, accounting for chain shifts such as Western Basque hiatus raising, in which /a/ → [e] and /e/ → [i] (Kirchner 1995, Kawahara 2002). Their local conjunction of IDENT[LOW]&IDENT[HIGH] prevents /a/ from raising all the way to [i] (Moreton & Smolensky, 2002:5-6).

The third type of conjunction, F&M, has a different role. It will account for the non-lenition of some underlying labials by requiring faithfulness to the feature [stop] and prohibiting the feature [labial]. The faithfulness violation activates the markedness constraint (Łubowicz, 2002). Labials are allowed in Danish in general but if a particular labial also violates a faithfulness constraint requiring identity between [stop] features, the markedness constraint against labials becomes active. This will prevent labials from leniting, as doing so would fatally violate both constraints in the conjunction (see Tableau VI and Tableau VII below).

The last constraint conjunction, MAX(F)&MAX-SEG, is also a kind of F&F conjunction but listed separately because of its definition. Since MAX is violated when a segment is deleted its combinatory powers are limited. As shown in (3.2), it can only combine with itself and even then it is limited. This is because once a segment is deleted it can no longer violate another constraint by not being there. However, to account for Danish, combining a MAX[FEATURE] constraint with MAX-SEG will explain certain SSQ reparations in codas (see Tableau XIV below). This conjunction is violated if *both* the feature and the segment are deleted, whereas deleting only the feature will not cause any violation. This will exclude certain segment classes from deletion.

3.2.4 Coda conditions and local conjunction

The lenition data in chapter two are examples of a Coda Condition in Danish, i.e. a restriction on the types of segments that can be in a coda position, typically unmarked elements

(Itô, 1986). The condition restricts the form of the coda by blocking any violating segments. Itô (1986) illustrates this as in (3.8) below using some language, *L*, that, for example, does not allow syllables to be closed by any consonant that is not a sonorant.

(3.8) Coda condition for language *L*:

$$\begin{array}{c} *\mathrm{C}]_{\sigma} \\ | \\ [\text{-sonorant}] \end{array}$$

Many languages exemplify coda conditions. For example, Bedouin Arabic and Biblical Hebrew do not allow pharyngeals in coda position (McCarthy & Prince, 1993), German disallows voiced obstruents (see below) (Itô & Mester, 2002), and Lardil has a condition on word-internal codas, forcing them to be either coronal sonorants or non-coronal sonorants homorganic with a following onset consonant (Itô & Mester, 1994) to name a few. The coda conditions working in Danish prohibit syllable-final [spread glottis] segments altogether and limit approximants and stops to derived forms only.

Itô (1986) uses the coda condition as illustrated in (3.8) above to account for Japanese (and other) coda restrictions. The coda condition works to eliminate non-nasal segments in coda position (*C/[-nas]). However, in Japanese, obstruents are also allowed in codas if they are geminates, i.e. gak.koo *school*. With the help of a linking constraint, which doubly links geminates, keeping them out of coda position, she accounts for the restrictions displaying in Japanese codas. The same type of account can be used on Italian coda conditions (Itô, 1986: 35-39). Only sonorants and [s] are permitted in coda position, along with the first part of a geminate. The coda condition for Italian is thus *C/[-son], ruling out the correct codas with the help of the linking constraint mentioned earlier (see Itô, 1986 for more on the linking constraint).

More recently, Itô and Mester (2002) have also accounted for coda conditions in German using a slightly different formulation of the coda condition, namely local conjunction. A summary of these conditions is illustrated in (3.9) below.

(3.9) X is disallowed in the syllable coda, where X= (Ito & Mester, 2002:275)
a. voiced obstruents
b. the segment [g]
c. the cluster [ŋg]

Taking the voiceless obstruents as an example, this condition can be accounted for using an M&M conjunction, much like those proposed for Danish, prohibiting such segments from coda position as illustrated in the tableaux below.

(3.10) Coda condition for coda devoicing (a) but not onset devoicing (b) in German (Moreton & Smolensky, 2002:2, based on Itô & Mester, 2002:275).

a.

/li:b/ *lieb* ‘dear, pred.’	NoCoda & *[+voi,-son]	Ident	*[+voi,-son]	NoCoda
li:b	*!		*	*
☞li:p		*		*

b.

/li:bə/ *liebe* ‘dear, attr.’	NoCoda & *[+voi,-son]	Ident	*[+voi,-son]	NoCoda
☞ li:.bə			*	
li:.pə		*!		

In tableau (a) the first candidate is ruled out because it violates **both** NoCoda **and** *[+voi,-son] in the same domain. The second candidate, though it violates NoCoda, does not violate *[+voi,-son] and does not therefore violate the conjunction. In tableau (b), devoicing does not take place in onset position here because the first candidate no longer violates NoCoda and cannot therefore violate the conjunction either. In this situation, the second candidate is the loser for violating the next highest constraint, Ident, by changing from a /b/ in the input to a [p] in the output. Individually, the constraints cannot account for this phenomenon and would choose the wrong candidate in one or the other position no matter the ranking. Thus, local conjunction works to rule out the right candidate in the right positions.

3.2.5 Derived environment effects and local conjunction

Local conjunction can account for a typology of derived environment effects (DEE) (Kiparsky 1973, Łubowicz 2002) including non-derived environment blocking (NDEB) (Kiparsky, 1993) and derived environment blocking (DEB) (Danish).

Derived environment effects:

Łubowicz (2002) uses Polish velar palatalization and spirantization to illustrate a derived environment effect. Velars become postalveolars before front vocoids, though in the same environment, /g/ also spirantizes, resulting in /g/ → [ʒ] not */g/ → [ʤ], though surface [ʤ]s exist when underlying. To explain why /g/s do not only palatalize, Łubowicz (2002) uses a F&M conjunction prohibiting [ʤ] and requiring coronal identity, *ʤ&IDENT[COR]. This is illustrated in the tableau below.

(3.11) NDEB (Łubowicz, 2002:249):

a. /g/ in the input

/rog+ek/	*ʤ&IDENT[COR]	IDENT[CONT]	*ʤ
a. roʤek	*!		*
☞ b. roʒek		*	

b. /ʤ/ in the input

/banʤ+o/	*ʤ&IDENT[COR]	IDENT[CONT]	*ʤ
☞ a. banʤo			*
b. banʒo		*!	

The faithfulness constraint activates the markedness constraint: /g/ becoming [ʤ] violates both constraints, whereas underlying /ʤ/ staying [ʤ] only violates the first part of the conjunction. Underlying /ʤ/ is prevented from becoming [ʒ] by ranking IDENT[CONT] after the conjunction and *ʤ stays low, resulting in the following ranking for derived environment effects: F&*M » IDENT[M] » *M (Łubowicz, 2002:254). This ranking allows M in some environments but not when faithfulness is also violated in the same domain. Thus, the derived structure undergoes the process of spirantization but it is blocked in the underived structure.

The typology for the DEE, normal application and blocking in all environments is as illustrated in (3.12) below.

(3.12) **Predicted grammars** (Łubowicz 2002:254):

a. Derived environment effect
   $[F\&{*}M]_D$ » IDENT » *M
b. Normal application
   *M » IDENT
c. Blocking in all environments
   IDENT » $[F\&{*}M]_D$ » *M

The Danish data do not fall into this typology as is. However, as mentioned above F&F constraints can account for chain shifts (Moreton & Smolensky, 2002) and this is a type of derived environment blocking (DEB), which is what we find in Danish. This is the opposite of what happens in NDEB, namely the *underived* structure undergoes the lenition process but the derived structure does not. For example, underlying /t^s/ becomes [t] but that output [t] cannot lenite further to [ð] even though it may otherwise be a better coda. The latter change is blocked because it violates two faithfulness constraints, whereas the former only violates one. The ranking then for DEB would be: $[F_1\&F_2]_D$ » M » F_1, F_2. Though, because the Danish chain shift is triggered by coda position, a M&M constraint is actually required to drive the chain shift, blocking the marked segment from appearing in the coda, whereas in Moreton and Smolensky (2002) a markedness constraint requiring hiatus raising is all that is necessary.

Summary:

In sum, local conjunction works by combining two constraints within the same domain to rule out unwanted candidates through OT tableaux. A candidate can violate one constraint or the other, or violate both in different locations, without violating the local conjunction. This can explain processes such as coda conditions and derived environment effects similar to those found in Danish (see also Łubowicz, 2005 for a list of other phenomena accounted for using local conjunction). In sections 3.2.1 and 3.2.2, I argued for the use of positional markedness and *F&NOCODA conjunctions and the analysis below will put these constraints into action.

Chapter Four: Analysis using Local Conjunction in Optimality Theory

4.1 Overview

As discussed above, I will use four types of local conjunctions (see (3.6)) to account for the coda conditions found in Danish. I will begin with plosives in onset position, which require only individual constraints, followed by complex onsets (i.e. [sp]). Plosives in syllable-final position, starting with aspirated plosives, will require local conjunctions prohibiting [sg] and [stop] segments from the coda. I also discuss the non-lenition of syllable-final /p/ with an indexed F&M conjunction. This is followed by an account of the approximants in onset and coda position and an account of approximants in complex codas interacting with sonority sequencing constraints. The analysis finishes with an account of the overapplication of lenition and a final constraint hierarchy.

4.2 Optimality theoretic analysis

The following includes the tableaux necessary to illustrate the constraint ranking explaining lenition in Danish using local conjunction in OT. The constraints are introduced and explained before each tableau as necessary.

4.2.1 Syllable-initial segments

Constraints:

In order to analyze the data above using local conjunction starting with syllable-initial segments, the following constraints, listed as (4.1), will be needed.

(4.1) Constraints for syllable-initial segments

a. Faithfulness constraints

i. MAXSEG: Every segment of the input has a correspondent in the output (McCarthy & Prince, 1995).

ii. IDENT[SG]: Correspondent segments in the input and output have identical values for [spread glottis](McCarthy, 1995).

iii. IDENT[STOP]: Correspondent segments in the input and output have identical values for the feature [stop] (McCarthy, 1995).

b. Markedness constraints

i. *[SG]: [spread glottis] stops are prohibited.

The first constraint, MaxSeg, incurs a violation each time an input segment is deleted in the output. The second and third constraints require identity between input and output segments with the features [spread glottis] and [stop] respectively. A violation is incurred if an input loses or gains that feature in the output. The last constraint is a markedness constraint stating the opposite of the identity constraint. It *prohibits* all stops with the feature [spread glottis] in the output, no matter the input. This constraint must be a low ranked constraint in Danish, since we find [SG] stops in the output. In (4.2) below the Danish words and English glosses for tableaux I and II are listed.

(4.2) Syllable-initial segment and consonant clusters

i.	pil	[pʰi:ˀl]	*arrow*	bil	[pi:ˀl]	*car*
	tal!	[tˢæ:ˀl]	*speak!* (imp)	dal	[tæ:ˀl]	*valley*
	kat	[kʰat]	*cat*	gal	[kæ:ˀl]	*angry*
ii.	spil	[spel]	*game*			
	sten	[ste:ˀn]	*stone*			
	ske	[ske:ˀ]	*spoon*			

Tableau I: Syllable-initial segments

MAXSEG » IDENT[SG], IDENT[STOP] » *[SG]

	MAXSEG	IDENT[SG]	IDENT[STOP]	*[SG]
1. /pʰi:l/ ☞a. pʰi:ˀl				*
b. pi:ˀl		*!		
c. i:ˀl	*!			
2. /tˢal/ ☞ a. tˢæ:ˀl				*
b. tæ:ˀl		*!		
3. /kʰat/ ☞ a. kʰat				
b. kat		*!		
4. /pi:l/ ☞ a. pi:ˀl				
b. pʰi:ˀl		*!		*
5. /tal/ ☞ a. tæ:ˀl				
b. tˢæ:ˀl		*!		*
c. ðæ:ˀl			*!	
6. /kal/ ☞ a. kæ:ˀl				
b. kʰæ:ˀl		*!		*

The highest ranked constraint, MAXSEG is illustrated in 1 above. In 1, the choice between [pʰ] and [p] in this onset (or any other) cannot be solved by deletion. In 1-6 IDENT[SG] and IDENT[STOP] prevent the output onsets from leniting or aspirating and ensure that the input and output onsets are always identical. The last constraint prohibiting the feature [spread glottis] is ranked lowest and has thus no effect on any of the candidates. It will, however, become important in the tableaux to follow when they are combined with other constraints to account for lenition in syllable-final position.

One additional constraint is necessary to account for the deaspiration of stops in onset clusters. This is listed in (4.3) below.

(4.3) Additional constraint for syllable-initial clusters

a. Markedness constraint

i. OCP[SG]: Adjacent [spread glottis] features are prohibited (Leben 1973, Goldsmith 1976, Mester 1986, McCarthy 1986).

The Obligatory Contour Principle (OCP) prohibits identical segments from being adjacent to each other, in this case, two adjacent segments with the feature [spread glottis].

Tableau II: Syllable-initial clusters

OCP[SG] » IDENT[SG], IDENT[STOP] » *[SG]

	OCP[SG]	IDENT[SG]	IDENT[STOP]	*[SG]
1. /sp^hel/ ☞ a. spel		*		
b. sp^hel	*!			*
2. /st^se:n/ ☞ a. ste:$^?$n		*		
b. st^se:$^?$n	*!			*
3. /sk^he:/ ☞ a. ske:$^?$		*		
b. sk^he:$^?$	*!			*

In 1-3, the expected onset [sp^h] is prohibited by the highly ranked OCP[SG] which does not allow the adjacent segments [s] and [p^h] as they both have the feature [spread glottis]. Thus, IDENT[SG] is violable in onsets with consonant clusters /sp^h/, /sk^h/ and /st^s/.

4.2.2 Syllable-final /p^h t^s k^h/

Constraints:

In addition to the constraints defined above the following constraints are necessary for the analysis of the deaspiration of syllable-final segments.

(4.4) Constraints for syllable-final /pʰ tˢ kʰ/

a. Markedness constraint

i. NOCODA: Codas are prohibited.

b. M&M conjunction

i. *[SG]&NOCODA: Spread glottis stops are prohibited in coda position.

NOCODA incurs one violation for any coda segment and is low-ranked in Danish, since we do find codas. *[SG]&NOCODA will, however, force lenition by keeping spread glottis segments out of the coda. The candidates are listed with their English glosses in (4.5) below.

(4.5) Syllable-final /pʰ tˢ kʰ/:

a. lap *patch*

vat *cotton wool*

lak *lacquer* (n.)

Tableau III: Syllable-final aspirated stops

*[SG]&NOCODA » IDENT[SG] » *[SG], NOCODA

	*[SG] & NOCODA	IDENT [SG]	*[SG]	NOCODA
1. /lapʰ/ ☞ a. lɑp		*		*
b. lɑpʰ	*!		*	*
2. /ʋatˢ/ ☞ a. ʋat		*		*
b. ʋatˢ	*!		*	*
3. /lakʰ/ ☞ a. lɑk		*		*
b. lɑkʰ	*!		*	*

*[SG]&NOCODA forces lenition to take place by disallowing stops with the feature [spread glottis] in syllable final position (/pʰ tˢ kʰ/ should thus never occur syllable-finally in Danish, as desired). This is where the reference to stops specifically in the definition in (4.4) is important as other [spread glottis] segments, such as /s/, are allowed in syllable-final position

(i.e. *bus*). All the (b) candidates are ruled out because they violate *both* *[SG] and NOCODA . Local conjunction is important here because, as illustrated, these constraints on their own are violable and cannot affect the candidates in the same way. Individually, no ranking would be possible as illustrated later in tableaux Va and Vb below. This leaves the (a) candidates as the winners, violating only the lower ranked constraints, IDENT[SG] and NOCODA.

4.2.3 Syllable-final /t k/

Constraints:

Two additional constraints are needed for the analysis of /t k/ lenition.

(4.6) Additional constraints for /t k/ lenition

a. Markedness constraint

i. *[STOP]: Stops are prohibited.

b. M&M conjunction

i. *[STOP]&NOCODA: Stops are prohibited in coda position.

The first is a single markedness constraint prohibiting stops. When combined with NOCODA this constraint can account for the lenition of /t k/ in syllable-final position. The candidates and their glosses are listed below.

(4.7) Syllable final /t k/

a. abbed *abbot*

bage *bake*

Tableau IV: Syllable-final /t k/

*[SG]&NOCODA » *[STOP]&NOCODA » IDENT[STOP] » *[STOP]

	*[SG] & NOCODA	*[STOP] & NOCODA	IDENT[STOP]	*[STOP]
1. /apet/ ☞ a. apeð			*	*
b. apet^s	*!	*		
c. apet		*!		
2. /pa:kə / a. pæ:k(ə)		*!		
☞ b. pæ:ɪ			*	
c. pæ:k^h(ə)	*!	*		

As in tableau III above, *[SG]&NOCODA is important here to prevent aspiration in the coda, eliminating fortition. *[STOP]&NOCODA ensures that the coda segments actually lenite, as staying identical with the input incurs a fatal violation, illustrating its crucial ranking above IDENT[STOP].

In this tableau *[STOP]&NOCODA seems to cover the job of *[SG]&NOCODA , but both constraints are necessary as illustrated below in tableau V. *[SG]&NOCODA must be ranked higher to ensure that [p t k] still occur in coda position when derived from underlying /p^h t^s k^h/.

The following tableau also illustrates why the aspirated segments cannot lenite too far (*/p^h/ → [ʊ̯]) using the local conjunction defined below.

(4.8) Additional constraint to prevent ‘overleniting’

a. F&F constraint conjunction

i. IDENT[SG]&IDENT[STOP]: Correspondent segments in the input and output must have identical values for [spread glottis] and [stop].

Tableau V: Syllable-final /t k/

IDENT[SG]&IDENT[STOP], *[SG]&NOCODA » *[STOP]&NOCODA

	IDENT[SG] & IDENT[STOP]:	*[SG] & NOCODA	*[STOP] & NOCODA
1. /ʋatˢ/ ☞ a. ʋat			*
b. ʋatˢ		*!	*
c. ʋað	*!		
2. /apet/ ☞ a. apeð			
b. apetˢ		*!	*
c. apet			*!

The F&F conjunction prevents the aspirated segments from leniting too far, as shown in the first (c) candidate. *[SG]&NOCODA is crucially ranked above *[STOP]&NOCODA in order to ensure output [p t k] when derived from underlying aspirated segments. Thus, this ranking gives us the shift in Danish /tˢ/ → [t], /t/ → [ð]

Below, in tableaux Va and Vb, I illustrate the importance of using local conjunction in this analysis. The two tableaux show that no ranking of the constraints individually can result in the desired outputs for syllable-final lenition.

Tableau Va:

	*[SG]	IDENT [STOP]	*STOP	IDENT [SG]	NOCODA
1. /lap^h/ ☞ a. lɑp			*	*	*
b. lɑp^h	*!				*
c. laɪ̯		*!			
2. /ʋat^s/ ☞ a. ʋat			*	*	*
b. ʋat^s	*!				*
c. ʋað		*!	*	*	*
3. /lak^h/ ☞ a. lɑk			*	*	*
b. lɑk^h	*!		*		*
c. lɑʊ̯/laɪ̯		*!		*/*	
4. /apet/ ☞ a. apeð		*!			*
💣 b. apet			*		*
c. apet^s	*!		*	*	*
5. /pa:kə/ 💣 a. pæ:k(ə)			*		*
☞ b. pæ:ɪ		*!			
c. pæ:k^h(ə)	*!		*	*	*

Ranking *[SG] highest rules out all of the [spread glottis] stops as desired, though this would present a problem for onset positions without an IdentOns constraint. It was established in section 3.2.1 above, however, that positional faithfulness was not the ideal way to account for such processes due to its inability to predict all possible solutions to coda conditions. Thus, IdentOns is not an option.

The next constraint is more difficult to choose. IDENT[STOP] chooses the correct candidate in 1-3 but not in 4-5. In tableau Vb below we can see that choosing *STOP as the next constraint gives us the opposite problem, 1-3 fail and 4-5 are fine. Raising NOCODA will also give problems, as codas are allowed in Danish and raising IDENT[SG] would be useless as it would allow aspirated stops in the coda as well.

Lowering *[SG] would also be a problem because it is the only constraint that rules out the aspirated stops. Thus, local conjunction is absolutely necessary here to account for lenition in syllable-final position.

Tableau Vb:

	*[SG]	*STOP	IDENT[STOP]	IDENT[SG]	NOCODA
1. /lap^{h}/ ☞ a. lɑp		*!		*	*
b. lɑp^{h}	*!	*			*
💣 c. laɪ̯			*		
2. /ʋat^{s}/ ☞ a. ʋat		*!		*	*
b. ʋat^{h}	*!	*			*
💣 c. ʋað			*	*	*
3. /lak^{h}/ ☞ a. lɑk		*!		*	*
b. lɑk^{h}	*!	*			*
💣 c. lɑʊ̯/laɪ̯			*	*/*	
4. /apet/ ☞ a. apeð			*		*
b. apet		*!			*
c. apet^{h}	*!	*		*	*
5. /pa:kə/ a. pæ:k(ə)		*!			*
☞ b. pæ:ɪ			*!		
c. pæ:k^{h}(ə)	*!	*		*	*

4.2.4 Syllable-final /p/

Syllable-final /p/, in the Copenhagen dialect of Danish, is a bit more complicated. While it is more or less consistently lenited in the Jutlandic dialects, it is variable in Copenhagen dialects. Basbøll (2005:76) states that "in certain native words |b| can be realized as /v/ ([ʊ̯]) depending on style" (here |b| refers to |p| in my transcriptions). However, he does not go into much detail and gives the examples listed in chapter three above, repeated here in (4.9) below. No explanation is given as to which native words allow the variation and which do not or why.

(4.9) **/p/ syllable-final = [p], [ʊ̯]** (Basbøll, 2005:74-76)

a. hydrofo**b** [hytʁoˈfo:ˀ**p**] *hydrophobe*

b. kø**be** [ˈk^{h}ø:**p**ə] / [ˈk^{h}ø:**ʊ**] *to buy*

c. ski**b** [ˈski**p**] / [ˈski**ʊ̯**(ˀ)] *ship*

After speaking with different native speakers of the Copenhagen dialect, there also seems to be some disagreement with regards to this question. Most agree on the words above as well as *løbe* (to run) [lø:**p**ə] / [ˈlø:**ʊ**], and they also agree that most other words with syllable-final /p/ should not lenite at all: *døbe* (to baptize), *læbe* (lip), *drab* (murder (n.)), *skab* (closet). It seems then that the leniting /p/s are the exception. There are also two words that I could find that are spelled with *b*s, which are always pronounced as [ʊ]: *peber* [pʰeʊ̯ɐ] (pepper) and *ræbe* (to belch). However, since the *b* in the spelling never appears in any form of the words, there is no real reason to believe that there is an underlying /p/ in these words.

In order to account for this sort of variation, it will be necessary to use indexed constraints (McCarthy & Prince 1995, Pater 2000). Put simply, a constraint can be indexed to a specific input morpheme and only that morpheme. In this case, we could postulate two different /p/ inputs: one that can lenite freely and one that cannot lenite at all. The one that can lenite freely could, for example, be indexed as (1) and a constraint with that same index would only be relevant for that input. The /p/ that cannot lenite would be without an index and thus irrelevant for the indexed constraint. The ranking between the lenition-prohibiting constraint and the lenition-inducing, indexed constraint would be random, resulting in a 50/50 choice for an optimal candidate. This is illustrated with the relevant constraints below.

Constraints:

In order to account for two different types of /p/ in the Copenhagen dialect, one that is in free variation with [ʊ̯] and one that cannot lenite, the following constraints will be needed.

(4.10) Additional constraints for syllable-final /p/:

a. F&M conjunction
   i. IDENT[STOP]&*[LAB]: Correspondent segments in the input and output must have identical values for [stop] and must not be [labial].
b. M&M conjunction
   i. *[STOP] & NOCODA$_1$: Stops are prohibited in output coda positions when the input shares the index 1.

The first constraint requires that stops in the input stay stops in the output while also disallowing labials. The appearance of a [p] in the output will then activate the faithfulness constraint. This will ensure that /p/ does not lenite, and this is the default result desired. The second constraint is the same as the one defined in (4.4) above but indexed with a 1, which will ensure that an output /p/ does lenite if the input /p/ is indexed. The gloss is listed in (4.11) below.

(4.11) Syllable-final /p/:

a. skib *ship*

b. hydrofob *hydrophobe*

Tableau VI: Syllable-final /p$_1$/

*[SG]&NOCODA » *[STOP]&NOCODA$_1$, IDENT[STOP]&*[LAB]

	*[SG] & NOCODA	*[STOP] & NOCODA$_1$	IDENT[STOP] & *[LAB]	*[STOP] & NOCODA
1. /sk^{h}ip$_1$/ ☞ a. skip		*		*
b. skip^h	*!	*		*
☞c. skiʊ̯			*	

What this tableau shows is a random ranking between the indexed constraint *[STOP]&NOCODA$_1$ and IDENT[STOP]&*[LAB]. The violations show that when *[STOP]&NOCODA$_1$ is ranked higher, candidate (a) is the winner. When IDENT[STOP] &*[LAB] is ranked higher, candidate (c) is the winner. The speaker then should choose candidate (a) half the time and candidate (c) half the time. With the unindexed constraint *[STOP]&NOCODA ranked below IDENT[STOP]&*[LAB], as illustrated in Tableau VII below, the /p/ will never lenite if the input is not indexed. The indexed constraint is irrelevant to unindexed inputs.

Tableau VII: Syllable-final /p/

IDENT[STOP]&*[LAB] » *[STOP]&NOCODA

/hytʁofo:ˀp/	*[STOP] & NOCODA_1	IDENT[STOP] & *[LAB]	*[STOP] & NOCODA
☞ a. hytʁofo:ˀp			*
b. hytʁofo:ˀʊ̯		*!	

4.2.5 Syllable/-final /k/ with assimilation

In the tableau for syllable-final /t k/ above, assimilation was not taken into consideration. In the following, I will account for the assimilation of lenited /k/s to preceding vowels.

Constraints:

To analyze the assimilation process in syllable-final /k/ three additional constraints are necessary as listed in (4.12) below.

(4.12) Assimilation constraints for /k/ lenition
- a. Markedness constraints
  - i. * x: No [x] in the output.
  - ii. AGREE[FRONT]: Adjacent output segments have the same value of the feature FRONT. (Baković, 2007:336)
  - iii. AGREE[ROUND]: Adjacent output segments have the same value of the feature ROUND. (Baković, 2007:336)

The first constraint prohibits all instances of [x], preventing /k/ from spirantizing to a fricative. The last two constraints require agreement between two adjacent output segments. In this case, the features FRONT and ROUND are relevant. Adjacent output segments not agreeing in these features receive a violation mark. The gloss for Tableau VIII is listed in (4.13) below.

(4.13) Syllable-final /k/:

a. bage *to bake*
koge *to cook*
søge *to search*

Tableau VIII: Syllable final /k/ after front vowels

* x, MAXSEG » * [STOP]&NOCODA, AGREE[FRONT] » IDENT[STOP]

/pa:kə/	* x	MAXSEG	*[STOP] & NOCODA	AGREE[FRONT]	IDENT [STOP]
a. pæ:k(ə)			*!		
☞ b. pæ:ɪ					*
c. pæ:ʊ				*!	*
d. pæ:x(ə)	*!				*
e. pæ:		*!			

In this tableau, *[STOP]&NOCODA prohibits /k/ from staying faithful. Keep in mind that schwas are dropped in Danish except in distinct speech, so both /k/ and /x/ are in coda position. AGREE[FRONT] ensures that the vowel choice is [ɪ] and not [ʊ] and MAX prevents the segment from deleting altogether.

Tableau IX: Syllable-fnal /k/ after back (round) vowels

/kʰɔ:kə/	*[STOP] & NOCODA	AGREE[FRONT]	IDENT [STOP]
a. kʰɔ:k(ə)	*!		
☞ b. kʰɔ:ʊ			*
c. kʰɔ:ɪ		*!	*

This tableau works just as tableau VIII does, except AGREE[FRONT] ensures this time that [ʊ] is the winning vowel.

Tableau X: Syllable final /k/ after front round vowels

/sø:kə/	*[STOP] & NOCODA	AGREE[FRONT]	IDENT [STOP]	AGREE[ROUND]
a. sø:k(ə)	*!			
b. sø:ʊ		*!	*	
☞ c. sø:ɪ			*	*

Again AGREE[FRONT] picks the correct vowel and AGREE[ROUND] is included to illustrate that the two segments do not need to agree in rounding, only in frontness.

4.2.6 Underlying geminates

Geminate Inalterability:

Phonological processes affecting short segments often do not affect long, geminate segments (Guerssel, 1977). This is universally true with respect to consonant lenition (Churma, 1988). A change such as /kk/ → *[ʊ̯ʊ̯] should not be possible in Danish (and it isn't) and is presumably, universally unattested. Other processes related to geminate inalterability also seem to be unattested such as a single becoming a lenited geminate, /k/ → *[xx] or a geminate only partially leniting /kk/ → *[xk], etc. (Kirchner, 2000).

However, since geminate consonants are not found anywhere in Danish, why should we assume that there are any underlying geminates? Historically, Danish did have geminate consonants but these went through a degemination process in Old Danish around 1300 (Bandle et al., 2002). Lenition processes in Danish had already started around 1200 (Bandle,et al., 2002), in which case we might expect underlying geminates to be the likely reason for the lack of lenition illustrated in chapter two above and repeated here in (4.14).

(4.14) No lenition of /k/ after some short vowels:

a.	mug	[ˈmɔk]	*mould*
b.	dug	[ˈtuk]	*dew, steam*
c.	ryg	[ˈʁœk]	*back (n.)*
d.	rigtig	[ˈʁɛktit]	*right, correct*
e.	træagtig	[ˈtʁaˌɑkti]	*tree-like*

Underlying /k/ is not the only segment that does not lenite in these cases. There are also examples of underlying /t/ not leniting as illustrated in the tableau below.

Constraints:

To analyze underlying geminates and account for geminate inalterability we need three new constraints.

(4.15) Constraints for geminate inalterability:

a. Faithfulness constraint and F&F conjunction

i. IDENT[LONG]C: Correspondent consonantal segments in the input and output have identical values for [long] (based on McCarthy, 1995).

ii. IDENT[LONG]C&IDENT[STOP]: Correspondent consonantal segments in the input and output have identical values for [long] and [stop].

b. Markedness constraint

i. *[LONG]C : No long consonants (Holt, 1997).

The first constraint requires long consonants in the input to be long in the output. The second is a local conjunction preventing lenition from occurring in this context as shown in tableau IX below. The third constraint prohibits input long consonants from remaining long in the output. We know the first constraint must be ranked low since there are no long consonants in Danish and the third ranked high. The gloss is given in (4.16) below.

(4.16) Underlying geminates:

a.	mug	[muk]	*mold*
b.	bredde	[pʁetə]	*width*

Tableau XI: Syllable final /kk/ and /tt/: Geminate inalterability

*LongC, Ident[long]C&Ident[Stop] » *[Stop]&NoCoda » Ident[long]C

	*LongC	Ident[long]C & Ident[Stop]	*[Stop] & NoCoda	Ident[long]C
1. /mukk/ ☞ a. muk			*	*
b. muʊ̯		*!		*
c. mukʊ̯		*!		*
d. mukk	*!		*	
e. muʊ̯ʊ̯		*!		*
2. /pʁettə/ ☞ a. pʁetə			*	*
b. pʁeð		*!		*
c. pʁettə	*!		*	
d. pʁeððə	*!			

As mentioned, Danish does not allow any geminate consonants in the output so *LongC is ranked high and rules out all geminate consonants as in 1d, 2c and 2d. Ident[long]C&Ident[Stop] prevents the geminates from leniting, whether they stay geminate or not, at the expense of *[Stop]&NoCoda. In 1b, there is no long consonant and one has been changed to the vowel [ʊ̯]. In 1c, the consonant is shortened and, though one still remains, the other has been changed to a vowel. In 1e, a long consonant no longer exists as both have been changed to vowels. In 2b, the long stop is changed to a short vowel.

4.2.7 Syllable-initial /j ʋ ʁ/

Constraints:

Two new constraints are necessary to account for syllable-initial approximants.

(4.17) Constraints for syllable-initial approximants

a. Faithfulness constraint

i. Ident[approx]: Correspondent segments in the input and output have identical values for [approximant] (McCarthy, 1995).

b. Markedness constraint

i. *[Approx]: Approximants are prohibited.

The gloss for tableau XIII is in (4.18) below.

(4.18) Syllable-initial /j ʋ ʁ/ including consonant clusters:

a.	hjul	*wheel*	b. fjern	*far*
	våd	*wet*	svær	*difficult*
	ro	*row*	tro	*believe*

Tableau XII: Syllable-initial approximants

IDENT[APPROX] » *[APPROX]

	IDENT[APPROX]	*APPROX
/ju:l/ ☞ a. ju:ˀl		*
b. ɹ̯u:ˀl	*!	
/ʋɔt/ ☞ a. ʋɔðˀ		*
b. ʋ̯ɔðˀ	*!	
/ʁo:/ ☞ a. ʁo:ˀ		*
b. ʁ̯o:ˀ	*!	
/ fjæʁn / ☞ a. fjæʁ̯ˀn		*
b. fɹ̯æʁ̯ˀn	*!	
/ sʋɛʁ/ ☞ a. sʋɛʁ̯ˀ		*
b. sʋ̯ɛʁ̯ˀ	*!	
/tˢʁo:/ ☞ a. tˢʁo:ˀ		*
b. tˢʁ̯o:ˀ	*!	

In this tableau, IDENT[APPROX] rules out any changes in the feature [approx] in the onset at the expense of the lower ranked *APPROX (I ignore coda approximants in the violations for this tableau as they are not relevant at this point). This is the same result achieved in tableau I with the use of IDENT[SG]. Clusters here do not violate the OCP[SG] constraint here and are thus permitted in the output as expected.

4.2.8 Syllable-final /j ʋ ʁ/

Six new constraints are needed to account for syllable-final /j ʋ ʁ/ lenition.

(4.19) Constraints for syllable-final /j ʋ ʁ/:

a. Faithfulness constraints
   - i. MAX[LAB] / [PHAR]: Every [labial] / [pharyngeal] feature of the input has a correspondent in the output (McCarthy, 1995).

b. F&F conjunction
   - i. IDENT[COR]&IDENT[APPROX]: Correspondent segments in the input and output have identical values for [coronal] and [approximant].

c. M&M conjunction
   - i. *[APPROX]&NOCODA: Approximants are prohibited in coda position.
   - ii. *ʝ / *v : No [ʝ] / [v] in the output.

The constraints in (a) are all faithfulness constraints prohibiting the deletion of input place features. The second constraint requires approximant coronals to be faithful to the input. We will see in (4.21) below that stop coronals do delete in certain environments, thus the need for the conjunction referring specifically to approximants. The third constraint prohibits approximants from appearing in coda position and the last constraint prohibits the fricatives [ʝ] and [v] from ever appearing in the output. The gloss for tableau XIII is listed below.

(4.20) Syllable-final /j ʋ ʁ/:

a. sag *case*
b. liv *life*
c. stor *big*

Tableau XIII: Syllable-final approximants

MAX[LAB]/[PHAR], IDENT[COR]&IDENT[APPROX] »*[ʝ], *[v], *[APPROX]&NOCODA » AGREE[FRONT]

	MAX [LAB]	MAX [PHAR]	IDENT [COR] & IDENT [APPROX]	*[ʝ] / *[v]	*[APPROX] & NOCODA	AGREE [FRONT]
1. / saj/ ☞ a. sæɪ̯ˀ						
b. sæjˀ					*!	
c. sæʝ				*!		
d. sæʊ̯ˀ			*!			
2. / liʋ/ ☞ a. liʊ̯ˀ						*
b. liʋ					*!	
c. liɪ̯ˀ	*!					
d. liv				*!		
3. / stʰoʁ/ ☞ a. stoɐ̯ˀ						
b. stoʁ					*!	
c. stoʊ̯ˀ		*!				

The high-ranked MAX constraints and the F&F conjunction ensure that the lenited segments keep the place of articulation of the input segments, so /j/ → [ɪ̯], /ʋ/ → [ʊ̯] and /ʁ/ → [ɐ̯]. *[ʝ] and *[v] keep the approximants from leniting to fricatives while *[APPROX]&NOCODA prevents them from staying approximants. AGREE[FRONT] has no influence here, though it was important in the lenition of /k/, and I include it here to illustrate its ranking below the other constraints.

4.2.9 Syllable-final /j ʋ ð/ after /l n ʁ/

As shown in the data in chapter two, repeated here in (4.21), underlying approximants do not lenite in the same way after /l/ and underlying /t/ cannot lenite after /l n ʁ/.

(4.21) Approx lenition after liquids and nasals

i.	elg	[ˈɛlˀʝ]	*elk*	
ii.	ulv	[ˈulˀv]	*wolf*	
iii.	held	[ˈhelˀ]	*luck*	heldig [ˈhelti] *lucky*
iv.	mand	[manˀ]	*man*	mandig[ˈmanti] *manly*
v.	kurv	[k^{h}uɐ̯ˀʊ̯]	*basket*	
vi.	værd	[ˈvɛɐ̯ˀ]	*worth*	værdig [ˈvæɐ̯ti] *worthy*
vii.	*lr *nj, *nv, *rj : non-existent coda combinations			

As the data show, after /l/ the approximants /ʋ/ and /j/ become corresponding labiodental and palatal fricatives, respectively, while [ð] is deleted completely. This is due to sonority sequencing (see below), which requires falling sonority in complex codas. It is also unacceptable to stay faithful to the underlying /t/ *[helˀt] (with the meaning *luck*). If the segment cannot lenite then it cannot be there at all. The same goes for [ð] after /ʁ/ and /n/. There is no problem leniting /ʋ/ after /ʁ/, though. The combinations listed in (g) do not exist in Danish but would all be violations of the same sonority sequencing constraint if they did.

The stød [ˀ] in the [ð] forms does not seem to be the reason for deletion as shown in the additional data below, which do not have stød but still delete [ð].

(4.22) /nt/ forms without stød:

i.	sind	[sen]	*mind*	sindig	[ˈsenti]	*calm/sober-minded*
ii.	ynde	[ønə]	*charm*	yndig	[ˈønti]	*charming*

It is also possible to have a [ˀt] combination if the underlying segment is /t^{s}/. The following data show this and can also be used to argue against a possible OCP analysis for these forms. A constraint against a [cor][cor] sequence cannot explain why [ð] is also deleted after /ʁ/ (which is not [cor]) nor can it explain the following data with underlying /t^{s}/ surfacing as [lt], [nt] [ɐ̯t], the first two of which are [cor][cor].

(4.23) Forms with underlying /tˢ/:

i.	helt	[hɛlˀt]	*hero*
ii.	pant	[pant]	*deposit*
iii.	vært	[væɐ̯t]	*host*

If we then assume that the underlying /t/ must lenite or not show up at all we can explain why sonority sequencing causes it to delete instead of staying faithful and why the forms in (4.23) are allowed: because /tˢ/ does in fact lenite. This is analyzed with the constraints defined below.

Constraints:

To account for the surface forms of underlying approximants and /t/ after /l/, the following additional constraints are necessary.

(4.24) Constraint for syllable-final /j ʋ/ after /l/

a. Faithfulness constraints and F&F conjunctions

   i. MAX[F]: Every feature of the input has a correspondent in the output (Lombardi 1995, Lamontagne & Rice 1995).

   ii. MAX[SG]&MAXSEG: Every [sg] feature of the input and every segment of the input has a correspondent in the output.

b. Markedness constraint

   i. Sonority Sequencing (SSQ): Penalizes instances in which complex onsets do not rise in sonority, or in which complex codas do not fall in sonority.

The last constraint is based on the universal Sonority Hierarchy (Prince & Smolensky, 1993), illustrated in (4.25) below. Segments rise in sonority from left to right on the hierarchy and coda sequences are expected to fall in sonority from right to left on the hierarchy. Therefore, after /l n ʁ/ we would not expect to find approximants or vowels but instead stops or fricatives.

(4.25) Sonority Hierarchy

stops » fricatives » nasal stops » liquids » glides » vowels

The first constraint is violated whenever a feature is deleted (just as in (4.19) above to prevent place feature deletion). This constraint, used in combination with MAXSEG prohibits the deletion of the features [spread glottis] and [approximant] as well as the deletion of a segment. This conjunction is violated if both the feature *and* the segment are deleted. Using the examples from the data above these constraints are ranked as shown in Tableau XIV below.

Tableau XIV: Approximants after /l ʁ n/

SSQ, MAX[SG]&MAXSEG, *[SG]&NOCODA » *[STOP] & NOCODA » MAXSEG » MAX[SG]

	SSQ	MAX[SG] & MAXSEG	*SG & NOCODA	*[STOP] & NOCODA	MAXSEG	MAX[SG]
1. /hɛlt/ ☞ a. hɛlˀ					*	
b. hɛlˀt				*!		
c. hɛlˀð	*!					
2. /hɛltˢ/ ☞a. hɛlˀt				*		*
b. hɛlˀ		*!			*	*
c. hɛlˀtˢ			*!			

This tableau illustrates what happens when we have the input /lt/ compared to /ltˢ/. The /t/ cannot lenite as usual because such an output violates the high-ranked SSQ constraint. However, it cannot stay faithful either because that fatally violates *[STOP]&NOCODA[4]. The only option left then is to delete, requiring us to lower MAXSEG below *[STOP]&NOCODA since this violation is allowed (until now we had assumed that MAXSEG was a higher ranked constraint because it was never violated, as in tableau I and VI). The underlying /tˢ/, however, can lenite without incurring any SSQ violations and thus there is no reason to delete. In fact, deletion would incur a violation of the conjoined constraint MAX[SG]&MAXSEG because both the feature [spread glottis] and the segment /t/ are no longer present in the output. As we know from previous tableaux, [spread glottis] segments are not allowed in syllable-final position so [tˢ] is also ruled out. The winning candidate with [t] deletes the feature [spread glottis] but keeps the segment and thus only incurs a violation of the lower-ranked *[STOP]&NOCODA constraint.

[4] I also assume that becoming the fricative version of ð, as with *[x] in (4.12) would violate a constraint ruling out such as segment from ever occurring in Danish.

Tableau XV: SSQ repairs, approximants

SSQ » MAX-SEG » *[j̝], *[v]

	SSQ	MAXSEG	*[j̝] / *[v]
1. / εlj/ ☞ a. εlˀj̝			*
b. εlˀɪ̯	*!		
c. εlˀj	*!		
d. εlˀ		*!	
2. / ulʋ/ ☞ a. ulˀv			*
b. ulˀʋ	*!		
c. ulˀʊ̯	*!		
d. ulˀ		*!	

The SSQ constraint prevents [ɪ̯] [j] [ʊ̯] and [ʋ] from appearing in the output after [l]. Deletion is prevented by MAXSEG. The violations of *[j̝] and *[v] are unimportant here and the fricatives are used to repair the SSQ violations that both lenition and faithfulness incur.

For the next tableau we need to take a closer look at the sonority hierarchy from (4.25) above. The categories listed do not include the segment [ð]. It is an approximant but not a glide or liquid. As the data above show, *[ɐ̯ð] is not a permissible output in Danish but [ɐ̯ʊ̯] is. This seems fine in itself if we say that [ð] is more sonorous than the non-syllabic vowels, which may not be so odd since *[ɪ̯ð] and *[ʊ̯ð] do not occur either (unless ð is syllabic, and thus not part of the same coda: *farvede* [fɑʊ̯ð̩] ‘color (past)’). Basbøll (2005) categorizes ð as a non-syllabic vocoid in a group with [ɐ̯ ɪ̯ ʊ̯] but the non-syllabic vowels are [-approx] while ð is [+approx], and can in fact be syllabic (see example above). It also makes such a bad onset in Danish that it is completely forbidden from that position, so we might assume that a sonority hierarchy for Danish looks something like (4.26) below.

(4.26) Sonority hierarchy for Danish:

stops » fricatives » nasal stops » liquids » glides » ð » vowels

That we do not find *[ɐ̯ɪ̯] in Danish (derived or otherwise) may be an accident for historical reasons. Before lenition processes took place [ʁj] would have been in violation of the sonority hierarchy (when [ʁ] was a trill) but [ʁv] would not (if [v] was a fricative).

If [ð] and the non-syllabic vowels fall under a 'vocoid' category together, they may also fall into the same category on the sonority hierarchy that needs a finer distinction. Since sonority in Danish is not the main topic of this thesis, though, I leave a more detailed hierarchy for further investigation The hierarchy in (4.26) suffices for our purposes.

Tableau XVI: SSQ repairs, /t/ and approximants

SSQ » *[STOP]&NOCODA » MAXSEG »*[v]

	SSQ	*[STOP] & NOCODA	MAXSEG	*[v]
1. / væʁt/ ☞a. vɛɐ̯ˀ			*	
b. væɐ̯t		*!		
c. væɐ̯ð	*!			
2. /kuʁʋ/ ☞a. kʰuɐ̯ˀʊ̯				
b. kʰuɐ̯ˀv				*!
c. kʰuɐ̯ˀ			*!	

Taking into account the discussion above, the SSQ rules out the combination [ɐ̯ð] in (1c) but not [ɐ̯ʊ̯] in (2a). MAXSEG does not allow [ʋ] to delete but does its lower ranking must allow [t] to delete. *[STOP]&NOCODA prohibits [t] from staying in the coda in (1b) and *[v] prohibits a change to fricative [v] in (2b). This leaves us with deletion to repair the SSQ violation in (1) and normal coda lenition in (2).

Moving MAXSEG below *[STOP]&NOCODA in these tableaux affects tableaux VI and VII above for syllable-final labial lenition. This ranking makes deleting /p/ or /p_1/ the more optimal choice. However, in tableau XIII MAX[LAB] is a high-ranked constraint and will prevent labial deletion as illustrated in Tableau XVII below, using the same examples as in tableaux VI and VII.

Tableau XVII: No labial deletion

MAX[LAB], *[SG]&NOCODA » *[STOP]&NOCODA$_1$, IDENT[STOP]&*[LAB] » *[STOP]&NOCODA » MAXSEG

	MAX [LAB]	*[SG] & NOCODA	*[STOP] & NOCODA$_1$	IDENT[STOP] & *[LAB]	*[STOP] & NOCODA	MAXSEG
1. /skʰip$_1$/ ☞ a. skip			*		*	
b. skipʰ		*!				
☞c. skiʊ̯				*		
d. ski	*!					*
2. /hytʁofo:ˀp/ ☞ a. hytʁofo:ˀp			*			
b. hytʁofo:ˀʊ̯		*!				
c. hytʁofo: ˀ	*!					*

4.3 Overapplication

The above analysis accounts for lenition in syllable-final position, which I have claimed is the only position displaying lenition in Danish. However, with the addition of certain suffixes in Danish, we actually find lenition in what looks like syllable-initial position. In this section, I will show that this does not present any problems to the analysis above. Using output-to-output Correspondence (OO-correspondence) (Kenstowicz 1996, Benua, 1997), described below, I will show that these forms are examples of overapplication and, with the addition of OO constraints, they fit into the analysis without any other adjustments to the overall ranking.

In McCarthy & Prince's (1999) Correspondence Theory, they discuss different types of correspondence, such as input-output, base-reduplicant, truncation, etc. They use the three constraint families, MAX, DEP and IDENT(F), and relate a string S_1 (base, input, etc) to a string S_2 (reduplicant, output, etc). They also put forth a basic model of correspondence illustrated in (4.27) below:

(4.27) Basic Model (McCarthy & Prince, 1999:11)

Input: /Af$_{RED}$ + Stem/

$\upharpoonleft\downharpoonright$ *I-O Faithfulness*

Output: R $\rightleftarrows$ B

B-R Identity

In this model, we can see that there are interactions between an input and an output as well as, for example, a base and reduplicant. In OO-Correspondence Theory (Kenstowicz 1996, Benua, 1997), Correspondence Theory is extended to relationships between free-standing output forms. In this theory, IO-faithfulness constraints are ranked with respected to OO-identity constraints and markedness constraints, accounting for relationships between, for example, base and affix. This not only illustrates but also explains the morphological relationship between a base and an affix straightforwardly, with constraints from the same families used in IO correspondence. In other words, cases of correspondence between an affixed form and its base are treated in the same way as the correspondence between an input and its optimal output.

The data for the overapplication of lenition is illustrated in (4.28) below.

(4.28) Overapplication of Danish lenition:

a. **affixes /-isk/ /-ik/ nominal /-i/**

i.	**metode**	**metodisk**	**metodik**
	[me.ˈt^{s}o:ð̞]	[meˈt^{s}o:^{ʔ}ð̞isk]	[met^{s}oˈtik]
	method	*methodic*	*methodology*
ii.	**profet**	**profetisk**	**profeti**
	[p^{h}ʁo.ˈfe:^{ʔ}t]	[p^{h}ʁoˈfe:^{ʔ}tisk]	**[**p^{h}ʁofeˈt^{s}i]
	prophet	*prophetic*	*prophecy*

b. **affix /-eŋ/ - ‘ing’**

i.	**mad**	**madding**
	[mað]	[maðeŋ]
	food	*bait*

c. **adjectival affix /-i/ *‘ig’***

i.	**nåde**	**nådig**
	[ˈnɔ:ð̞]	[ˈnɔ:.ði]
	grace	*gracious*
ii.	**dyd /ð/**	**dydig**
	[ˈtyð]	[ˈty:.ði]
	virtue	*virtuous*
iii.	**Todi**	
	*[t^{s}o:.**ð**i] , [t^{s}o:.**t**i]	
	nonce word	

In (a), the suffix /-isk/ is added to the base of *metode* and *profet* resulting in lenited forms in syllable-onset position. A position we do not expect to find lenited forms in. However, the suffix /-ik/ and nominal /-i/ do not give this result. These affixes do not require identity between the base and affix but between the input and affixed form. This is comparable to æ-tensing in varieties of American English. This process occurs as expected with the addition of adjectival class 1 suffixes, which only require a root, but overapplication occurs with the addition of class 2 suffixes, which require a stem as their base (see Benua, 1995)[5]. In Danish, roots can take both /-ik/ and /-isk/ and when no stem is available /t^{s}/ is epenthesized and we see regular application. This is illustrated in (4.29) below:

[5] Class 1 and class 2 affixes are lexical terms referring to the two groups of affixes in English distinguished by the different phonological behavior of words with the addition of different affixes.

(4.29) /-ik/ vs. /-isk/ (Basbøll, 2005:345,489):

a. **erotik** **erotisk**

[eʁoˈt^{s}ik] [eˈʁo:t^{s}isk]

eroticism *erotic*

b. **drama** **dramatic** **dramatisk**

[ˈtʁɑ:ma] [tʁɑmaˈt^{s}ik] [tʁɑˈmat^{s}isk]

drama *drama (genre)* *dramatic*

It seems that /t^{s}/ is a default for both forms when no stem is available (though this may not always be the case, i.e. *prosaisk* [p^{h}ʁoˈsæ:ˀisk] 'prosaic' from *prosa* (Basbøll, 2005:489)). In (a) there is no stem **erot* for either form to be faithful to and in (b) *drama* ends in a vowel resulting in an epenthesized /t^{s}/. These forms are not a problem for the following analysis since identity between a base and an affix is not relevant here.

The stress shift does not seem to be the reason for regular application in the /-ik/ forms because we find unaspirated /p t k/ in stressed position when they are underlying in onsets and elsewhere, i.e. *kvadrat* [k^{h}ʋaˈtʁa:ˀt] 'square', *igen* [i.ˈkɛn] 'again', *problem* [p^{h}ʁoˈple:ˀm] 'problem'. Thus, in *profeti* there should be no reason to aspirate unless faithfulness to the input is the issue. The aspirated forms /p^{h} t^{s} k^{h}/ are also found in both stressed and unstressed positions, i.e. *mikroskop* [mik^{h}ʁoˈsko:ˀp], *papir* [p^{h}ɑˈp^{h}iɐ̯ˀ]. Thus, there is no indication of fortition processes in Danish. The only segment never found in stressed position is /ð/.

In (4.28) (b) and (c) the suffixes also require identity between base and affix. In (4.28) (c.iii) is an example of a made up name ending in /i/ that would never be pronounced with the lenited segment. This illustrates that it is not the segment /i/ in itself that causes overapplication (as was claimed for schwa) unless one were to claim there were two types of /i/ in Danish, which does not seem plausible (see Basbøll, 2005:344). The example in (4.28) (b) illustrates overapplication before /e/, as well, so a special account would also be needed for that vowel.

Using OO-correspondence as described above we can account for the data as in Tableau XVIII below using *metode* as the obvious case of overapplication compared to *melodi* ('melody') as a not so obvious case, with [t] in syllable-initial position in both forms as expected.

Tableau XVIII: Overapplication of lenition

IDENT-BA » IDENT-IO[STOP]

	IDENT-BA[STOP]	*[STOP] & NOCODA	IDENT-IO[STOP]
1. Input:/meloti + iskʰ/ Base: [meloti] ☞ a. meˈlo:ˀtisk			
b. meˈlo:ˀðisk	*!		*
2. Input: /metˢoð̩ + iskʰ/ Base: [metˢoð̩] ☞ a. meˈtˢo:ˀð̩isk			*
b. meˈtˢo:ˀtisk	*!		

IDENT-BA[STOP] requires identity between the base correspondent [metˢoð̩] and its affix correspondent [meˈtˢo:ˀð̩isg̊]. This prevents *[meˈtˢo:ˀtisk] from winning even though it is faithful to IDENT-IO[STOP], the constraint that prevented onset lenition in tableau I above. Due to this being a case of overapplication in the onset, none of the candidates can violate the NOCODA conjunctions (I ignore [isk] here as it is not relevant to overapplication). 2a. does violate IDENT-IO[STOP] but its low ranking makes this violation obsolete.

4.4 Overall Ranking

Below is a diagram of the constraint hierarchy for Danish lenition based on the above ranking arguments.

(4.30) Constraint Hierarchy

OCP[SG], *[SG]&NOCODA, IDENT[SG]&IDENT[STOP], *[LONG]C,
IDENT[LONG]C&IDENT[STOP], MAX[LAB], MAX[PHAR], IDENT[COR]&IDENT[APPROX],
SSQ, MAX[SG]&MAXSEG, IDENT-BA[STOP], *[x]

|

IDENT[STOP]&*[LAB], *[STOP]&NOCODA$_1$

|

*[STOP]&NOCODA

|

MAXSEG

|

*[APPROX]&NOCODA, *[j̥], *[v]

|

AGREE[FRONT], IDENT[APPROX], IDENT[SG]

|

*[SG], IDENT[STOP], NOCODA, *[STOP], *[APPROX], AGREE[ROUND], IDENT[LONGC],
MAX[SG], MAX[APPROX]

The constraints on the top tier are never violated, and thus ranked the highest. This is shown in tableau II- tableau VI, tableau XI and tableau XIII – tableau XVIII. The second stratum contains the constraints from tableau VI, tableau VII and tableau XVII regarding labials in syllable-final position. This was an example of the random ranking, where IDENT[STOP]&*[LAB] is violable when lenition is prohibited and *[STOP]&NOCODA$_1$ when it is permitted. *[STOP]&NOCODA ranking below these is illustrated in tableau VII and tableau XVII. Its ranking relative to other constraints is illustrated in tableau III – tableau XI and tableau XIII – tableau XVI. MAX-SEG's ranking relative to *[STOP]&NOCODA was established in tableau XIV – tableau

XVII. Its ranking relative to other constraints is illustrated in tableau I and tableau VIII. *[APPROX]&NOCODA is ranked in tableau XIII. AGREE[FRONT], IDENT[APPROX] and IDENT[SG] are all ranked in tableau I – tableau III, tableau VIII – tableau X, tableau XII and tableau XIII. They are violable in most cases but not when in conflict with the constraints on the last tier, illustrated in tableau I – tableau V and tableau VIII- tableau XV.

The ranking of these constraints explains the coda conditions in Danish. All [spread glottis] segments are prohibited from ever appearing in the coda, stops are only allowed when derived from underlying [sg] segments and [ð] is the only approximant permitted in coda position. The MAX constraint rankings explain why /t/ deletes when it cannot lenite instead of remaining faithful in SSQ conflicts (see tableau XIV) and /t^s/ acts as normal. The lower ranked IDENT constraints on the second to last tier account for non-lenition in all other positions, as the conjoined NOCODA constraints only affect segments in coda position, leaving it up to them to determine the winner.

Chapter Five: Alternative analyses within OT
Ternary scales and the effort-based approach

5.1 Effort-based approach

The first theory within OT that I will discuss with regards to lenition is the effort-based approach (Kirchner, 1998). Kirchner (1998) proposes an effort minimization constraint, which he calls LAZY. This constraint interacts with other, lenition-blocking constraints to explain lenition patterns throughout languages. Kirchner (1998) splits the lenition-blocking constraints into two groups: faithfulness constraints and fortition constraints ("which serve to enhance the salience and robustness of perceptual distinctions" (Kirchner, 1998:26)). For example, whether or not a language has spirantization can be explained by the opposition between the LAZY constraint and a faithfulness constraint which requires the preservation of continuancy, which Kirchner (1998:26) calls PRESERVE(continuant). If the preservation constraint is ranked above LAZY then lenition is blocked, if below then lenition is triggered. The two possibilities are illustrated in the tableaux below.

(5.1) Spirantization (Kirchner, 1998:26):

a.

/d/	LAZY	PRES(cont)
D	**!	
☞ð	*	*

b.

/d/	PRES(cont)	LAZY
☞d		**
Đ	*!	*

Without a PRESERVE constraint, or with a lower ranked one, lenition can take place. PRESERVE(X) constraints can also be used to account for position specific lenition, i.e. coda, word-final, intervocalic, etc. Fortition constraints come into play in cases of complementary distribution. For example a constraint such as (*[+cont, -son]/#_) can prevent word-initial obstruents and force them to become stops (Kirchner, 1998:31). These markedness constraints as well as the context-sensitive faithfulness constraints are necessary due to perceptual considerations (Kirchner, 1998). Those positions where audibility is more important (word-initial) are represented in higher-ranked constraints.

Kirchner (2004) also proposes a universal ranking of LAZY constraints. These are given the form LAZY(C, K, R) » LAZY(C', K', R') where *C* refers to a class of consonants, *K* to context and *R* to speech rate (Kirchner, 2004:321). An example of this ranking with regards to consonant constriction is given below in (5.2). The greater the degree of constriction, the more effort it takes and the faster the rate of speech, the more effort it takes.

(5.2) Universal ranking of LAZY constraints (Kirchner, 2004:321):

Lazy(vcl_strid_affric, K, R)	»	Lazy(vcl_strid_fric, K, R)
Lazy(vcd_strid_affric, K, R)	»	Lazy(vcd_strid_fric, K, R)
Lazy(vcl_stop, K, R)	»	Lazy(vcl_clos_fric, K, R)
Lazy(vcd_stop, K, R)	»	Lazy(vcd_clos_fric, K, R)
Lazy(vcl_fric, K, R)	»	Lazy(vcl_approx, K, R)
Lazy(vcd_fric, K, R)	»	Lazy(vcd_approx, K, R)
Lazy(vcl_clos_fric, K, R)	»	Lazy(vcl_fric, K, R)
Lazy(vcd_clos_fric, K, R)	»	Lazy(vcd_fric, K, R)
Lazy(trill, K, R)	»	Lazy(long_vcd_approx, K, R)
Lazy(flap, K, R)	»	Lazy(vcd_approx, K, R)
Lazy(nas, K, R)	»	Lazy(vcd_approx, K, R)
Lazy(lat, K, R)	»	Lazy(vcd_approx, K, R)
Lazy(vcl_approx, K, R)	»	Lazy(vcl_glot_fric, R)
Lazy(vcd_approx, K, R)	»	Lazy(vcd_glot_fric, K, R)

According to this, we can see that voiceless strident affricates should incur more LAZY violations than voiceless strident fricatives. It is also possible to use the *K* part of the constraint to show that V_V lenition is better than C_V lenition, etc.

The basic definition of the LAZY constraint is to minimize articulatory effort (Kirchner, 1998:38). Kirchner (1998) proposes that an estimate of the cost of this articulatory effort is computed for each candidate by GEN and the candidate with the higher estimate incurs more violations of LAZY. For a more detailed explanation of this articulatory effort and analyses using LAZY see Kirchner (1998) and Kirchner (2004).

Why not Lazy?

In this section I will argue that the effort-based approach (Kirchner, 1998) described above in chapter two, section three is not the most optimal way to explain Danish lenition. First, it is not possible, as far as I can see, to explain the chain shifts taking place, such as $t^h \rightarrow t \rightarrow ð$ using the LAZY constraint alone. There is nothing stopping /t^s/ from leniting to [ð] as illustrated in the tableau below.

(5.3) Danish lenition using ‘Lazy’:

	LAZY	PRES[SG]	PRES[STOP]
/ʋat^s/ a. ʋat	*!	*	
b. ʋat^s	**!		
💣 c. ʋað		*	*
/apet/ ☞ a. apeð		*	*
b. apet	*!	*	
c. apet^s	**!		

Assuming that [t] is less effortful than [t^s] and that [ð] is less effortful than [t], we would expect the LAZY violations to reflect this as illustrated in the tableau above. However, a constraint needs to be ranked above LAZY that prevents /t^h/ from becoming [ð] without also preventing /t/ from doing so. Moving either of the lower ranked constraints higher will result in the wrong winning candidate for /apet/. It seems that local conjunction is absolutely necessary here as well, *[SG]&NOCODA, IDENT[SG]&IDENT[STOP] and *[STOP]&NOCODA accomplish this as shown in Tableau III and Tableau IV, without introducing entirely new constraints but by combining constraints already established in Optimality Theory. There is also more explanatory power in the conjoined constraints. The lenition takes place in coda position and requires some sort of change in the segment’s identity. This is exactly what the conjoined constraints do, constraints against something in coda position, constraints requiring identity and the rankings between them.

Kirchner (1998) does, however, as shown in (5.2), give the possibility of adding a context to the constraint LAZY, making it possible to account for such a shift. This could be seen as a type of constraint conjunction in itself, but as my analysis shows, a new constraint is not necessary.

Moreover, as Jun (2008) notes, the universal hierarchy in (5.2) above predicts that strident fricatives are more likely to undergo lenition than stops. Kirchner (1998) also states that, “Under this model, then, the strident fricative (i.e. with a sustained partial constriction) emerges as more effortful (65.98) than the corresponding stop (60.99),” (Kirchner, 1998:112). However, this pattern does not reflect what we find in lenition patterns in natural languages. For example, in Tümpisa Shoshone stops spirantize but strident fricatives do not lenite, and in Florentine Italian stops undergo lenition obligatorily while strident fricatives only lenite in fast, careless speech (Kirchner, 1998:102,306).

Lastly, the terms *effort* and *LAZY* are not entirely accurate descriptions of all lenition processes and this may also be a problem for the definition of lenition in general as ‘weakening’ discussed at the beginning of the thesis. If lenition as the weakening of a segment is to be understood as something that requires less effort or as lazy, then we would not expect the lenition of stops to fricative (as the quote from Kirchner above also implies). Producing a fricative involves more muscular control for an accurate articulation than plosives (Ladefoged & Maddieson 1996: 137, Perkell 1997: 352). As Bauer (2008) discusses, this can then not be seen as something that requires less effort or that is lazy yet Spanish lenition involves exactly this process: “Latin vita ‘ life ’>Spanish vida>Modern Spanish viða” (Bauer, 2008:609). The same process is also found in Danish historically, though the [ð] is no longer a fricative but an approximant.

Local conjunction, on the other hand, is able to explain lenition processes without referring to effort or weakening. Certain segmental features are not allowed in certain positions and this is accounted for by combining constraints referring to both.

5.2 Ternary Scales

The second theory within OT that I will discuss with regards to lenition is ternary scales (Gnanadesikan, 1997). In this theory, Gnanadesikan (1997) develops a scale to explain the relationship between different kinds of segments that interact in a single process. For example, she proposes the Inherent Voicing scale, illustrated below, to account for the relationship between voiced obstruents, voiceless obstruents and sonorants:

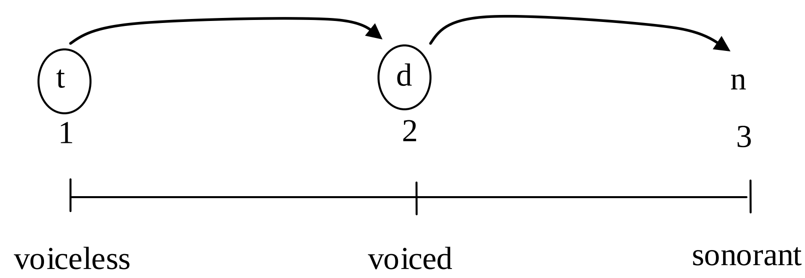
(5.4) The Inherent Voicing Scale (IV) (Gnanadesikan, 1997:1)

Voiceless obstruent, voiced obstruent, sonorant

1 2 3

This scale is used to explain why, in languages such as Irish, a voiceless obstruent becomes a voiced obstruent and a voiced obstruent becomes a sonorant and that in Hungarian a voiceless obstruent in the coda voices before a voiced obstruent in the following onset but not before sonorants (Gnanadesikan, 1997:1). The Irish example is illustrated in (5.5) below.

(5.5) Chain shift in Irish (Gnanadesikan, 1997:3)



This sort of ternary scale thus illustrates a natural, single process, whereas within binary scales two processes are needed to reach the same result (voiceless → voiced and voiced → sonorant).

With regards to lenition, she proposes a Consonantal Stricture scale illustrated in (5.6) below.

(5.6) Consonantal Stricture Scale (CS) (Gnanadesikan, 1997:2)

Stop, fricative/liquid, vocoid/laryngeal

1 2 3

By using OT constraints referring to this scale, it is possible to explain different lenition processes as a single, natural process. Gnanadesikan (1997) proposes the following constraints:

(5.7) Constraints with reference to the CS scale

a. IDENT-ADJ(CS-SCALE): "Given an input segment α and its correspondent output segment β, then α and β must have related values on scale x, where the defined relations are *identity* and *adjacency*. (In other words, the output may not have moved *more than one step* on the scale)" (Gnanadesikan, 1997:78).

b. IDENT[CS-SCALE]: “Given an input segment α and its correspondent output segment β, then α and β have identical values on the CS-scale. (In other words, the output may not have moved on the scale from the input)” (Gnanadesikan, 1997:78).

c. RESIST[X]: “If α is an input segment and β is an output correspondent of α, then if α does not possess a scale value X, then β does not possess X. (Intuitively, an output segment may not take on value X if the corresponding input segment does not possess value X)” (Gnanadesikan, 1997:18).

d. STAY[Y]: “If α is an input segment and β is an output correspondent of α, then if α possesses scale value Y, then β possesses scale value Y. (Intuitively, an output segment may not lose value Y if the corresponding input segment possesses it)” (Gnanadesikan, 1997:18).

The first constraint, IDENT-ADJ(CS-SCALE), prevents outputs from having moved more than one step on the scale (a violation for a jump from 1 to 3) while IDENT[CS-SCALE] prevents any change in the output whatsoever (1 to 2, 2 to 3, etc). The RESIST constraints prevent output segments from taking value X while the STAY constraints prevent output segments from losing value Y. For example, a constraint such as STAY 3 prevents an output segment from losing the value for 3 on the CS-scale, while RESIST 3 prevents an output segment from becoming 3 on the scale. Violations of STAY and RESIST are illustrated below using the Inherent Voicing scale (see above).

(5.8) Violations of STAY and RESIST (Gnanadesikan, 1997:19):

Input	Output	STAY 3	STAY 2	STAY 1	RESIST 3	RESIST 2	RESIST 1
P	B			*		*	
P	M			*	*		
B	P		*				*
B	M		*		*		
M	B	*				*	
M	P	*					*

This tableau shows the first two candidates violating STAY 1 by changing to /b/ and /m/ respectively, thus losing their 1 value. The same goes for candidates three and four and candidates five and six. The first and fifth candidates violate RESIST 2 by changing to /b/ (value 2 on the scale) and the same goes for candidates two and four with respect to RESIST 3 and candidates three and six with respect to RESIST 1.

Gnanadesikan (1997) also proposes universal rankings for these constraints, illustrated below.

(5.9) Universal Ranking of Relative Faithfulness Constraints (Gnanadesikan, 1997:79):

IDENT-ADJ(CS-SCALE) » IDENT[CS-SCALE]

(5.10) Universal Ranking of STAY and RESIST Sub-hierarchies (Gnanadesikan, 1997:19)

a. STAY 3 » STAY 2 » STAY 1

b. RESIST 3 » RESIST 2 » RESIST 1

Thus, by using these constraints and other markedness and faithfulness constraints within OT along with ternary scales, one should be able to explain lenition and chain shifts as single, natural processes. The scales can also introduce a new type of faithfulness, namely that of adjacency. Moving further down the scale incurs more violations. Gnanadesikan (1997) also uses this theory to explain assimilation and neutralization. For a more in depth explanation of ternary scales and examples of analyses done using this theory, see Gnanadesikan (1997).

Why not Ternary Scales?

The ternary scales theory (Gnanadesikan, 1997) does not have the same problem as the effort-based approach has describing chain shifts. The ADJACENCY constraints can prevent moves “too far” down the scale, keeping /t^s/, for example, from moving past [t] to [ð]. However, as we have seen, local conjunction does the same thing without using any scales or adding constraints that then have to refer to such scales. The combination of constraints already well-established in OT explains why segments lenite and where they lenite.

More seriously, though, the ternary scales theory is not as unified as it appears to be. For example, the lenition of the aspirated segments to unaspirated segments is not a move up or down any ternary scale but in the examples of Welsh, these changes are accounted for as a "decrease in length or tension" (Gnanadesikan, 1997:201-02). Thus, the chain shifts in Danish could not be explained as a unified account under this theory but first as a decrease in tension ($t^s \rightarrow t$) followed by an increase on the IV and CS scales ($t \rightarrow ð$). See also Green (2006) for problems explaining Irish and Welsh mutations using ternary scales (though whether those problems are solved by local conjunction is still up for further investigation).

Chapter Six: Analysis implications and lenition in other languages

In this chapter I will discuss the implications of my analysis and the use of local conjunction in OT, not only with regards to lenition, but also other language processes. I will also discuss lenition patterns in other languages and how the Danish data fits in with these processes.

6.1 The implications of using local conjunction

The conjoining of two constraints through local conjunction raises several questions with regards to its use in OT. If a local conjunction is a constraint in Universal Grammar (UG) then it must also be able to apply cross-linguistically. This leads to the question of whether any constraint can combine with any constraint or should there be restrictions? If so, what kinds of restrictions? (This was discussed briefly in chapter three and will be discussed in more detail below). Lastly, it is also important to ask whether local conjunction makes the right predictions for natural languages. Do its rankings predict languages that do not exist?

6.1.1 Restrictions on types of local conjunctions

First, the question of whether there should be restrictions on local conjunctions. As mentioned, this was discussed briefly in chapter three with the discussion of conjunctions yielding violable constraints in some domain (Moreton & Smolensky, 2002:3).

One restriction on local conjunction in general is locality. As Smolensky (1993, 1995, 1997) states, the conjoined constraints must share a common domain. As Moreton & Smolensky (2002) point out, this restriction is actually a part of the definition of local conjunction, as stated in chapter three above and repeated here in (6.1) below. Constraints that are violated within the same domain are worse than when violated in different domains.

(6.1) Definition of local conjunction (Moreton & Smolensky, 2002:1):

If C1 and C2 are constraints, and D is a representational domain type (e.g. segment, cluster, syllable, stem), then (C1 & C2)D, the local conjunction of C1 and C2 in D, is a constraint which is violated whenever there is a domain of type D in which both C1 and C2 are violated. It is used in situations where violations of C1 alone or of C2 alone do not eliminate a candidate, but violations of both constraints simultaneously do.

It is generally agreed upon that some restrictions must apply to the conjoining of two constraints, but which restrictions is still up for debate. Different proposals have been made with regards to restrictions on both the domain and the types of constraints that can be conjoined (McCarthy 1996, Hewitt & Crowhurst 1997, Fukazawa & Miglio 1997, Ito & Mester 1996, Baković 2000, Moreton & Smolensky 2002, Łubowicz 2005). Allowing any constraint to conjoin with any other constraint would result in, not only implausible constraints, but also predictions for languages that do not exist. Also, as discussed in chapter three, some constraint combinations never share a common domain or can never be violated within the same domain (Moreton & Smolensky, 2002).

The analysis in chapter four uses the following types of constraint conjunctions: F&F (IDENT[SG]&IDENT[STOP], see (4.4)), M&M (*[SG]&NOCODA, see (4.4)), F&M (IDENT[STOP]&*[LAB], see (4.10)) and Max&Max (MAX[SG]&MAX-SEG, see (4.24)). I mention the MAX constraints separately from the other faithfulness constraints because the definition of this constraint, prohibiting deletion, limits its ability to conjoin with other constraints. Once a segment is deleted, violating MAX, it cannot, in the same domain, violate any other constraint because it is no longer there. However, it can conjoin to itself because, as illustrated in the above analysis, a segment and a feature can delete within the same domain or two features of the same segment, etc. As mentioned in chapter three, MAX cannot conjoin to DEP or to markedness constraints. A (MAX&M) conjunction never shares a common domain and the same goes for (MAX&DEP).

The definition given in Moreton & Smolensky (2002:1) is the least restrictive, requiring only that two constraints share a common domain to conjoin. Others have suggested more restrictive theories for constraint conjunctions such as Fukazawa & Miglio (1998) and Fukazawa

(1999), requiring that two constraints belong to the same constraint family and respect both locality and phonetic conjoinability (the latter based on McCarthy, 1996). The important restriction here is that two constraints must belong to the same constraint family. That does not fit the analysis of Danish lenition as a M&F conjunction is required to account for the non-lenition of labials in certain words (IDENT[STOP]&*[LAB], see (4.9) - (4.11)), so this theory is too restrictive.

It is also too restrictive for Baković's (2000) analysis of vowel harmony, which requires M&F. However, Itô & Mester (1998) have also argued against M&F conjunctions claiming that unnatural predictions are made with, for example, the conjunction of NOCODA & IO-IDENT[VOI], which, when highly ranked, predicts a voicing contrast in codas only. This is the opposite of what is generally found in the world's languages. Baković (2000) thus argues for the restriction of co-relevance as defined in (6.2) below.

(6.2) Co-relevance (Baković, 2000:35)

A markedness constraint μ and a faithfulness constraint φ are *co-relevant* iff:

a. satisfaction of μ depends in part on the output not containing a particular value of a feature [F], and
b. satisfaction of φ depends on the value of the same feature [F] not having changed in the mapping from input to output.

Thus, a faithfulness violation is the cause of the markedness violation and the local conjunction NOCODA & IO-IDENT[VOI] does not reflect that because whether or not there is a change in [voice] NOCODA remains unsatisfied (Baković, 2005). Itô & Mester (2002) have, however, also proposed M&F conjunctions that do not meet this requirement for their analysis on types of opaque processes.

Fukazawa & Miglio's (1998) restriction on conjunction types turns out to be too restrictive for other analyses as well though, such as Łubowicz's (2002) derived environment effect in Polish, as described in chapter three above. This is illustrated again in (6.3) below.

(6.3) Derived environment effect (Łubowicz, 2005:254)

a. /brɨ**dʒ**+ek/ → brɨ**dʒ**ek
b. /ro**g**+ek/ → ro**ʒ**ek, *ro**dʒ**ek

These data are accounted for by using the M&F conjunction, [*ʤ & IDENT(coronal)]$_{SEGMENT}$, in the ranking [*ʤ & IDENT(coronal)]$_{SEGMENT}$ » IDENT(continuant) » *ʤ (Łubowicz, 2002). Łubowicz (2005) also emphasizes the importance of the locality of conjunction, stating that if the domain is too large, unattested patterns emerge. This is illustrated in (6.4) below with the word as the domain.

(6.4) Unattested prediction (D=word) (Łubowicz, 2005:255)

/ʤem+ik+ek/ → *ʒ e m i ʧ e k ʤemiʧek (actual)

| |

spir *pal*

Łubowicz (2005:255) restricts M&F conjunctions by using *locus of violation* (McCarthy 2003ab, 2004, 2005, McCarthy & Wolf 2005, Riggle & Wilson 2004). Łubowicz (2005) proposes that in order for local conjunctions to be interpretable, each conjoined constraint must have the same locus of violation. The example in (6.4) does not violate the local conjunction [*ʤ & IDENT(coronal)] because the constraint violations are in different locations. This restriction can also be applied to the Danish data. An example such as *tolv* [tˢʌlˀ] ('twelve') violates the constraints *[SG] and NOCODA but satisfies the local conjunction *[SG]&NOCODA because the violations are not in the same location. It is only when the [spread glottis] segment occurs in coda position that this local conjunction is violated (*[kʰa**tˢ**]).

In sum, it is necessary to have some restrictions on types of local conjunctions, though which restrictions need to apply is still up for debate. Locality is extremely important and precise definitions are essential. The Danish analysis is proof in favor of the Moreton & Smolensky (2002) and Łubowicz (2005) restrictions on the domain but does not meet the requirements made by Fukazawa & Miglio (1998), theirs being too restrictive. The proposal of co-relevance is also too restrictive for Danish as the constraints making up IDENT[STOP]&*[LAB] are not co-relevant according to Baković's (2005) definition as stated in (6.2) above.

6.2 Implications of the ranking of Danish LCs

The ranking of the NOCODA conjunctions in Danish, as illustrated in (6.5) below, follows the universal coda markedness hierarchy proposed by Prince & Smolensky (1993) and I propose thus that these constraints are also in a fixed ranking.

(6.5) **Ranking of Danish NoCoda conjunctions:**

*[SG]&NoCoda » *[Stop]&NoCoda » *[approx]&NoCoda

The [spread glottis] feature is the most marked and thus never allowed in the coda. The [stop] feature is only allowed when derived from underlying [spread glottis] segments and [approx] is only allowed when derived from underlying [stop] segments ([ð]) The coda markedness hierarchy is illustrated in (6.6) below with the addition of [spread glottis] stops.

(6.6) **Extended sonority-based coda markedness hierarchy** (based on Prince & Smolensky (1993)**:**

*Coda-t^s » *Coda-t » *Coda-f » *Coda-n » *Coda-r » *Coda-w,j

While the ranking of these constraints may be fixed, the ranking of other constraints in between results in cross-linguistic variation. A language that is always faithful no matter the input will have the relevant faithfulness constraint ranked above the markedness constraint, forcing marked structure to appear in the output.

As mentioned in chapter three, the use of NoCoda conjunctions predicts that languages may avoid marked codas by using epenthesis, deletion or other repair strategies. It has been claimed that this is not the case (Lombardi 2001, Steriade 2001, Blumenfeld 2006), that neutralization is the only strategy used to avoid, for example voiced obstruents in codas. However, as discussed in chapter three, Korean loanword adaptation and second language phonology show that such reparations are in fact used to avoid marked codas (Kang 2003, Iverson & Lee 2006, Flynn 2007).

6.3 Lenition in other languages

In this section I will discuss consonant lenition in other languages and compare them to the data and analysis proposed here for Danish lenition. As mentioned, lenition in syllable-final position is not as common as it is in other positions such as word-final or intervocalic. Kirchner (1998) lists a number of lenition processes in natural languages in different positions and I borrow the table for coda position lenition with his references in (6.7) below.

(6.7) Lenition in coda position (Kirchner, 1998:9)

Language	Reference	Description
Arbore	Harris 1990	Debuccalization of coda ejectives
Hausa	Klingenheben 1928	b,d,g → w,r,w in coda
Quechua	Whitley 1978	k.q → x,χ in coda
Toba Batak	Hayes 1986	p,t,k → ʔ in coda
Uyghur	Hahn 1991	k,g → x, q → χ in coda

I will discuss some of these coda lenition processes as well as coda lenition in different dialects of Spanish. As I will describe in more detail below, some Spanish dialects also lenite in onset position. This tends to result in different output forms than the lenition processes taking place in the coda due to the coda conditions restricting certain lenited forms from appearing in codas.

6.3.1 Hausa lenition

In Standard Hausa, all syllable-final obstruents undergo lenition as illustrated in (6.8) below. The dorsal and labial obstruents in Hausa are /k g ƙ b ɓ f/ and lenite to [u] ([w]), the coronals are /t ts d ɗ s z/ and lenite to [r̃] (Newman, 2000). The sonorants can all occupy coda position (Newman, 2000:404).

(6.8) Obstruent lenition in Hausa

a. Dorsal lenition in Hausa (Newman, 2000:230)

i.	tala**u**cī̀	*povery*	<*tala**k**-cī̀, cf. talàkà	*common man*
ii.	ha**u**ni	*left*	<*ha**g**ni, cf. *the doublet* hagu(n)	
iii.	ha**u**rḕ	*tooth*	<*ha**ƙ**rḕ, cf. haƙōrī	*tooth/teeth*
iv.	wā̀tà**u**	*that is to say*	<*wā̀tà**k**, cf. wā̀tàkà	*WH*

b. Coronal lenition in Hausa (Newman, 2000:413)

i.	fa**r̃**kē	*trader*	<*fa**t**kē, cf. pl. fatā̀kē	
ii.	ma**r̃**màtse	*push, rep.*	< ma**ts**ā̀	*push*
iii.	ka**r̃**kàɗā	*beat, rep.*	<*ka**ɗ**kàɗā, cf. kaɗā̀	*beat*
iv.	ma**r̃**maza	*very quickly*	< ma**z**a	*quickly*

c. Labial lenition in Hausa (Newman, 2000:404)

i.	à**u**ku	*happen*	<a**f**ku
ii.	a**u**dùgā	*cotton*	<a**b**dùgā

Ignoring the exceptions for brevity (sometimes /s/ and /z/ do occupy syllable-final position and sometimes rhotacism does not occur word-finally), the data show that Hausa prohibits obstruents from coda position. These can occupy onset position however as illustrated by *kar̃kàɗā*, *audùgā* and *bir̃ini*. These processes can be explained by a high-ranked *[OBS]&NOCODA constraint in Hausa and IDENT[SON] constraints ranked above the relevant markedness constraints prevent the sonorants from leniting. This is illustrated briefly in the tableau below.

Tableau for Hausa lenition

	*[OBS]&NOCODA	IDENT[SON]	*[SON]&NOCODA	IDENT[OBS]
1. /talakcì̄/ ☞talaucì̄		*		*
talakcì̄	*!			
2. /sarki/ ☞sarki			*	
sauki		*!		

6.3.2 Quechua lenition

In Quechua, the dorsal stops /k/ and /q/ lenite to the dorsal fricatives /x/ and /χ/ as illustrated in (6.9) below (Bills et al., 1969).

(6.9) Quechua dorsal lenition (Bills et al., 1969:xix)

a. /ʎi**k**ʎa/ → [ʎi**x**ʎa] *small shawl*

b. /ʧi**q**nin/ → [ʧi**χ**nin] *he hates*

Due to limited access to data, these two examples are the only ones I could come across. Kirchner (2000) also mentions that lenition occurs in intervocalic and word-final positions but the result can be [ɣ] and deletion, respectively. However, a ban on dorsal stops in coda position seems to be relevant at any rate, suggesting high-ranked F&M constraints ruling out the lenition of labials and coronals, i.e. *LAB&IDENT[CONT] (perhaps even a higher ranked *[STOP]&NOCODA, though it seems to be different depending on dialect whether labials and coronals are permitted in coda position). This is like what we found in Danish for the non-lenition of labials, see (4.10). This is illustrated in the tableau below with nonce words for candidates 2 and 3 for lack of data for labials and coronals.

Tableau for Quechua lenition

	*[LAB] & IDENT[CONT]	*[COR] & IDENT[CONT]	*STOP & NOCODA	IDENT[DORS] & IDENT[CONT]	IDENT[CONT]
/ʎi**k**ʎa/ ☞ ʎi**x**ʎa				*	*
ʎi**k**ʎa			*!		
/lip/ ☞ lip			*		
liɸ	*!				*
/lit/ ☞ lit			*		
liθ		*!			*

6.3.3 Uyghur lenition

In Uyghur, dorsals and affricates spirantize in coda position as illustrated in (6.10) below.

(6.10) Uyghur lenition (Hahn, 1991:89)

a. /ʧ/ → [ʃ] : küʃlük *powerful* aʃquʃ *a/the key*
b. /ʤ/ → [ʒ] : wiʒdan *a/the conscience* wäʒ *a/the reason*
c. /k/ →[x̧] : mäx̧täp *a/the school* bäx̧ tar *very narrow*
d. /g/ → [γ] : täγdim *I reached* bäγ *a/the beg*
e. /g/ → [χ] : išäχtin *from a/the donkey* künlüχ *a/the parasol*
f. /q/ → [χ] : uχturuš *a/the notification* näχpul *the cash*
g. /ɢ/ → [ʁ] : yaʁdin *from (the) oil* taʁ *mountain*
h. /ɢ/ → [χ] : tamaχnin *of (the) food* tuzluχ tamaq 'salted food'

There are also some exceptions to these lenition processes (as the data also show) but generally, the data show that dorsals are prohibited from coda position (different triggers may cause the same underlying segment to lenite to different output forms). Labials and coronals appear relatively freely in all positions (see Hahn, 1991). This suggests high-ranked F&M constraints again like we had in Hausa.

Tableau for Uyghur lenition

	*[LAB] & IDENT[CONT]	*[COR] & IDENT[CONT]	*[STOP] & NOCODA	*[DORS] & IDENT[CONT]
1. / mäktäp / ☞ mäẋtäp				*
mäktäp			*	

6.3.4 Spanish lenition

Lenition processes vary in different dialects of Spanish. I will concentrate on the syllable-final lenition processes here but both syllable-initial and/or intervocalic lenition also take place in some dialects.

Chilean Spanish

In Chilean Spanish, stops are banned from coda position and so vocalize as illustrated in (6.11) below.

(6.11) Stop lenition in Chilean Spanish (Piñeros, 2001:164):

a. Coronals /t d/ → [i̯]

i. adkirir → a[i̯]kirir *to acquire*

ii. etniko → e[i̯]niko *ethnic*

b. Labials /p b/ → [u̯ i̯]

i. absurdo → a[u̯]surdo / a[i̯]surdo *absurd*

ii. kaptura → ka[u̯]tura / ka[i̯]tura *capture*

c. dorsals /g k/ → [u̯ i̯]

i. dogma → do[u̯]ma / do[i̯]ma *dogma*

ii. korekto → kor[u̯]to / kor[i̯]to *correct*

This data is similar to the Danish case, though in Danish only /k/ and sometimes /p/ vocalize. This dialect of Spanish also lenites voiced onset stops to the approximants [β̞ ð̞ ɣ̞] when preceded by another continuant, but these segments are not allowed in syllable -final position (Piñeros, 2001). *[STOP]&NOCODA and *[APPROX]&NOCODA must be ranked higher than the relevant faithfulness constraints for this dialect. Also a high-ranked *VOISTP constraint is necessary to force lenition in onsets, though not higher-ranked than the constraints controlling the environment for onset lenition. For example, an AGREE constraint for sonorants. The F&F constraint used to keep Danish [sg] stops from leniting too far would be low-ranked here, since the stops do in fact lenite too far in codas (*_g$_\sigma$ → [ɣ̞] but _g$_\sigma$ → [u̯]). This is illustrated briefly in the tableau below.

Tableau for Chilean Spanish lenition

	*[STOP]&NOCODA	*[APPROX]&NOCODA	IDENT[STOP] & IDENT[CONS]
/ adkirir/ ☞ai̯kirir			*
Adkirir	*!		
að̞kirir		*!	

North-central Peninsular Spanish

In this dialect, voiced coda stops spirantize and devoice while voiceless coda stops only spirantize when followed by a voiced consonant (Morris, 2000). This is illustrated in (6.12) below.

(6.12) Spirantization and devoicing (Morris, 2000:1-2)

a. Voiced coda stops

i.	abdicar	[aɸ.ði.kar]	*abdicate*
ii.	admirar	[aθ.mi.rar]	*admire*
iii.	zigzag	[θix.θax]	*zigzag*

b. Voiceless coda stops

i.	apto	[ap.to]	*apt*
ii.	etnico	[eθ.ni.ko]	*ethnic*
iii.	frack grande	[frax.ɣran.de]	*large tuxedo*

Morris (2000) provides an OT account for these processes using local conjunction. A high-ranked *VOIOBS&NoCoda forces leniton of the voiced stops to voiceless fricatives, while a constraint requiring stops to be assimilated for voice forces voiceless stops to spirantize only when followed by a voiced consonant. Since the voiceless segments cannot voice to assimilate (at the risk of fatally violating *VoiObs&NoCoda) they become voiceless fricatives instead. This is illustrated briefly in the tableau below (though see Morris (2000) for a full analysis).

Tableau for North-central Peninsular Spanish syllable-final lenition

	IDENT[STOP] & IDENT[CONS]	*[VOIOBS]&NOCODA	IDENT[STOP]
/ abdicar/ ☞ aɸðikar			*
abðicar		*!	
aβðicar		*!	
aiðicar	*!		

North Rustic Dominican Spanish (NRDS)

In this dialect, all syllable-final segments, obstruents and sonorants, lenite. Most vocalize, leaving mostly open syllables, though some become [h], [ŋ] or nasals homorganic to the following stop/affricate (Piñeros, 2002). This is illustrated briefly in (6.13) below (see Piñeros, 2002 for more in depth data).

(6.13) NRDS syllable-final lenition (Piñeros, 2002:4-8)

a. Liquids
   i. /kortar/ [koi̯.tai̯] *to cut*
   ii. /kulpa/ [kui̯.pa] *blame*
b. Nasals
   i. /kanpo/ [kam.po] *field*
   ii. /sinko/ [siŋko] *five*
   iii. /konfiansa/ [kõŋfjãŋsa] / [kõfjãsa] *trust*
c. Fricatives
   i. /pasto/ [pato] / [pahto] *grass*
d. Stops
   i. /absolute/ [asoluto] / [ai̯soluto] *absolute*
   ii. /etniko/ [eniko] / [ei̯niko] *ethnic*

Nasals assimilate to the following stop or affricate, otherwise they surface as [ŋ]. All non-assimilating nasals and obstruents can also delete but the liquids and assimilating nasals cannot. Piñeros (2002) accounts for the surfacing coda [h]s [ŋ]s and other nasals with their lack of place features. Since the surfacing nasals share the same place features as the following stop/affricate, they are parsed by the syllable onset. He claims [h] has no place features and [ŋ] shares features with the preceding vowels (Piñeros, 2002:2). Piñeros accounts for these data using the alignment constraint interpretation of the Coda Condition (Itô & Mester, 1994, 1999). However, such an analysis runs into the same problems as positional licensing (see (3.5) above) with regards to the too-many-solutions problem, though it is not obvious in the Spanish data since epenthesis is not the solution used to respect coda conditions. However, NOCODA conjunctions can do the job as illustrated in the tableau below (Piñeros assumes that [h] is not an obstruent) (see Piñeros (2002) for a more detailed analysis with regards to other possible output candidates).

Tableau for NRDS syllable-final lenition:

	*[OBS] & NOCODA	IDENT [OBS]	MAX-SEG	*[SON] & NOCODA
1. /direkto/ a. [di.rek.to]	*!			
☞b. [di.rei̯.to]		*		
☞c. [di.re.to]			*	
2. /kanasta/ a. [ka.nas.ta]	*!			
☞b. [ka.nah.ta]		*		
☞c. [ka.na.ta]			*	
3. /alarma/ a. [a.lar.ma]				*!
☞b. [a.lai̯.ma]				
c. [a.la.ma]			*!	

6.3.5 Summary

While the Danish lenition process may seem to be a somewhat rare case at first glance, the above data show that, in fact, the coda conditions found in Danish are very similar to those found in other natural languages in different language families. These languages also illustrate similar repair strategies, leniting to less marked, more sonorous segments. However, the fixed ranking of NOCODA conjunctions with different FAITH constraints ranked in between also accounts for the *different* types of coda lenition processes, such as vocalization, spirantization, deletion and combinations of these. We also saw that the F&F-type constraint used to prevent over-leniting in Danish, was low-ranked for Chilean Spanish, thus allowing for over-lenition.

I have chosen the above cases of lenition because they pattern with the Danish data presented in this thesis. Another possibility suggested by these constraints is the lenition of syllable-final sonorants with the preservation of syllable-final obstruents. Such cases do in fact exist and are illustrated in different dialects of English with r-vocalization (Lubov, 1966) and l-vocalization (Ash, 1982). For example, in varieties spoken in southern England, we find pronunciations such as *feel* [fi:w] and *table* [tabu] (Britain & Johnson, 2003:1) or in RP *near* [niə], but no weakening of syllable-final obstruents. Thus, an analysis with the ranking IDENT[OBS] »*OBS&NOCODA »*SON&NOCODA » IDENT[SON] is a proven possibility.

I have been unable to find any clear instances of syllable-final strengthening. It has been claimed that, in some dialects of Spanish, coda taps, /ɾ/, strengthen to trills [r], /maɾ/ → [mar] *'sea'* (Roca, 2003). Whether this is actually a strengthening, though, is debatable and it has also been argued that the surfacing trill is actually from underlying, geminate taps (Bradley, 2001), in which case this is may be considered a weakening.

Chapter Seven: Overall summary

In this thesis, I have presented data for different coda conditions in Danish, namely deaspiration, stops becoming approximants and vocalization. I have shown that these processes can be accounted for using local conjunction with optimality theory. In chapter three, I discussed the differences between positional faithfulness, positional licensing and positional markedness and concluded that positional markedness is the most ideal way of dealing with coda conditions. Positional markedness allows for a number of repair solutions, such as neutralization, epenthesis, deletion, metathesis, etc. I have shown that this theory does not predict too many solutions but in fact predicts those repairs found in languages cross-linguistically.

In chapter four, I used positional markedness constraints, such as *[SG]&NOCODA, to account for the coda conditions found in Danish and related these types of constraints to the coda markedness hierarchy (Smolensky, 1993), and assumed that their ranking is fixed in the same way.

In chapter five, I discussed why other possible alternatives to local conjunction are inadequate for describing the lenition processes in Danish. The effort-based approach was shown to make incorrect predictions, while the ternary scales theory was unable to provide a unified account of lenition processes.

Finally, in chapter six, I discussed the implications of my analysis and related it to other languages. I have shown that the fixed ranking of NOCODA conjunctions combined with FAITH constraints ranked in between can account for a number of different coda lenition processes cross-linguistically.

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