Voicing in **Contrast**

Acquiring a Second Language Laryngeal System

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Ellen Simon
Ghent, January 2010

Symbols and abbreviations

/ /	=	underlying form
[ ]	=	surface form
→	=	‘is realised as’
#	=	morpheme boundary
# #	=	word boundary
σ	=	syllable
ø	=	(laryngeally) unspecified
>>	=	‘outranks’
*	=	‘illicit’
C	=	consonant
DEL	=	deletion
DLE	=	Dutch Learner English
EF	=	East-Flemish
FIN	=	final devoicing (final laryngeal neutralisation)
GLOT	=	glottal replacement
L1	=	first language
L2	=	second language
O	=	obstruent
OCP	=	Obligatory Contour Principle
OT	=	Optimality Theory
PVA	=	progressive voice assimilation
R	=	sonorant
RP	=	Received Pronunciation
RVA	=	regressive voice assimilation
UNM	=	unmodified (surface form is the same as underlying form)
V	=	vowel
VOT	=	Voice Onset Time
WF	=	West-Flemish

Preface
What this book is about

Situating this study and its objectives

This book provides a study of the acquisition of the English consonantal voicing system by native speakers of Dutch. It focuses on differences between the phonological systems of Dutch and English with regard to one aspect, voicing contrasts. On the one hand, Dutch and English both make use of a two-way laryngeal contrast and distinguish between voiced and voiceless consonants. Thus both languages make a distinction between say *big* and *pick* (English) and *biggen* ('piglets') and *pikken* ('to pick') (Dutch). On the other hand, there are important differences in the way voicing is realised in the two languages, or more generally in the way the laryngeal systems operate. For example, one obvious difference is that voiceless stops in English are aspirated in most positions (such as the first consonant in the English name *Pete*), while they are unaspirated in Dutch (such as the first consonant in the Dutch name *Piet*). Another example is that utterance-initial 'voiced' stops are in fact often phonetically voiceless in English, while they are usually produced with voicing in Dutch. The different realisations of the initial consonants in the English word *better* and the Dutch word *beter* illustrate this difference. Consequently, native speakers of Dutch learning English as a foreign language have to acquire knowledge of new rules and hence of another laryngeal system. This book takes a close look at the laryngeal systems in Dutch and English and examines what happens in the production of English by speakers of Dutch. As such, the study is embedded in several strands of research: contrastive phonetics and phonology, second language phonology and laryngeal phonology. It aims to contribute to all three areas in addressing some crucial questions which have arisen from previous research. Further, by adding more empirical evidence the book hopes to broaden the perspective on and deepen our insight in phenomena which have so far been only partly explored.

Firstly, the study is embedded in research on contrastive phonology. Relatively few studies have contrasted the phonological system of Dutch with that of English in any detailed way. Exceptions include Gussenhoven & Broeders (1976; 1997) and Collins & Mees (1999), both of which compare the sound systems of Netherlandic Dutch and English and provide information for the native speaker of Dutch learning the pronunciation of English. Collins & Vandenbergen (2000) is a practical English pronunciation guide for native speakers of Dutch in the Dutch-speaking part of Belgium. As these studies take an all-encompassing perspective, however, they devote little attention to the details of any particular phenomenon. The present study is the first to compare in depth one specific aspect of the phonological systems of these two languages. By examining the realisation of the voice contrast in three different positions (i.e. utterance-initial, utterance-final and word-final preceding different segments) as well as assimilation processes in both languages it adds to our knowledge of how seemingly similar systems in closely related languages are nevertheless very different in the way they operate. Aspects of the voice systems have been examined in monolingual studies, both of Dutch and of English[1]. However, despite the abundance of literature on the topic, a comprehensive contrastive study of the voice systems in English and Dutch is lacking. Drawing partly on those monolingual studies and partly on new empirical data this book contributes to contrastive linguistics, in particular contrastive phonology. Where the relevant information is available this study also discusses the wider implications for typological research.

Secondly, the book examines the voicing contrasts as realised in the English of native speakers of Dutch. As such, it is also embedded in research on second language, or interlanguage, phonology. The notion of 'interlanguage' – a term coined by Selinker in 1972 – arose from the awareness that the language system of second language speakers is a linguistic system in its own right rather than just a deficient form of the target language (see also White 2003:19 for a definition). An interlanguage is shaped by three main influences: the target language (the language that the speaker aspires to acquire), the source language (the speaker's mother tongue) and universal principles of markedness. On the one hand, this means that 'transfer' from the source to the target language or, more generally, cross-linguistic influence, will be responsible for certain features in the interlanguage. There is indeed a great deal of evidence that cross-linguistic influence takes place in second language phonology and more specifically a number of perception studies have provided evidence on transfer of voicing contrasts[2]. The present study adds to this field of research by looking at production (rather than perception).

On the other hand, some phenomena in interlanguages cannot be attributed to cross-linguistic influence, but arise from general principles of markedness. The Markedness Differential Hypothesis (Eckman, 1977) states that those areas in which the source and target languages differ will be most difficult to acquire (an idea which lay at the basis of the Contrastive Analysis Hypothesis) but also that the degree of difficulty correlates with the degree of markedness: if a structure is more marked in the target language than in the source language, it will be difficult to acquire. The Markedness Differential Hypothesis was later reformulated as the Interlanguage Structural Conformity Hypothesis (cf. Eckman, 1984), which states that "[t]he universal generalizations that hold for the primary languages hold also for interlanguages" (Eckman, 1991: 24). Several studies have provided empirical evidence for the influence of general principles of markedness on interlanguage phonology[3] and the present study examines the extent to which the principle can account for some of the empirical findings in Dutch Learner English.

A third question arising in the field of interlanguage studies is the distinction between competence ('knowledge') and performance ('mastery'). Lakshmanan & Selinker write that:

> "[a]s in the case of the linguistic competence of child first language (L1) learners and adult native speakers, interlanguage competence cannot be examined directly. Instead, information about the nature of interlanguage competence can only be derived indirectly, through an examination of interlanguage performance data" (Lakshmanan & Selinker, 2001: 393).

The interpretation of phonological findings in interlanguage is not always easy and the present study also shows that deriving information about underlying – in this case phonological – representations from 'performance data' is a complex matter. If a particular surface (or output) form in the interlanguage of a speaker does not correspond to a form in the target language, this may be because the speaker's representation differs from the representation in the target form (and hence may be the result of transfer from the mother tongue) or because the output form obeys more general principles of markedness (and hence may be the result of the learner's access to aspects of Universal Grammar). Another possibility is that the learner has acquired the phonological representation of the target language, but for some reason – for instance because the structure is articulatorily complex – has not succeeded in phonetically implementing this representation. It is well known, for instance, that the successful phonetic implementation of an acquired phonological contrast may depend on the degree of attention paid to form (cf. e.g. Archibald, 1998: 7).

Thirdly, this study builds on and contributes to specific research on laryngeal phonology. The central aim, which is a description of the laryngeal representations in the English interlanguage of native speakers of Dutch, raises at least three subsidiary questions.

The first of these questions is whether laryngeal features are unary or binary. Features which are unary have only one value: the feature is either present or it is not and the contrast is thus privative. Binary features, on the other hand, have a positive and a negative value. Arguments in favour of a unary interpretation of laryngeal features have been put forward by – among others – Cho (1999) and Lombardi (1995b, 1996). Proponents of a binary interpretation include Wetzels & Mascaró (2001). The various arguments in this debate are examined in the present study.

The second subsidiary question which is explored in this book is whether there is a single feature ([voice]) involved in both Dutch and English, or whether [voice] is operative only in Dutch and an additional feature, namely [spread glottis], is found in English. Arguments in favour of the former view are given by Kingston & Diehl (1994), the latter opinion has been defended by Iverson & Salmons (1995, 1999). Evidence for the presence of a feature [spread glottis] in English is provided by Kager et al. (2007) and by Honeybone (2005).

The third question concerns the possible similarities and differences between first and second language acquisition of laryngeal contrasts. A number of recent studies have examined the first language acquisition of voicing contrasts[4]. In addition, two studies (Flege & Eeftink, 1987; Broersma, 2005) have thrown light on the acquisition of the English laryngeal system by native speakers of Dutch. However, Flege & Eeftink (1987) examined only the production of alveolar /t/, and did not include the other places of articulation or the voiced counterpart /d/, and Broersma (2005) examined perception rather than production. The present study aims to add to our knowledge by looking at interlanguage production. In addition, it attempts a more comprehensive investigation than previous studies. Both Kager et al. (2007), Kerkhoff (2004, 2007) and Van der Feest (2007) restrict their attention to the acquisition of voice contrasts in stops. Fricatives are omitted because voiced fricatives are often phonetically voicelesss in most varieties of Dutch and the contrast between voiced and voiceless fricatives has disappeared in some regions of the Netherlands[5]. However, the contrast between voiced and voiceless fricatives is still relatively strong in Belgian varieties of Dutch, and the present study examines such varieties with a view to contributing information in this area.

Data and methodology: a focus on natural, non-standard speech

The empirical data were gathered from native speakers of two distinct regional varieties of Dutch as spoken in Flanders (Belgium): West-Flemish and East-Flemish. These regiolects were chosen for a specific purpose: they differ in one particular assimilation process, viz. the realisation of final fricatives before onset sonorant consonants. These fricatives can be voiced in West-Flemish, but not in East-Flemish or in Standard Dutch. The data allow us to examine differences, if any, in the informants' realisations of assimilation in English. It needs to be emphasised then that the term *Dutch* in the context of the informants' native language refers to one specific regiolect, which is their vernacular, or most natural language variety, which is sometimes quite distinct from Standard Dutch.

A second decision was to base the investigation on two types of data: the main part of the data consist of natural running speech (in the form of conversations), but additional reading tests were carried out. The former is characterised by minimal attention paid to form, while reading tasks tend to activate ample attention. A detailed description of the method of collecting the data is provided in Chapter 3.

Summing up, this book is the first to provide a detailed description of voicing in Dutch Learner English and to discuss and compare in depth different theoretical accounts of laryngeal phonological processes for their value in explaining the data. Rule-based and constraint-based accounts will be combined to describe typological differences between Dutch and English and to explain interlanguage patterns. Its contribution to the field of phonology goes beyond its analysis of a specific corpus. Learner language systems (including learner phonology) can provide crucial information about the way in which speakers apply language specific rules as well as universal principles. By combining analytical detail with theoretical discussion this book aims to contribute to cross-linguistic phonology in general.

Audience

As the present work is embedded in different strands of research – contrastive phonology, second language phonology and laryngeal phonetics and phonology – it is relevant to students and researchers interested in any of these fields. Although the book focuses on varieties of Dutch and English, it also makes reference to a great many other languages and language varieties (including Catalan, Japanese, German, Kikuyu, Polish), and parallels can be drawn from Dutch to any other 'voicing language' (such as French and Spanish) and from English to any other 'aspirating language' (such as German and Swedish), though there may of course be differences in the specific realisations or assimilation patterns. Moreover, the book deals with general theoretical problems such as how information about laryngeal representations can be deduced from production data and how sonorant consonants are able to trigger voice assimilation, which are of interest to scholars working on acquisition and/or theoretical phonology.

The empirical data on which the book is based are drawn from a database of Dutch and Dutch Learner English conversational speech, specifically compiled for this study. The compilation of the database, the acoustic analyses and the statistical measurements of interrater agreement are explained in detail and the book will thus also be of interest to anyone who wants to compile and/or analyse a spoken corpus. A number of screenshots from *Praat* (Boersma & Weenink, 2009) illustrate how information can be deduced from waveforms and spectrograms.

The book is accessible to anyone with a background in linguistics. A basic knowledge of rule-based frameworks, such as standard generative theory, and constraint-based frameworks, such as Optimality Theory, may be required to reach a full understanding of some issues, though the main claims needed to follow the discussion are always summarized.

Outline of the book

Chapter 1 discusses the differences between the Dutch and English voice systems from a phonetic point of view. Chapter 2 sketches the scene of laryngeal phonology in general and provides a phonological account of the laryngeal representations in Dutch and in English. It deals in some depth with the notion of markedness, which plays a significant role in the remainder of the study. Chapters 1 and 2 give descriptive accounts of Dutch and English on the basis of existing literature and tackle theoretical issues arising from these accounts. In Chapter 3 the methodology used in this study is explained. This chapter provides details about the participants and the set-up of the recordings and more information is given about the data, the transcription process, the coding system and the database. In Chapters 4 to 10, the data are analysed. Chapter 4 contains a discussion of aspiration and prevoicing in DLE; Chapter 5 deals with the production of fricatives. Chapters 6-10 then discuss various neutralisation and voice assimilation processes which occur in (some varieties) of Dutch, but not or not to the same extent in English. In Chapter 11 the results are brought together. This chapter aims to arrive at a characterisation of the representations and the laryngeal systems of Dutch Learner English. Chapter 12 formulates conclusions and offers suggestions for further research. A language index, a list of references and an appendix with full information on the participants and the tasks are added at the end of the book. An audio-CD with examples from the Dutch and Dutch Learner English corpora can be found in a sleeve attached to the back cover.

Notes

1. Voice assimilation rules in Standard Dutch have been discussed by – among many others – Eijkman (1937), Blancquaert (1964), Van den Berg (1964), Trommelen & Zonneveld (1979), Zonneveld (1982, 1983), Berendsen (1983), and more recently by Booij (1995a) and Ernestus (1997, 2000). Assimilation rules in Dutch and Flemish dialects have been investigated by Leenen (1954), Stroop (1986), De Schutter & Taeldeman (1986) and Weijnen (1991). Examples of phonetic (or more phonetically oriented) studies on laryngeal aspects in Dutch are Slis (1985), Slis & Cohen (1969), Jansen (2004, 2007), Van Alphen (2004), Van de Velde, Gerritsen & Van Hout (1995) and Kissine, Van de Velde & Van Hout (2005). Aspects of the voice system in English have been discussed by – among others – Gimson (1962) (revised by Cruttenden, 2001), Klatt (1975), Flege (1982), Haggard (1987), Baum & Blumstein (1987), Docherty (1992), Pirello et al. (1997), Smith (1997) and Jansen (2004).

2. See e.g. Eliasson, 1984; Weinberger & Ioup, 1987; Archibald, 1998). A number of investigations have further shown that speakers transfer Voice Onset Time values from their mother tongue into a second language. Examples are Suomi (1980) on the production of English stops by native speakers of Finnish, and Flege et al. (1998) on the production of English stops by native speakers of Spanish. The role of transfer in the perception of voice contrasts has been examined by, among others, Flege & Eeftink (1987) on the perception of English stops by native speakers of Dutch, and Curtin, Goad & Pater (1998), together with a follow-up study by Pater (2003) on the perception of the Thai voice contrast by native speakers of English.

3. See e.g. Broselow et al. (1998) on the realisation of final obstruents in English by native speakers of Mandarin Chinese. Mandarin Chinese lacks obstruent codas, and native speakers who are learning English use a variety of repair strategies. Broselow et al. (1998: 274-275) note that devoicing of final obstruents in the English speech of Mandarin speakers cannot be the result of influence of either the source language or the target language and argue that it must be the result of what is termed ‘the emergence of the unmarked’. This term is used in Optimality Theory (cf. McCarthy, 2002: 129-134) to refer to the situation in which low-ranked markedness constraints become active because the higher ranked constraints are not able to select an optimal output candidate.

4. The laryngeal representations of Dutch and/or English have recently been discussed by Iverson & Salmons (1995, 2003), Ernestus (2000), Iverson & Ahn (2004) and Kager et al. (2007). Kager et al. (2007) also examine the acquisition of the Dutch, German and English laryngeal stop contrasts by children acquiring these languages as their mother tongue. The acquisition of voicing alternations by L1 Dutch children has been investigated by Kerkhoff (2004).

5. See Kerkhoff, 2004, footnote 2; Kager et al, 2007: 6.

Chapter 1

Voicing in contrast: The case of Dutch and English

1.1. Introduction

This chapter looks at the phonetic differences between the laryngeal systems of Dutch and English. It begins with a brief discussion of the phoneme inventories of the two languages. Where they are relevant, regional differences in the realisation of the Dutch phonemes are mentioned. Because of its central relevance to the description of laryngeal phenomena a very brief account is given of the physical mechanism behind the production of laryngeal sounds. The main focus of the chapter is on the two major laryngeal differences between Dutch and English, i.e. aspiration and prevoicing, and on two acoustic cues signalling voice contrasts in these two languages. Finally, Dutch and English are placed within larger language groups with whose members they share the laryngeal characteristics discussed in this chapter.

1.2. The phoneme inventories of Dutch and English

Phoneme inventories can be structured according to different criteria. As the present study deals with the production rather than the perception of sounds, the phonemes of English and Dutch – presented in the phoneme inventories in Table 1 – are classified according to articulatory criteria. From this point of view a major division is made between obstruents and sonorants. Sonorants are defined by Chomsky & Halle as "sounds produced with a vocal tract configuration in which spontaneous voicing is possible" (1968: 302). In contrast to sonorants, obstruents are not produced with spontaneous voicing.

		Dutch	English
obstruents	stops (affricates)	p / b t / d k / (g)	p / b t / d k / g tʃ / dʒ
	fricatives	f / v s / z x / ɣ ɦ	f / v s / z ʃ / ʒ h θ / ð
sonorants	nasals	m n ŋ	m n ŋ
	liquids	l r or ʀ	l r
	glides	j w	j w
	vowels: monophthongs diphthongs	 ɪ ɛ ɑ ɔ ʏ ə i u yː aː eː øː oː ɛ^{ɪ} œ^{y} ɑ^{ʊ}	 ɪ e æ ɒ ʌ ə ʊ iː uː ɑː ɔː ɜː eɪ əʊ aɪ ɔɪ aʊ ɪə ʊə ɛə (or ɛː)

Table 1. Phoneme inventories of (Belgian) Dutch and English (adapted from Verhoeven, 2005: 243, 245 and Collins & Mees, 1999: 12, 14).

Table 1 shows that English and Dutch have the same stops or plosives, apart from the velar plosive /g/, which only occurs in loan words in Dutch (e.g. *goal*) and is often replaced by a voiced velar fricative /ɣ/, especially in southern varieties of Dutch, spoken in the south of the Netherlands and in Flanders. The velar plosive [g] also occurs as the result of voice assimilation, in words such as *zakdoek* ('handkerchief'), in which the underlying /k/ is realised as [g] under the influence of the following voiced stop [d] (/ˈzɑkduk/ is thus realised as [ˈzɑgduk]). English has two affricates /tʃ/ and /dʒ/, which do not exist as phonemes in Dutch, though they occur in non-native words, such as *jeep* [dʒip] and *chip* [tʃɪp] (Booij, 1995a: 7). Collins & Mees (1999: 201) transcribe these sounds in Dutch as /tj/ [tɕ] and /dj/ [dʑ] and note that they can also occur in native Dutch /tj/ sequences, both within words, as in *praatje* ('talk'), and across word boundaries, as the result of assimilation, as in *praat je* (lit. 'talk – you'; 'do you talk').

Both Dutch and English have the fricative phonemes /f, v, s, z/. In addition to these four, Dutch also has two velar fricatives /x/ and /ɣ/. Whereas most speakers in the Netherlands have a velar or even uvular realisation of [x], speakers of Belgian Dutch usually produce a palatal [ç]. It should, however, be noted that the voiced/voiceless distinction in Dutch fricatives is much weaker than in stops, since voiced fricatives are often phonetically voiceless in all contexts[1]. The regional distribution of the different realisations can be found in the maps of the *Fonologische Atlas van de Nederlandse Dialecten* (FAND[2]).

The fricative phoneme /h/ occurs both in Dutch and in English. Whereas in English it is only voiced when occurring between voiced sounds, it is usually realised with voice in all contexts in Dutch, as /ɦ/ (Collins & Mees, 1999: 148). In most regional varieties of Belgian Dutch (in East- and West-Flanders and the Brabantine area) /h/ is frequently elided, as in, for instance, *hand* (ditto), which is pronounced as [ɑnt]. In West-Flemish and some western varieties of East-Flemish, /h/ often serves as a substitute for the fricative /ɣ/. Collins and Mees (1999: 192) illustrate this by means of the words *hoed* ('hat') and *goed* ('good'), which in these regiolects are realised as, respectively, [ut] and [ɦut].

English also has two postalveolar fricatives /ʃ/ and /ʒ/, which are absent in Dutch, though they again occur in loan words, such as *chique* (sic) [ʃik] and *genre* [ˈʒɑ̃rə]. The two interdental fricatives, /θ/ and /ð/, which occur in English, are absent in Dutch.

The same sonorant consonant phonemes occur in Dutch and in English: three nasals (/m,n,ŋ/), two liquids (/l,r/) and two glides (/j,w/). However, the actual realisations of these phonemes differ not only in the two languages but also in different regional varieties of English and Dutch. For example, English /l/ has three important allophones: a clear [l] before vowels and /j/ (as in *million* [ˈmɪljən] and *lip* [lɪp]), a dark variant [ɫ] before consonants or a pause (as in *milk* [mɪɫk]) and a phonetically voiceless [l̥] after initial /p/ or /k/ (as in *clean* [kl̥iːn]). Dutch has a similar distribution for clear and dark /l/, but does not have a voiceless allophone after /p/ or /k/. Another example is /r/, which has different realisations in regional varieties of Dutch, including an alveolar thrill [r] ('tonguetip-/r/'), which is the most usual pronunciation in the dialects of East- and West-Flanders, and a uvular [ʀ], which is most noticeable in the city of Ghent. It should also be noted that in Belgian Dutch the glide /w/ is bilabial, whereas it is labiodental in the Dutch variety spoken in the Netherlands ([ʋ]).

The vowel phonemes in Dutch and English vary considerably but because vowels are of less importance in this study, they are not further discussed here.

1.3. A note on terminology

Numerous terms are used to refer to the contrast between voiced and voiceless phonemes. It is necessary to make a distinction between phonetic and phonological terms. The most commonly used terms are *voiced* and *voiceless*. It is clear, however, that these terms do not cover the phonetic and phonological laryngeal contrasts in all languages. English is a case in point. The English plosives /b, d, g/ are often realised without vocal fold vibration and are thus phonetically voiceless (see especially Docherty, 1992). However, phonologically they can be called voiced in contrast to their phonologically voiceless counterparts /p t k/. Hence, it is not phonetic voice in the sense of vocal fold vibration which distinguishes /b, d, g/ from /p, t, k/ in English (at least not in all contexts). Some linguists therefore prefer to use the terms *fortis* and *lenis* to refer to voiceless and voiced consonants (cf. e.g. Kohler, 1984). These terms refer to the stronger and more energetic articulation of fortis sounds in comparison with lenis ones, which are produced with less muscular effort and breath force (Collins & Mees, 1999: 47). Other terms which have been used are *tense* and *lax*, as proposed by Jakobson and Halle in 1962. Tense sounds are defined by Crystal (2003: 460) as sounds produced "with a relatively strong muscular effort, involving a greater movement of the (supraglottal) vocal tract away from the position of rest (…)". The term corresponds to fortis or voiceless sounds. Lax sounds are produced with less muscular effort and less movement and correspond to lenis or voiced sounds.

In this book, the traditional terms *voiceless* and *voiced*, rather than *fortis* and *lenis* or *tense* and *lax*, are used to refer to *phonologically* voiceless and voiced phonemes. When reference is made to the presence or absence of vocal fold vibration, this is explicitly mentioned and the terms *phonetically voiceless* and *phonetically voiced* are then used.

1.4. Laryngeal phonetics: The structure of the larynx and vocal fold vibration

This section briefly discusses the structure of the larynx and the mechanism of phonetic voicing. It draws on information provided by Sonesson (1968), Collins & Mees (1999) and Catford (2001). Good descriptions of laryngeal phonetics can also be found in Rietveld & Van Heuven (1997) and Van Alphen (2007).

The larynx is a framework of cartilages which contains the vocal folds. At the lower end, it is connected to the trachea, which ends in the bronchial tubes in the lungs, and at the upper end, it joins the pharyngeal cavity. Figure 1, taken from Collins & Mees (1999: 82), presents a schematic representation of the larynx, illustrating the position of the epiglottis, vocal folds, glottis and the arytenoids cartilages.

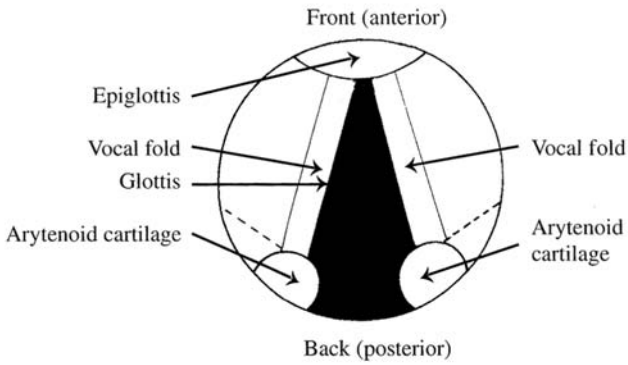


Figure 1. Schematic representation of the larynx (from Collins, B. & I.M. Mees. 1999. The Phonetics of English and Dutch – p. 82, Figure 10.2.).

The larynx has a twofold function. First, the vocal folds in the larynx can seal off the trachea when food is swallowed (though this is primarily done by the epiglottis): the food is then directed into the oesophagus. Secondly, the larynx is responsible for the production of sound. It contains two vocal folds, which each consist of a muscle (the vocal muscle, conus elasticus) and the vocal ligament. The vocal folds are controlled by the arytenoid cartilages, to which they are attached. The space between the vocal folds is termed the glottis. During normal breathing, the glottis has a triangular shape.

For the production of voice, the vocal folds are adducted, forming a close slit. The air stream coming from the lungs through the trachea, however, forces the vocal folds apart and the air starts leaking through the glottis. Due to the Bernoulli effect (which says that an increased flow of air through a passage leads to a drop in air pressure) and the elasticity of the vocal folds, the vocal folds are sucked together again. However, the subglottal pressure immediately increases and then the vocal folds are abducted. The very rapid opening and closing of the vocal folds is called vocal fold vibration. For voiceless sounds, the vocal folds are held apart and air streams freely through the glottis.

For stops, the soft palate and uvula are raised (thus blocking the airstream from escaping via the nasal cavity) and the articulators form a complete closure. During the production of voiceless stops, the vocal folds are wide open, so that air can escape freely through the glottis into the oral cavity, where the air pressure rapidly builds up behind the articulators. When the articulators part, the air is released with an audible burst. Voiceless fricatives are produced in almost the same way, with the difference that the articulators do not form a complete closure but a close approximation, which allows the air to escape through a narrow opening. The effect is a friction noise.

Voiced stops and fricatives are produced with the vocal folds tightly adducted. As a result of the interaction between the air coming from the lungs and the Bernoulli effect, the vocal folds start vibrating. However, during the production of stops and fricatives, the articulators form a complete or near-closure and the soft palate is raised. As a result, the air cannot (or can only very slowly) escape through the mouth or the nose. This causes the supraglottal air pressure to increase so that the supra- and subglottal air pressure reach an equilibrium position. As a result, the vocal folds stop vibrating and when the articulators part, the air pressure built up behind the articulators is released with a sudden burst (for stops) or a friction noise (for fricatives). Because it is difficult to keep the vocal folds vibrating during the production of stops and fricatives, two strategies could theoretically be employed by speakers to increase the duration of vocal fold vibration. One is to increase the pulmonic airstream, so that it takes longer for the air pressure across the glottis to reach an equilibrium. It has been shown, however, that this strategy is not used by speakers. A second strategy, which is used in practice, is to increase the supraglottal space, by slightly lowering the larynx and/or by expanding the larynx and puffing out the cheeks (Docherty, 1992: 19; Catford, 2001: 45).

During the production of sonorants, the glottis is closed and the vocal folds vibrate. Because the articulators are far enough from each other to allow the air to escape freely through the mouth (for glides, liquids and vowels) or through the nose (for nasals), the supraglottal air pressure remains lower than the subglottal air pressure and the vocal folds can keep vibrating. Sonorants are said to be *spontaneously voiced*, meaning that no extra gestures, such as increasing the supraglottal space, are necessary in order to maintain voicing (cf. e.g. Chomsky & Halle, 1968: 300-301). For the production of voiced obstruents, on the other hand, such extra gestures are needed, and they are thus *actively voiced* sounds. Sounds are said to be *passively devoiced*, if "a closed equilibrium position of the vocal folds and normal subglottal pressure are insufficient to initiate or maintain the physical conditions for vocal fold vibration" (Jansen, 2004: 36). Jansen notes that passive devoicing is typical of the closure phase of plosives, where the closure formed by the articulators is responsible for the increased supraglottal air pressure, so that an equilibrium between supra- and subglottal air pressure is reached (Jansen, 2004: 36).

1.5. The main laryngeal differences between Dutch and English

The phoneme inventories discussed in Section 1.2 above show that the laryngeal phonologies of Dutch and English are similar in the sense that both languages (1) make a contrast between voiced and voiceless obstruents and (2) have spontaneously voiced sonorants (sonorant consonants and vowels). However, there are two important laryngeal differences between English and Dutch. The first difference is that voiceless plosives can be aspirated in English, but are unaspirated in Dutch. The second one is that voiced stops are prevoiced in Dutch, but not in English. These two differences are discussed below. Further, there are two acoustic correlates of voicing in English, viz. vowel length and glottal reinforcement, whose effects are also described.

1.5.1. Aspiration

Voice onset time (VOT)

Aspiration is often defined as a period of voicelessness and as an h-like puff of air, which is phonetically transcribed as [ʰ]. Lisker & Abramson (1964) were the first to carry out a systematic and cross-linguistic study of aspiration in stops. They analysed stops in eleven different languages, which can be divided into three groups according to the number of laryngeal contrasts they have: (1) languages with a two-way laryngeal distinction (American English, Cantonese, Dutch, Hungarian, Puerto Rican Spanish, and Tamil), languages with a three-way distinction (Korean, Eastern Armenian, and Thai) and languages with four laryngeal categories (Hindi and Marathi). The stops they analysed all occurred in a word-initial, prevocalic context. They were produced by seventeen informants, of whom one provided the Dutch data and four the American English data. Lisker & Abramson (1964) define aspiration in terms of the period of voicelessness between the release of the stop (equated with zero) and the onset of voicing, which they call the Voice Onset Time (abbreviated as VOT). The main purpose of their study was to find out to what extent all the differences between the various stops realised in the different languages can be expressed in terms of VOT. Stops are classified according to three conditions of voice onset time: voicing lead (voicing begins before the release phase of the stops and the VOT is thus negative, as in most realisations of voiced stops in Dutch, e.g. [b] in *boek* 'book'), short voicing lag (voicing begins shortly after the release of the stop, so that the VOT is positive, as is typical in English voiced stops, e.g. [b̥] in *book*) and long voicing lag (voicing begins considerably later than the release of the stop and the VOT is thus again positive, as in voiceless stops in English, e.g. [pʰ] in *pie*). Figure 2 illustrates the three types of VOT distinguished by Lisker & Abramson (1964). A straight line indicates voicelessness, a waved line indicates voicedness, and the vertical line marked zero ('0') represents the release of the plosive.

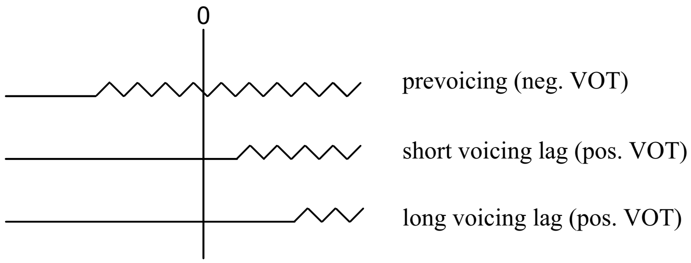


Figure 2. Schematic illustration of negative VOT, short lag VOT and long lag VOT.

On the basis of isolated words read by native speakers of Dutch and (American) English Lisker & Abramson (1964) concluded that the VOT values for Dutch (word-initial, prevocalic) voiced stop are roughly situated around –100 milliseconds (ms) and for voiceless stops roughly around +10 ms. The English values are located around +10 ms for voiced and around +75 ms for voiceless stops. Stops with VOT values of around +75 ms (long lag VOTs) are clearly perceived as aspirated. Lisker & Abramson also noted "a scattering of items around the –100 msec range" in the analysis of the English voiced stops (Lisker & Abramson, 1964: 404). However, 95% of the items produced with voicing lead were produced by one and the same speaker and Lisker & Abramson conclude that their informants

> "do not randomly produce such stops [i.e. word-initial, prevocalic stops] with positive and negative values of relative onset time; rather, each speaker, in isolated words at least, always produces a single kind of /b d g/" (Lisker & Abramson, 1964: 395).

A comparison between the VOT values in these isolated words and in running speech (read sentences) showed that "voice onset time values, both lead and lag, tend to be a bit compressed in comparison with the values measured in the citation forms of words" (Lisker & Abramson, 1964: 414). However, they note that this tendency is not a very strong one and that there is certainly no overlap between the two categories.

Glottis size

Lisker & Abramson (1964) assumed that aspiration is controlled by laryngeal activity and that the timing of the glottal closure is responsible for the different degrees of aspiration with which stops can be produced. Later research by Kim (1970), however, revealed that it is the laryngeal muscles, rather than the timing of the glottal closure, which control the size of the glottis during the production of the stop. Whereas, according to Lisker & Abramson, VOT differs according to the point at which the muscles close the glottis (a late closure of the glottis means a long VOT and vice versa: an early closure means a short VOT), Kim showed that the muscles instruct the glottis to close at the same time for all (i.e. aspirated and non-aspirated) stops. What is responsible for the distinction between stops is the size of the glottis at the point of release. He argues that

> "aspiration is nothing but a function of the glottal opening at the time of release. This is to say that if a stop is *n* degree aspirated, it must have an *n* degree glottal opening at the time of release of the oral closure" (Kim, 1970: 111).

Kim based his statement on a cineradiographic film of the larynx which was made during the production of stops in Korean, in which there is a three-way contrast between unaspirated, lightly aspirated and heavily aspirated stops. The film showed that there was a clear correlation between the size of the glottis at the point of release and the degree of aspiration. Catford (1977) points out that Kim's figures, which indicate a correlation between glottal width and VOT in Korean, reflect a situation which is generally true, namely that a wide glottis is necessary for aspirated sounds and that a small glottis size leads to the production of unaspirated sounds (Catford, 1977: 114).

Dutch and English compared

Since voiceless stops in English are aspirated, the glottis must be wide open at the point of closure. As a result, it takes some time before the glottis is closed enough for the vocal folds to start vibrating. This period of voicelessness between the moment the laryngeal muscles instruct the glottis to close and the beginning of vocal fold vibration is aspiration. In Dutch, the size of the glottis during the production of plosives is much smaller at the time when the stop is released, so that it takes less time for the glottis to close and the vocal folds can start vibrating immediately, resulting in absence of aspiration.

It should be mentioned that, although the glottis is wide open for the production of fricatives as well, the articulators do not form a complete closure, so that the release is not as sudden as for stops. As a result, fricatives are not normally aspirated.

Gradience and variation

As mentioned above, Lisker & Abramson (1964) distinguish three types of VOT: voicing lead, short voicing lag and long voicing lag. Whereas a division of plosives into these three categories (or in only two categories: an aspirated and an unaspirated category) is common (cf. also Kim, 1970), aspiration is not an all-or-nothing phenomenon: there is considerable variation in the extent to which aspiration occurs. Phonetically, there is a continuum which ranges from completely unaspirated sounds at one end of the scale to heavily aspirated sounds at the other end. There is, however, intraspeaker consistency in the production of aspiration, in the sense that, within one speaker, there will be no overlap between the different (phonological) categories of stops.

Apart from the inherently gradient nature of aspiration, aspiration is subject to variation due to different factors. Docherty (1992) discusses various factors which influence the VOT of voiceless stops, such as the effect of the place of articulation of the stop (cf. also Lisker & Abramson, 1964; Cho & Ladefoged, 1999), vowel quality and the position of the stop in the utterance. Some of the factors are picked up again later in this study (for the relation between VOT and place of articulation, see Section 4.2.2).

Another kind of variation in the production of aspiration is that between the different dialects of English, especially between British and American English (Spencer, 1996: 206). In the following sections the discussion focuses on Standard British English, though occasionally references are made to other varieties.

Aspiration in English stops: distribution

Traditionally, it was assumed that voiceless stops in English are unaspirated, except when they occur initially in a stressed syllable and are not preceded by /s/. More accurate descriptions by, for instance, Wells (1982a) and Kreidler (1989) showed that light aspiration occurs in many more environments, at least in some varieties of British English. On the basis of the overview given by Spencer (1996: 206-212), roughly five environments can be listed in order of decreasing amount of aspiration.

(i) Stops occurring initially in a stressed syllable: usually heavy aspiration
- in monosyllabic words:
  e.g. *pie* [p^{h}aɪ], *time* [t^{h}aɪm], *keep* [k^{h}iːp]
- in polysyllabic words
  e.g. *Paddy* [ˈp^{h}ædi], *timing* [ˈt^{h}aɪmɪŋ][3], *cobble* [ˈk^{h}ɒbl̩]

(ii) Stops occurring initially in an unstressed syllable: lighter aspiration
e.g. *tomorrow* [t^{h}əˈmɒrəʊ], *capitulate* [k^{h}əˈpɪtjʊleɪt], *console* [k^{h}ənˈsəʊl]

(iii) Stops occurring in word-final position: light aspiration possible (also when following /s/; compare (v) below).
- following /s/
  e.g. *wasp* [wɒsp^h], *waste* [weɪst^h], *risk* [rɪsk^h]
- not following /s/ (and no glottalisation)
  e.g. *lip* [lɪp^h], *meat* [miːt^h], *sock* [sɒk^h]

(iv) Stops occurring in word-medial position (light aspiration only in emphatic speech)
e.g. upper [ˈʌp^{h}ə], *hotter* [ˈhɒt^{h}ə], *quicker* [ˈkw̥ɪk^{h}ə]

(v) Stops occurring in initial position preceded by /s/ (minimal or no aspiration)
e.g. *spy* [spaɪ], *steal* [stiːl], *skip* [skɪp]

This overview shows that stops can be aspirated in almost all positions, except in position (v), i.e. in initial position following /s/, where it is impossible (e.g. Spencer, 1996: 210) or at least minimal (Collins & Mees, 1999: 151)[4]. This has important consequences for phonological theory, as the lack of aspiration in /s/ + stop clusters can then be viewed as an exception rather than as the default realisation. This view may have an effect on the laryngeal features proposed for English (see Section 2.4.2). It has traditionally been assumed that the reason why there is no aspiration in /s/ + stop clusters in English is that in this position aspiration is not necessary to maintain the contrast between voiced and voiceless stops, as initial /s/ + voiced stop clusters (*/sb/-, */sd/-, */sg/-) do not exist in English. The explanation why English does not have /s/ + voiced stop clusters would thus lie in a general constraint against clusters in which the members differ in voice specification. However, Kim (1970: 113) argues that the (phonetic) reason why stops are unaspirated after /s/ is that the glottis, which needs to open for the production of the stop, already starts widening during the production of the first consonant in the cluster, i.e. during the /s/. Kim gives the example of an initial /sp/ cluster and argues that

> "if the glottis is instructed to open to the same degree and for the same period for /p/ of /sp/ as it would for initial /p/, the glottis will begin to close by the time the closure for /p/ is made, and consequently, by the time /p/ is released, the glottis will already have become so narrow that the voicing for the following vowel will immediately start, and thus we have an unaspirated /p/ after /s/" (Kim, 1970: 114).

The (near-) absence of aspiration in /s/ + stop clusters is thus simply considered to be the result of the coarticulation of the two initial segments (cf. also Iverson & Salmons, 1995: 371). Docherty (1992: 48) refers to a study by Davidsen-Nielsen (1974), which showed that, if a syllable- or word-final /s/ is followed by a voiceless stop in syllable- or word-initial position, the stop is aspirated in the normal way. Thus, aspiration occurs in, for instance, *this pie* [ðɪs pʰaɪ], but not in *a spy* [ə spaɪ].

The reason why aspiration is less strong intervocalically and before unstressed syllables is that the glottis is not as wide open in these positions, resulting in a shorter VOT and less aspiration (Kingston & Diehl, 1994: 431).

A related phenomenon: sonorant consonant devoicing

If an initial obstruent is followed by a sonorant consonant instead of by a vowel, a similar delay in VOT can be detected (Cruttenden, 2001: 151). The period during which the wide open glottis closes does then not lead to aspiration, but to (partial) devoicing of the sonorant consonant, accompanied by added friction. The delay is observable after voiceless as well as voiced obstruents, though it is considerably longer in the former case, as remarked by Docherty (1992: 44). Examples are *play* [pl̥eɪ], *try* [tr̥aɪ], *quit* [kw̥ɪt] and *cue* [kj̊uː]. Whereas Collins and Mees (1999: 169) note that "[s]ome devoicing may also be heard following fortis fricatives, e.g. *flat, slip*", Kenstowicz (1994: 67) remarks that "the voiceless fricatives in *f*[r]*om, sh*[r]*imp,* and *s*[l]*ip* fail to trigger the change". Experiments have shown that the delay in VOT is certainly greater if the obstruent is a stop than if it is a fricative, since the peak glottal opening in fricatives is earlier than in stops (cf. Docherty, 1992: 45, who refers to Jones, 1960; Bladon & Al-Bamerni, 1976 and Dent, 1984).

The degree of devoicing is subject to a number of factors. Collins & Mees (1999: 174) note that devoicing of the sonorant consonant is strongest when the obstruent occupies the initial position in a stressed syllable. Whereas the /w/ in, for example, the English word *inquest* is partly devoiced, it may be fully devoiced in words such as *quick* and *twelve*[5].

If the obstruent + sonorant consonant cluster is part of a three-consonant cluster in which the first segment is /s/, no devoicing occurs, as in *spray* [spɹeɪ] and *square* [skwɛʔ] (Collins & Mees, 1999: 152). The reason why there is no (or hardly any) devoicing in /s/ + obstruent + sonorant consonant clusters is the same reason which accounts for the lack of aspiration in /s/ + stop clusters: the glottis starts widening during the production of the /s/, so that it is closed by the time the obstruent is released.

The type of boundary occurring between the stop and the sonorant consonant has also been reported to influence the degree of devoicing. Docherty (1992: 177-190) analysed obstruent + sonorant clusters across different types of boundaries in Southern British English and found that if the obstruent is voiceless, VOT delay was largest when the cluster occurred syllable-initially. If the boundary between the two segments is stronger (e.g. a morpheme or word boundary), the VOT delay is much shorter.

In Dutch, a sonorant is usually not devoiced when following an obstruent, since, just as aspiration, sonorant consonant devoicing in English is the result of the wide open glottis during the production of the obstruent. As the glottal opening during the production of Dutch obstruents is smaller, no devoicing occurs in Dutch obstruent + sonorant consonant clusters. Collins & Mees (1999: 170) illustrate the difference between English and Dutch by means of the following words:

English: *plan* [pl̥æn] – Dutch: *plan* [plɑn]
English: *class* [kl̥ɑːs] – Dutch: *klas* [klɑs]

1.5.2. Prevoicing

The second important laryngeal difference between English and Dutch is prevoicing. Its mechanism and effect in Dutch and in English are described below.

The articulatory mechanism of prevoicing

It is aerodynamically difficult to produce voicing in obstruents as the closed articulators (and the raised soft palate) cause the supraglottal air pressure to increase very rapidly, thus inhibiting vocal fold vibration. Speakers of languages in which voiced stops are produced with vocal fold vibration (e.g. Dutch) therefore use a number of strategies to prolong the difference in supra- and subglottal air pressure. One such strategy is to increase the size of the supralaryngeal cavity by, for instance, lowering the larynx ('active expansion'). Another strategy is to allow the soft, compliant tissue of the lips, cheeks and soft palate to puff out ('passive expansion') (Kingston, in preparation). When vocal folds start vibrating before the release phase of a plosive in initial position, this is called prevoicing. Van Alphen notes that "[t]he fact that extra articulatory movements are required to produce prevoicing makes the production of prevoicing relatively difficult" (Van Alphen, 2004: 12; Van Alphen, 2007: 102-103). Yet, prevoicing occurs in a large number of languages, including Dutch.

Prevoicing in Dutch stops

Only a few studies have addressed the issue of prevoicing in Dutch. Notable exceptions are Lisker & Abramson (1964), Van Dommelen (1983) and Van Alphen (2004, 2007). Lisker & Abramson (1964) report on VOT in various languages, but the Dutch information is based on the speech of only one informant. Van Dommelen (1983) measured VOT in only five words read aloud by four native speakers of German and an equal number of speakers of Dutch. By far the most comprehensive study of prevoicing in Dutch was conducted by Van Alphen (2004, 2007).

In a production experiment, Van Alphen (2004) asked ten native speakers of Dutch (five male and five female speakers) to read out aloud 520 words in isolation, of which 64 were test items starting with a voiced plosive. Van Alphen does not mention where the informants come from, but states that they are native speakers of Dutch who were recruited in Nijmegen. Examples of test words are *boot* ('boat'), *bril* ('glasses'), *deur* ('door') and *duin* ('dune'). The remaining 456 items were fillers. The list contained both existing words and nonce words (such as *bleep* and *daaf*), but this distinction proved to have no significant effect on the production of prevoicing. Acoustic measurements showed that 75% of the test items were produced with prevoicing and that one fourth of all plosives was thus realised without prevoicing. Whereas some speakers produced prevoicing in all test items, others frequently omitted prevoicing. Van Alphen (2004: 20) mentions that some speakers produced prevoicing in less than half of the test items, which indicates that there is considerable variation in the production of prevoicing.

Van Alphen (2004, 2007) also investigated the possible influence of a number of factors on the production of prevoicing. First, her analysis showed that the sex of the speaker, the place of articulation of the stop and the following segment affected the percentage of prevoiced tokens. Because men have larger vocal tracts, it takes longer for the supraglottal air pressure to rise and it is thus easier to produce prevoicing. However, although the sex of the speaker affected the production of prevoicing to some extent, the difference between the male and female informants proved not to be significant. Secondly, it appeared that labials were more often produced with prevoicing than alveolars. Van Alphen argues that "[s]ince labial plosives are produced more anteriorly than alveolar plosives, the surface of tissue which can be pushed outward as a result of the raised oral pressure is larger for labials than for alveolars" (2004: 21; see also Kingston, in preparation). This means that the supraglottal cavity is larger for labials than for alveolars and that it is therefore easier to produce vocal fold vibration. A third factor which influenced the frequency and duration of prevoicing was the nature of the following phoneme: when the following phoneme was a vowel, prevoicing was produced more often and for a longer period than when it was a consonant (Van Alphen, 2004: 21). Van Alphen argues that "the degree to which the vocal tract can be expanded (passively or actively)" is probably responsible for these findings, but that articulatory measurements are needed in order to confirm this.

Van Alphen (2004: 47-48/52) has no explanation for the frequent absence of prevoicing in her Dutch data, which is not in accordance with other studies on prevoicing in various languages, where prevoicing was produced more consistently. She hypothesises that there may be two reasons for this.

First, obstruents in Dutch are often not realised according to their underlying voice specification. One example is the process of final laryngeal devoicing of obstruents which are voiced in the underlying form in Dutch. Another example is the frequent devoicing of underlyingly voiced fricatives in initial position in some varieties of Dutch. Van Alphen argues that the absence of prevoicing "would therefore fit into a pattern in which the underlying [voice]-specification is not always realised phonetically" (Van Alphen, 2004: 48). A second reason which, according to Van Alphen, might play a role is the influence from English. She states that

> "[i]t may be the case that the way in which the voicing distinction is implemented phonetically is changing as the result of the influence of English on the Dutch language" (Van Alphen, 2004: 52).

This claim is, however, unsupported by evidence and is therefore in need of further investigation.

The analysis of an experiment with native speakers of Belgian Dutch conducted for the present study revealed that the native speakers of Belgian Dutch omitted prevoicing less frequently than the native speakers of Dutch in the Netherlands in Van Alphen's (2004) study (see Section 4.5.2.).

Prevoicing in English stops

Voiced stops in English are not normally prevoiced, which means that they are produced without vocal fold vibration before the release phase. Phonetically speaking, they are therefore voiceless. However, there are studies which show the picture to be more complex.

Lisker & Abramson (1964) recorded and analysed words read by four native speakers of American English and found that one of the informants produced 41 out of 42 tokens starting with a voiced stop (/b/, /d/ or /g/) with prevoicing. One other informant produced only 2 out of 58 tokens with prevoicing and the other two informants did not produce prevoicing at all.

Flege (1982) examined the production of the initial voiced stops in the words *bay* and *pay* by ten male speakers of American English. He found that in 117 out of 200 realisations of *bay*, the initial /b/ was prevoiced. It appeared that, whereas three speakers typically did not produce prevoicing, three other speakers showed variation (some tokens were produced with prevoicing; others with short lag VOT), and the remaining four informants produced prevoicing in virtually all tokens. In another study published in the same year (1982), Flege & Brown investigated the production of voicing in English in relation to position-in-utterance. They found that only two out of the eight American English speakers, who were the informants for this study, produced prevoicing in initial /b/ in nonsense words.

Docherty (1992) measured VOTs in words read aloud by five native speakers of Southern British English, aged between 18 and 21. The words were read in three environments: in isolation, in a carrier phrase where they occurred between voiced segments and in a carrier phrase where they occurred between voiceless segments. The VOT differences between the different environments proved not to be significant, though there was a tendency for VOTs to be longer in post-pausal stops in isolated words. Docherty reported that

> "[f]or voiced stops there is a bi-modal distribution, reflecting the fact that there are two patterns of voicing timing used by speakers of this accent of English in realising VOICED stops; one which involves commencing voicing prior to stop release (within the range –19 ms to –143 ms), and one in which voicing commences at about the same time as, or relatively shortly after the release of the stop (as reflected by voice onset times in the range from 3 ms to 52 ms)" (Docherty, 1992: 116).

Speakers did not randomly produce voiced stops with prevoicing and with short lag VOTs, but each speaker proved to be more or less consistent in his/her production of either one or the other type of voiced stops. The reason why some speakers consistently produce prevoicing, whereas most speakers never produce it, is not clear. The overwhelming majority of tokens (346 out of 372), however, were realised with a positive VOT.

In sum, the production of initial voiced stops in English seems to be variable and studies differ in the reported frequencies of prevoicing in English. The different results obtained by Flege (1982), who found that prevoicing was produced in the majority of tokens, and Docherty (1992), who reported that the overwhelming majority of tokens was produced without prevoicing, could be due to the fact that they examined a different variety of English (American English vs. British English), though more results from both varieties would be needed in order to test such a hypothesis. See Section 4.5.2. for results on British English.

1.5.3. Vowel Length

Vowel length can be an acoustic cue for voicing contrasts. English and Dutch both have phonologically short and long vowels (cf. the phoneme inventory in Section

1.2). However, vowel length is not a phonological feature in either language, i.e. there are no minimal pairs which differ only in vowel length, since there is always a difference in quality between any short and long vowel (Collins & Mees, 1999: 71):

Dutch:	/ɛ/ vs. /eː/
	/ɑ/ vs. /aː/
	/ɔ/ vs. /oː/, etc.
(British) English:	/ɪ/ vs. /iː/
	/æ/ vs. /ɑː/
	/ɒ/ vs. /ɔː/, etc.

Phonetically, vowel length in English varies depending on the following segment. Cruttenden (2001: 96) refers to a study by Wiik (1965), who measured vowel duration in English in different contexts.

The graph in Figure 3 is based on measurements of the duration of the vowels /ɪ/ and /iː/ given in Cruttenden (2001: 96).

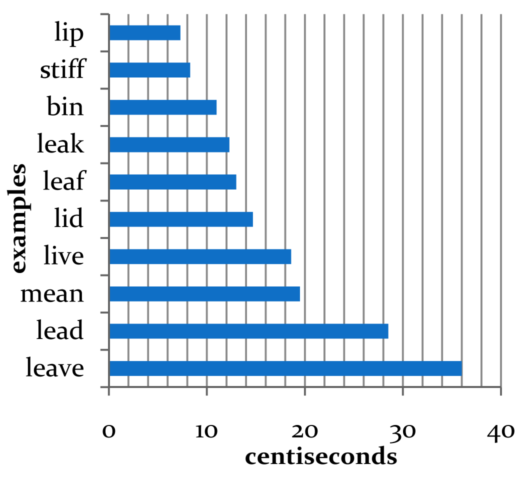


Figure 3. Vowel duration in relation to following consonant (based on Cruttenden, 2001: 96).

Figure 3 shows that the vowel /iː/ is longest before a voiced fricative and a voiced plosive. Before a voiceless fricative or plosive, the vowel is considerably shorter. This phenomenon is sometimes called pre-fortis clipping. It should be noted that the shortening is so drastic that a phonologically long vowel which is followed by a voiceless obstruent can even be shorter than a phonologically short vowel which is followed by a voiced obstruent. The vowels in *leaf* and *leak,* for instance, are often shorter than those in *live* and *lid*. Vowel length in English is thus an important cue for the listener in that it serves as an indication for the voice character of the following obstruent.

In Dutch, vowel length is not influenced by the following segment to the same extent as in English. Collins & Mees (1999: 243) note that in Dutch all vowels are somewhat shortened in syllable-final position, and that vowels are considerably lengthened only when followed by /r/ or – to a lesser extent – by /l/, /m/, /n/ or /ŋ/. In the following examples vowel length increases from left to right:

kat – kam – kar (‘cat’ – ‘comb’ – ‘cart’)
boot – boon – boor (‘boat’ – ‘bean’ – ‘drill’)

While distinction between voiced and voiceless obstruents is neutralised in syllable-final position in Dutch (see Chapter 6 on final laryngeal neutralisation), it is a matter of debate whether this neutralisation is complete or not. A study by Warner et al. (2004) with a large number of Dutch-speaking participants revealed that the underlying voice specification of a coda stop slightly but significantly affected the duration of the preceding vowel, with vowels being slightly longer before voiced than before voiceless stops. However, it should be noted that the difference was one of only 3.5 ms. The authors surmise that this explains why previous studies by Jongman et al. (1992) and Baumann (1995), with a limited number of participants, found no effect of voice specification of a final stop on preceding vowel duration. Ernestus & Baayen (2006) examined to what extent incomplete neutralisation is functional in Dutch, i.e. to what extent it plays a role in normal speech processing. The conducted a perception experiment in which native Dutch listeners were presented with a list of pseudo words ending in obstruents. One group of participants listened to pseudo words ending in voiceless obstruents (e.g. *duut*); the other group listened to pseudo words ending in underlying voiced obstruents (e.g. *duud*), which were realised as voiceless, though with some acoustic characteristics of voiced obstruents (e.g. shorter duration of the obstruent, longer duration of the preceding vowel). The participants were asked to write down the past-tense form of the words they heard. In Dutch, the regular past tense is formed by adding *–de* to voiced segments (e.g. *hij baad-de* ‘he bathed’) and *–te* to voiceless segments (e.g. *hij wacht-te,* ‘he waited’). The results revealed that listeners who were presented with the words ending in an underlying voiced stop gave more *–de* responses than listeners who were presented with the phonologically voiceless stops. This suggests that native speakers of Dutch can make use of incomplete neutralisation information to deduce information on the underlying specification of syllable-final obstruents.

1.5.4. Glottal reinforcement and glottal replacement

The second factor which may serve as an acoustic cue for voicing contrasts is glottal reinforcement. It involves the production of a glottal stop just before another segment. A glottal stop is formed by a complete closure of the vocal folds. As a result of this closure, the air stream is completely blocked and the preceding sound is cut off abruptly. When the vocal folds part again, the air is suddenly released (Cruttenden, 2001: 168-169).

Glottal reinforcement is common in English. In RP, the glottal stop is most frequently inserted as a syllable-boundary marker after a syllable-final vowel, when the following syllable starts with a vowel, as in *co-operate* [kəʊˀˈɒpəreɪt], *geometry* [dʒiˀˈɒmətrɪ] and *reaction* [riːˀ ˈækʃən] (Cruttenden, 2001: 169). If no glottal stop is produced, a vocalic glide is usually inserted between the two vowels, as in [kəʊˈʷɒpəreɪt], [dʒiˈʲɒmətrɪ] and [riːˈʲækʃən]. Some speakers also insert a glottal stop before a word-initial vowel in order to put emphasis on a particular word, even when the preceding word ends in a consonant. An example given by Cruttenden (2001: 169) is the phrase *I haven't seen* [ˀ]*anybody*, where the glottal stop puts emphasis on the word *anybody.*

The voiceless plosives /p,t,k/ and the affricate /tʃ/ can also be glottally reinforced when occurring in syllable-final position, preceded by a vowel, nasal or lateral and followed by a pause or consonant (or, in the case of /tʃ/, a vowel) (Cruttenden, 2001: 169-170). This means that a glottal stop is produced immediately before the plosive or affricate; the oral closure necessary for the production of a plosive or affricate is thus preceded by the glottal closure needed for the production of a glottal stop (Roach, 1973). Examples in which a plosive or affricate can be glottally reinforced are *bit cold* [bɪˀt kəʊld], *help you* [helˀp juː], *pick me up* [pɪˀk miː ʌp] and *switch it* [swɪˀtʃ ɪt]. Because voiced plosives are not normally glottally reinforced, glottal reinforcement can be an important cue to the listener for the voice character of the following obstruent.

Next to glottal reinforcement, some varieties of English also have a process of glottal replacement, in which a glottal stop actually replaces a whole segment. In some varieties of British English, voiceless plosives (particularly /t/) are commonly replaced by a glottal stop when the following consonant is homorganic, i.e. /t, d, tʃ, dʒ, n, l, r/, but sometimes also before other consonants. Examples are *not true* [nɒˀ truː], *let dry* [leˀ draɪ] and *hot cake* [hɒˀ keɪk]. Cruttenden (2001: 170) notes that, whereas glottal replacement is now also accepted in London Regional RP before vowels and syllabic [n̩] and [l̩] (as in *eat ice* [iːˀ aɪs], *cotton* [ˈkɒˀn̩] and *little* [ˈlɪˀl̩], it is regarded as non-RP when occurring word-medially between vowels as in *water* [ˈwɔːˀə].

In Dutch, syllable-initial vowels can be preceded by a glottal stop (especially when the word is emphasised, as in *op eigen initiatief* 'by your own initiative' [ˀɔp ˀɛiɣə ˀini(t)sjatif], Collins & Mees, 1999: 194, or *Ome Arie eet altijd aardappelen met appelmoes* 'Uncle Arie always eats potatoes with apple sauce', in which a glottal stop can be inserted before every vowel-initial word in careful speech; Collins & Mees, 1999: 84*;* cf. also Jongenburger & Van Heuven, 1991). However, there is no glottal reinforcement of syllable-final voiceless stops (Collins & Mees, 1999: 194) and glottal replacement does not occur in Standard Dutch. (It is, however, frequent in dialects in East- and West-Flanders, where, for instance, /k/ is often replaced by a glottal stop in intervocalic position, e.g. *zoeken* 'to search' /zukə/ can be realized as [zuˀən] or [zuˀn̩].) Hence, the glottal stop does not function as an extra acoustic cue for the voice character of the following stop, as it does in English.

1.6. Summary

The laryngeal differences between Dutch and English and the acoustic cues signalling the voice contrasts in the two languages are summarised in Table 2 (see p. 19).

	DUTCH	ENGLISH
(1) ASPIRATION	*Voiceless stops:* short lag VOT – no aspiration.	*Voiceless stops:* long lag VOT – aspiration, strongest in word-initial stops in stressed syllables.
(2) PREVOICING	*Voiced stops:* usu. negative VOT, i.e. prevoicing	*Voiced stops:* Variation: ▪ most speakers: short lag VOT ▪ some speakers: neg. VOT, i.e. prevoicing
(3) VOWEL LENGTH	*Less influenced by next segment:* ▪ somewhat shorter in syllable-final position ▪ considerably longer before /r/ (and somewhat longer before lateral and nasal consonants)	*Strongly influenced by next segment:* ▪ longest before voiced obstruents ▪ much shorter before voiceless obstruents
(4) GLOTTAL REINFORCEMENT	▪ *syllable-initial vowels* can be glottally reinforced for emphasis ▪ no glottal reinforcement of voiceless stops ▪ no glottal replacement	▪ as a syllable-boundary in *intervocalic position* ▪ glottal reinforcement of *voiceless stops* when preceded by a vowel, nasal or lateral and followed by a pause or consonant ▪ *glottal replacement* of voiceless stops possible in some contexts (especially when the following consonant is homorganic).

Table 2. Short summary of the laryngeal differences between Dutch and English.

The main differences between Dutch and English appear to be that voiced obstruents in Dutch are prevoiced and voiceless obstruents are unaspirated, while English voiced obstruents do not normally show prevoicing and voiceless obstruents have a long lag voice onset time, which leads to aspiration. These two types of contrast (voiced vs. voiceless and aspirated vs. unaspirated sounds) occur in a large number of languages. Languages which contrast prevoiced stops with unaspirated voiceless stops are often called voicing languages. Dutch belongs to this group of languages, together with, for instance, most (varieties of) Romance and Slavic languages, the Baltic languages, Hungarian and Japanese (Jansen, 2004: 41; Shimizu, 1996: 20). In the Germanic group of languages, only Dutch (the varieties spoken in the Netherlands as well as those spoken in Belgium), Afrikaans, West-Frisian, Yiddish, Scottish English and Rhineland German are reported to be voicing languages. Those languages which contrast unaspirated, phonetically voiceless stops with long-lag aspirated stops are called aspirating languages. English, as well as most Germanic languages not mentioned above, some languages of the Turkic group and Mandarin Chinese belong to the group of aspirating languages (Jansen, 2004: 41; Shimizu, 1996: 50)[6].

Notes

1. Whereas in some areas (especially in the western part of the Netherlands) all fricatives are voiceless, the devoicing effect is much weaker in Flanders (cf. e.g. Slis & Van Heugten, 1989; Van de Velde, Gerritsen & Van Hout, 1995). A recent paper by Verhoeven & Hageman (2007) shows, however, that devoicing of fricatives has also become extremely frequent in the speech of young speakers of Dutch in Flanders.

2. FAND is the abbreviation of *Fonologische Atlas van de Nederlandse Dialecten* 'Phonological Atlas of the Dutch Dialects'. The FAND IV (De Wulf, Goossens & Taeldeman, 2005) deals with consonants. It is based on questionnaires filled in by informants in 631 places in the Netherlands, Belgium/Flanders and French Flanders (2005:V).

3. Collins & Mees (1999: 161) note that /t/, when it occurs initially in a stressed syllable, can sometimes be realised with "brief [s]-like off-glide", as in *ten.*

4. An experiment by Klatt (1975) showed that the average VOT in /sp/, /st/ and /sk/ clusters in words occurring in a sentence frame was 12, 23 and 30 ms, respectively. The informants were three native speakers of American English.

5. Dent (1984), on the contrary, found that there is a shorter voice onset time in stop + lateral sequences in British English if the following vowel is stressed than if it is unstressed (Docherty, 1992: 180).

6. Some Germanic language varieties do not have a voice contrast at all. An example is the Alemannic dialect Thurgovian, in which there is a length contrast between single and geminated stops, but no voice contrast, cf. Kraehenmann, 2003.

Chapter 2

Laryngeal representations: The concepts of markedness, underspecification and voice assimilation

2.1. Introduction

In this chapter, the consequences of the phonetic differences between English and Dutch voicing (Chapter 1) for the phonological representations of the Dutch and English laryngeal systems are discussed. Three concepts which are crucial in a phonological account of laryngeal representations are presented: markedness, underspecification and voice assimilation. Different theoretical accounts are discussed and compared with each other. At the same time an overview is given of relevant research which has provided evidence for specific hypotheses on laryngeal representations in voicing vs. aspirating languages.

2.2. Markedness

The notion of markedness has a long history (reviewed in Andersen, 1989) and has received different interpretations over the years. Spencer notes in 1996 that it is "not a particularly well understood notion, though it is one which is regularly appealed to and discussed" (Spencer, 1996: 82). It may therefore be useful to give a brief overview of the major positions.

The notion emerged in Prague School Phonology at the beginning of the 20th century. According to Andersen (1989: 21), the terms *marked* and *unmarked* were first used in discussions between Trubetzkoy and Jakobson in 1930. Trubetzkoy (1969: 75) distinguished between three types of oppositions: privative, gradual and equipollent oppositions. Privative oppositions are oppositions in which one member has a mark which the other member lacks. Examples of privative oppositions are voiced/voiceless, nasalised/non-nasalised, and so on. In gradual oppositions the members do not differ by the presence or absence of a single mark, but are characterised by different degrees of the same property. Trubetzkoy gives the example of the gradual opposition between different degrees of aperture in vowels (1969: 75). In equipollent oppositions, finally, the members are "logically equivalent" (1969: 75), which means that they do not differ by one single mark (as in privative oppositions) or gradually (as in gradual oppositions). According to Trubetzkoy, German /f/ – /k/ stand in an equipollent opposition to each other.

When the members of an opposition lose their distinctive characteristics in a particular position, the contrast is said to be neutralised. Trubetzkoy coins the term *archiphoneme* to refer to “the sum of distinctive properties that can be neutralised” (Trubetzkoy, 1969: 79). He illustrates the concept of archiphoneme by means of the process of final laryngeal neutralisation in German, through which the opposition between voiced and voiceless obstruents is neutralised in final position. The word *Rad* /raːd/, for instance, is realised as [raːt]. Trubetzkoy argues that the final plosive is phonologically not voiced or voiceless, but “the nonnasal dental occlusive in general” (Trubetzkoy, 1969: 79). He argues that in cases in which one of the members of an opposition is neutralised, this member can be considered to consist of the “archiphoneme + zero”: it is the unmarked member of the opposition. The other member can be characterised as “archiphoneme + a specific mark”: it is the marked member of the opposition (Trubetzkoy, 1969: 81). An archiphoneme is represented by a capital letter: the notation for the archiphoneme representing the laryngeal neutralisation of German /d/ and /t/ in the Auslaut, for instance, is ‘T’.

The notion of markedness has since been discussed in various frameworks. It also turns up at the end of *The Sound Pattern of English* (*SPE*), where Chomsky & Halle (1968: 400) criticise their own model for its exclusively formal character and propose that the answer to the problem lies in a ‘theory of markedness’. Anderson (1989) characterises this theory as follows:

> “In essence, the theory consists of a set of ‘marking conventions’, or definitions of the values ‘m(arked)’ and ‘u(nmarked)’ for phonological features in particular contexts. Thus, the unmarked value for the feature [Round] in vowels is whichever value agrees with the value of the feature [Back] for the same segment; the unmarked value of the feature [Voice] in an obstruent followed by another obstruent is whatever value agrees with the voicing of the following one, etc.” (Anderson, 1989: 333)

An important difference between the notion of markedness in Prague School Phonology and *SPE* is that, whereas the Prague School approach was language-specific, the marking conventions proposed in *SPE* (which used only binary features) were argued to be universal (Crystal, 2003: 283).

In the framework of Natural Phonology, first proposed in Stampe (1973), the notion of markedness plays a central role. In Natural Phonology, the idea that some systems or rules are more natural than others – which was also the rationale behind the markedness theory in *SPE* – was further elaborated. The idea of ‘naturalness’ was linked to markedness: natural processes are unmarked; unnatural ones are marked.

In Optimality Theory, first proposed by Prince & Smolensky (1993), the idea of markedness is again foregrounded. Optimality Theory assumes that there is a universal set of (violable) constraints which are common to all languages. Two main types of constraints are distinguished: markedness constraints and faithfulness constraints. Whereas faithfulness constraints require the output (corresponding to the traditional ‘surface form’) to be faithful to the input (the ‘underlying form’), markedness constraints exert pressure towards unmarked structures. Kager (1999: 11) discusses two criteria which should ideally be satisfied by markedness constraints. The first criterion is a typological one: a markedness constraint should state "a preference for certain structures over other types of structures, which reoccurs in a range of unrelated languages" (Kager, 1999: 11). Because a purely typologically-based definition of markedness runs the risk of circularity ("[C]ertain properties are posited as 'unmarked' simply because they occur in sound systems with greater frequency than other 'marked' properties", Kager, 1999: 11), a second criterion should be fulfilled: markedness constraints should be phonetically grounded. This means that "phonetic evidence from production or perception should support a cross-linguistic preference for a segment (or feature value) to others in certain contexts" (Kager, 1999: 11). A voiced stop, for instance, is more marked than a voiceless stop from a phonetic point of view, since it is articulatorily difficult to produce voicing in a stop (and extra gestures, such as larynx expansion, are necessary).

It is clear from this overview of some interpretations of markedness that different criteria have been used to define the notion. The most frequently employed criteria are listed below. Criteria 1 to 4 are discussed by Tomić, 1989; criteria 5 and 6 are based on Gvozdanovic, 1989: 50. Each criterion is briefly characterised below.

(1) Functional load

The unmarked member has a higher functional load than the marked one. An example would be the nasals /n/ and /ŋ/ in English. Because /ŋ/ can only occur in syllable-final position, it has a lower functional load and is thus more marked than /n/.

(2) Learnability

The unmarked member of a pair will be acquired earlier and will be lost later than the marked one. The idea that cross-linguistic universals are reflected in first language acquisition and language loss was first discussed by Jakobson (1969). He found that structures which are cross-linguistically frequent tend to be acquired early by children and lost late in cases of aphasia. Locke (1983) also discusses this issue at length, drawing on data from language acquisition. An example of a much discussed phenomenon in this context is final devoicing. Locke (1983: 164) shows that the tendency to devoice final obstruents, which is a frequent cross-linguistic phenomenon, is also extremely common in child language and in the speech of brain-damaged adults. The production of voiced obstruents in final position can thus be said to be heavily marked.

(3) Cross-linguistic frequency

Cross-linguistic frequency is one of the most important distinguishing characteristics: the unmarked member occurs in more languages of the world than the marked one (cf. e.g. Spencer, 1996: 82: "When a structure is common throughout the world's languages we can say that it is universally unmarked"; Kenstowicz, 1994: 62:

"[T]he unmarked values appear in all grammars."). Markedness is also linked to cross-linguistic implicational universals: "A structure S_u is unmarked (with respect to another structure S_m) if, for every language, the presence of S_m implies the presence of S_u" (Kager, Pater & Zonneveld, 2004: 20).

(4) Neutralisation

The marked member is less often subject to neutralisation than the unmarked member (cf. Kenstowicz, 1994: 62). Gvozdanović refers to Trubetzkoy (1939/1985 second edn.: 73), who argues that

> "that member of the opposition which is admitted in the position of neutralisation is from the viewpoint of the given phonological system unmarked, whereas the opposed member of the opposition is marked" (Gvozdanović, 1989: 49).

If it is assumed that markedness is language-specific, rather than universal (as in Trubetzkoy's 1939/1985 and Dresher's 2003a view), criteria (3) and (4) can be in conflict: a particular language can have neutralisation to one member of a pair, which is cross-linguistically less frequent than the other member of that pair.

(5) Variability

Unmarked members are open to more variability than marked members. Gvozdanovic (1989: 50) notes that "the marked member has a well-defined characteristic or characteristics, whereas the unmarked member may vary considerably", i.e. the unmarked member typically has more allophones than the marked one.

(6) Distribution

The unmarked member has a wider distribution than the marked member (i.e. it occurs in more environments), since it occurs in neutralisation sites.

Although a definition of markedness is difficult to formulate, it seems that a combination of these six criteria can be used in order to determine which member of an opposition is marked and which one is unmarked.

We can now try to briefly apply these criteria to the voiced/voiceless distinction in Dutch and English.

(1) Functional load: Both in Dutch and English, voiced stops have a high functional load, i.e. there is a large number of minimal pairs differing only in the voice specification of the stop. Ernestus (2000: 50-52) points out that the functional load of fricatives is smaller than that of stops, since there are only few minimal pairs differing only in the laryngeal specification of the fricative (see Section 5.2). Since in Dutch, voiced stops are not allowed in coda position, they could be argued to have a lower functional load and thus to be more marked than voiceless stops.

(2) Learnability: Earlier research has shown that children learning a voicing language as well as children learning an aspirating language produce short-lag stops first, i.e. before prevoiced stops (in Dutch) and long-lag aspirated stops (in English) (see Section 2.4.2). This suggests that prevoiced stops and aspirated stops are more marked than short-lag stops.

(3) Cross-linguistic frequency: There is an absolute implication universal which says that "if a language has voiced stops, it must have voiceless stops" (Finegan, 2008: 230). This suggests that (phonologically) voiceless stops are more common in the world's languages and hence less marked than (phonologically) voiced stops. Note that, if we apply this criterion to the voiced/voiceless distinction in English, it is in conflict with criterion (2), learnability, according to which voiced stops in English are less marked than voiceless stops.

(4) Neutralisation: In Dutch, only voiceless stops are allowed in coda position (see Chapter 6) and voiced stops could therefore be considered to be more marked than their voiceless counterparts. In English, by contrast, both voiced and voiceless stops are usually realized according to their underlying specification (see Chapters 7, 8 and 9 on voice assimilation patterns).

(5) Variability: Whereas the realization of voiced and voiceless stops in Dutch tends to be fairly stable (though some speakers occasionally omit prevoicing and produce short-lag stops instead, see Section 1.5.2), the realization of voiced stops in English is variable. Most speakers produce voiced stops with VOT values in the short-lag region, but prevoiced stops are not uncommon in some speakers' speech (see Section 1.5.2). Voiceless stops in English can therefore be argued to be more marked than voiced stops.

(6) Distribution: With respect to the voiced/voiceless distinction in Dutch and English, the criterion of distribution is related to that of neutralisation (criterion 4): since voiceless but not voiced stops are allowed in coda position in Dutch, they have a wider distribution than their voiced counterparts and are hence less marked. In English, both voiced and voiceless stops are allowed in all positions in the word, and can thus be assumed to have a similar distribution.

In sum, an application of markedness criteria to the voiced/voiceless distinction in Dutch and English seems to suggest Dutch prevoiced stops are more marked than voiceless, short-lag stops, but that the reverse is true in English, in which voiceless, aspirated stops are more marked than short-lag, phonologically voiced stops. However, these commonly used criteria to determine markedness should be treated with caution. De Lacy (2006) has recently argued for a distinction between what he calls 'c-markedness' and 'p-markedness'. The distinction is based on the Competence (c) – Performance (p) distinction made by Chomsky (1965) and widely used in work within the generative framework. While c-markedness refers to those markedness relations that are determined in the language faculty, p-markedness refers to markedness relations that give insight into performance, but not into compentence. For instance, a process of neutralisation through which α and β neutralise to α implies a relation of c-markedness: there is a markedness hierarchy which states that β is more marked than α (de Lacy, 2006: 28). Cross-linguistic frequency, on the other hand, does not necessarily provide information about c-markedness. If a segment α is typologically more frequent than β, this does not automatically imply that β is more marked than α, as other factors besides the relative markedness of α and β may be responsible for this. To illustrate this point, De Lacy (2006: 13) imagines that all speakers of a particular language which lacks /t/ are wiped out (through war or disease): this will decrease the number of languages lacking /t/ (as opposed to /p/ or /k/), but it does not say anything about the markedness of /t/ as opposed to /p/ or /k/.

The notion of markedness plays an important role in the description of the laryngeal systems in Dutch and English, as well as in the acquisition of the English laryngeal system by native speakers of Dutch (see especially Chapter 11, in which the role of markedness is explicitly discussed).

2.3. Underspecification theory and the unary or binary nature of laryngeal features

This section starts out by discussing two types of underspecification, namely temporary and inherent underspecification, which will be relevant for the discussion in Chapter 8. It then goes on to discuss arguments in favour of and against the unary or binary nature of laryngeal features.

2.3.1. Temporary underspecification

The features proposed in *SPE* are binary, which means that each feature must always have one of two values: a positive or a negative value, represented by a plus or a minus mark before the feature. However, in two influential papers published in 1982 and 1985 Kiparsky argued that only unpredictable features need to be specified in the underlying representations and that predictable features could remain unspecified. The theory addressing this issue is called underspecification theory:

> "In underspecification theory, then, only the marked value of a feature is underlyingly specified; the unmarked (or default) value is added in the course of the derivation (…)" (Ewen & Van der Hulst, 2001: 66).

The predictable value is thus unmarked; the unpredictable value is marked. It should be stressed that the models discussed in the present section assume *temporary underspecification* of features (i.e. the missing values are filled in later), which is different from a model of *inherent underspecification,* in which all features have only one value throughout the phonology, i.e. all features are monovalent. Two main models of temporary underspecification can be distinguished: Radical Underspecification and Contrastive Underspecification.

Radical Underspecification

The first linguist to formalise the idea that not all segments necessarily need to be specified for all features was Kiparsky, who developed the theory of Lexical Phonology in the early 1980s[1]. Kiparsky (1985) argues that two systems govern lexical representations. The first system is formed by the set of rules of Lexical Phonology (language-particular rules as well as universal rules); the second system contains conditions. These conditions indicate which feature values are marked. Following Chomsky & Halle (1968), Kiparsky thus assumes a theory of markedness, "which provides a universal list of marked feature combinations and marked feature values" (Steriade, 1997: 124). Kiparsky gives the example of sonorants in English, which are always voiced. Since voice is not distinctive for sonorants, he proposes a marking condition which states that sonorants are not marked for voice in the lexicon; they are, in other words, *underspecified* for voice (Kiparsky, 1985: 92). The following condition bans (the ban is symbolised by the asterisk) any voice specification (α stands for '+ or –') on sonorants:

$$*\begin{bmatrix}\alpha \text{ voiced} \\ + \text{ son}\end{bmatrix}$$

This condition can be formulated as a default rule, which says that all sonorants are voiced. A default rule is defined by Roca & Johnson as "[a] redundancy rule that supplies the missing value of a feature in a given language, usually thought of as selected by UG" (Roca & Johnson, 1999: 687). In other words, if a feature is underspecified in a particular language, a redundancy rule will apply, which fills in a certain value for that feature that is universally preferred over the opposite value (hence the reference to Universal Grammar). The default rule specifying sonorants for voice is the following:

$$[+\text{sonorant}] \rightarrow [+\text{voice}]$$

The rule states that the default value for sonorants is [+voice]. Steriade (1995) points out that the underspecification of sonorants does not automatically follow from the fact that [voice] is not contrastive in sonorants, but is a result of a combination of the principle of Lexical Minimality, which says that "underlying representations must reduce to some minimum the phonological information used to distinguish lexical items" (Steriade, 1995: 114) and the principle of Full Specification, which claims that "the output of the phonological component must contain fully (or at least maximally) specified feature matrices" (Steriade,1995: 114).

In addition, Kiparsky proposes a principle called Structure Preservation, which states that marking conditions such as the one above apply not only to underived, but also to derived representations (Kiparsky, 1985: 92). The condition *[α voiced, +son] thus

> "not only blocks voiceless sonorants from appearing in underlying representations and lexical derivations but also blocks the redundant specification [+voiced] from being assigned to sonorants in lexical derivations" (Kiparsky, 1985: 92).

Next to default rules, Radical Underspecification makes use of complement rules. Complement rules "introduce the opposite feature value on a language-specific basis if a default rule is not available to supply the feature value" (Dresher, 2003a). Dresher gives the example of a language in which there is a contrast between voiced and voiceless stops. Either the positive value of [voice] is marked, in which case /b, d, g/, for instance, are marked [+voice] and /p,t,k/ are unspecified, or the negative value of [voice] is marked, meaning that /p,t,k/ are marked [–voice] and /b, d, g/ are unmarked. Two complement rules are thus possible: the first states that unmarked segments (represented by empty brackets) become [–voice]; the second one states that unmarked segments become [+voice].

a. [ ] → [–voice]
b. [ ] → [+voice]

Although the first option would be preferred by universal grammar (since in the opposition voiced-voiceless, the voiced member is usually marked and the voiceless member unmarked), the choice between the two options is dependent on language-particular rules (Dresher, 2003a).

Contrastive Underspecification

In Contrastive Underspecification, advocated by, for instance, Steriade (1987), only those features that signal a contrast between segments are assigned a value; the other features are left unspecified. If, for instance, a feature [spread glottis] is necessary to distinguish a voiceless unaspirated /p/ from a voiceless aspirated /p^h/, then /p/ will be marked [–spread glottis] and /p^h/ will be marked [+spread glottis]. The segment /b/, however, is not distinguished from /p/ or /p^h/ by means of the feature [spread glottis] and it is therefore unspecified for this feature.

Arguments raised against Contrastive Underspecification mainly come from language acquisition. Archangeli (1988) argues that the theory of Contrastive Specification implies the use of the following algorithm, dubbed the Pairwise Algorithm by Dresher (2003b):

> "a. fully specify all segments
> b. isolate all pairs of segments
> c. determine which segment pairs differ by a single feature specification
> d. designate such feature specifications as 'contrastive' on the members of that pair

e. once all pairs have been examined and appropriate feature specifications have been marked 'contrastive', delete all unmarked feature specifications on each segment" (Archangeli, 1988: 192).

Contrastive Specification is also called the Minimal Pair method as the third step (c) makes crucial use of minimal pairs, in that only the members of a set of minimal pairs are assigned a feature specification, whereas all other segments are unspecified for that particular feature. Dresher (2003b, 2003c) argues that this method has been used by a large number of linguists, though often implicitly. Trubetzkoy (1969), for instance, "understands a feature to be distinctive in a phoneme if there is a phoneme that is identical except for that feature" (Dresher, 2003b).

Dresher argues that the Minimal Pair method runs into several problems. He gives the example of the specifications of French /p, b, m/ proposed by Martinet (1964: 64). Table 3 shows full specification; Table 4 shows the specifications after the Pairwise Algorithm has applied. Only two features, [voice] and [nasal], are considered here.

	p	b	m
voiced	–	+	+
nasal	–	–	+

Table 3. Full specification of /p, b, m/.

There are two pairs which differ by one single feature: /p/ – /b/ and /b/ – /m/. The phonemes /p/ and /b/ differ in their values for [voice] and they thus keep these values. The phonemes /b/ and /m/, on the other hand, have different values for [nasal] and so remain specified for nasality. The other values are unspecified, which is indicated by the shaded cells in Table 4.

	p	b	m
voiced	–	+	
nasal		–	+

Table 4. Specifications after application of the Pairwise Algorithm.

Dresher argues that – after the Pairwise Algorithm has applied – it is indeed possible to distinguish /p/ ([–voiced]) from /b/ ([+voiced, – nasal]) and /b/ from /m/ ([+nasal]), but that it is not possible to distinguish /p/ ([–voiced]) from /m/ ([+nasal]). Dresher states the following:

> "[S]ince these are not privative features but truly binary, we cannot conclude that the absence of a specification is necessarily distinct from a specification. Without running through the redundancy rules that tell us how to fill in missing specifications, we cannot decide if /p/ is distinct from /m/ or not." (Dresher, 2003c: 50)

The algorithm also poses a serious problem for language acquisition in that it is in principle unlearnable, since it implies that a child needs to learn the specifications of all segments before it can delete those specifications that are not contrastive in the language. Dresher therefore proposes a new algorithm, which he calls the Successive Division Algorithm:

> "a. Begin with no feature specifications: assume all sounds are allophones of a single undifferentiated phoneme.
> b. If the primordial allophonic soup is found to consist of more than one contrasting member, select a feature and divide the set into as many subsets as the feature allows for. (…)
> c. Repeat step (b) in each subset: keep dividing up the inventory into sets, applying successive features in turn, until every set has only one member" (Dresher, 2003b).

Dresher argues that one of the reasons why the Successive Division Algorithm is superior to the Pairwise Algorithm is that "it does not assume prior full specification" (Dresher, 2003b). Though a child can have a detailed phonetic perception, it does not follow that it knows all the correct phonological representations from the beginning (Dresher, 2003b).

2.3.2. Inherent Underspecification

In contrast with radical and contrastive underspecification, inherent underspecification is not temporary. It holds that all features are unary: they have only one value. This approach is also called the Single Valued Feature Theory. It assumes that all features are inherently underspecified, i.e. that all contrasts are privative, rather than binary:

> "[T]he idea that one of the values of a feature is typically the default value is carried to its logical conclusion. The claim of Single-valued Feature Theory is simply that default values play no role in the phonology whatsoever, and so features do not have such default values: each feature is single-valued" (Ewen & Van der Hulst, 2001: 81).

This means that in Single Valued Feature Theory, a particular feature is either present or absent and if it is absent, it remains absent throughout the phonology and does not get filled in by means of Default or Complement rules. If we assume a monovalent feature [voice], for example, the feature is either present as [voice] or it is absent, but there is no feature [–voice]. Archangeli notes that Inherent Underspecification is similar to the idea of privative features expressed by Trubetzkoy (1969). The discussion of Inherent Underspecification below focuses on laryngeal features.

Arguments in favour of binary laryngeal features

The main argument in favour of binary features put forward in the literature is that the negative value of [voice] ([–voice]) is needed to account for voice assimilations in the direction of voicelessness. Wetzels & Mascaró (2001), for instance, argue that analyses which assume monovalent [voice], such as Cho (1999) and Lombardi (1995b, 1996), are deficient, because according to these analyses

"one does not expect to find a language where the feature [–voice] is specified phonologically at any level of representation, or participates in phonological processes of any kind, including rules of assimilation and dissimilation" (Wetzels & Mascaró, 2001: 226).

Wetzels & Mascaró argue that [–voice] is needed to account for assimilation patterns observed in a number of languages or language varieties. A first example discussed by Wetzels & Mascaró concerns the Yorkshire dialect, in which voiced obstruents become voiceless before voiceless obstruents across word boundaries (also in compounds). The following examples have been taken from Wells (1982b: 366-367):

(1)	*bed-time*	be[tt]ime
(2)	*a big piece*	a bi[kp]iece
(3)	*live performance*	li[fp]erformance

In the Yorkshire dialect, there is no regressive voice assimilation in the direction of voicedness in voiceless obstruent + voiced stop clusters.

(4)	*white book*	whi[tb]ook (not **whi[db]ook*)

Wetzels and Mascaró argue that, since Yorkshire English does not have a rule of syllable-final devoicing, the devoicing of these obstruents can only be explained by assuming a rule which spreads [–voice] from the word-initial obstruent leftward to the word-final obstruent. However, it should be noted that in an account which assumes that the feature [spread glottis] rather than [voice] is employed in English (see Section 2.4.2 for a detailed discussion), the devoicing of the word-final obstruent can be the result of spreading of the feature [spread glottis] from the following, word-initial obstruent.

Another example which Wetzels & Mascaró use to prove the necessity of [–voice] is the devoicing of the obstruent in the Dutch past tense suffix *–de* after voiceless obstruents, as in *klap-te* ('clapped') and *raap-te op* ('picked up'), which can easily be explained as a rightward spreading of [–voice] (Wetzels & Mascaró, 2001: 234; see also Zonneveld, 1982, 1983, 2007 for a discussion of the past tense suffix in Dutch).

Arguments in favour of unary laryngeal features

Proponents of unary features argue that it is not necessary to have both plus and minus values of the feature [voice], since only one value suffices to explain processes occurring in languages. The underlying idea is that, if it is not *necessary* to have both [+voice] and [–voice], it is better not to have them.

A proponent of a unary feature [voice] is Cho (1999). She argues that a monovalent feature [voice] is able to account for the voice assimilation patterns occurring in the languages of the world. In Cho's autosegmental analysis, two parameters are needed in order to analyse the different voicing assimilation patterns. First, devoicing is regarded as a delinking process, delinking the [voice] specification from a consonant, rather than as a spread of [–voice]. Secondly, voice assimilation is seen as a spreading process, through which the [voice] specification of an obstruent spreads to a neighbouring consonant.

Another argument in favour of unary [voice] is provided by Lombardi (1995b, 1995c), who points to the fact that neutralisation of syllable- or word-final obstruents always leads to plain, voiceless obstruents. She argues that, if it is assumed that positive as well as negative values of the laryngeal features are needed (as in Binary Feature Theories) one would expect that some languages have a process of neutralisation in the direction of, for instance, voiced or glottalised obstruents. Since no such languages exist, these theories can predict unattested patterns, which should of course be avoided. Lombardi argues that a voiceless obstruent simply does not have a laryngeal node. Because neutralisation means delinking of the laryngeal node, it always results in a voiceless obstruent and never in a voiced one.

2.4. One or more laryngeal features in Dutch and English?

This section deals with the issue of whether one or more laryngeal features should be posited to express the laryngeal contrasts in Dutch and English. Section 2.4.1. discusses arguments in favour of expressing the contrasts by means of a single feature single laryngeal feature; Section 2.4.2. discusses approaches with multiple laryngeal features.

2.4.1. One feature [voice] in Dutch and English

Kingston & Diehl (1994) argue that only one laryngeal feature, namely [voice], is active in Dutch and English. They give three arguments for why only [voice] is present in languages such as Dutch, English, German and Swedish.

The first argument is that in these four languages, voicing starts earlier in one series of stops than in the other. The series in which voicing starts earlier is the [+voice] series; the other one the [–voice] series. Although Dutch and English differ with regard to the point in time at which voicing starts relative to the release of the obstruent (voicing starts much earlier after the release of both voiced and voiceless obstruents in Dutch than in English, see Section 1.5.1.), the difference between the voiced and the voiceless obstruents can be expressed as a difference in onset of voicing in both languages.

Secondly, Kingston & Diehl (1994) note that F_0 (the fundamental frequency, i.e. the number of cycles of vocal fold vibration per second) is depressed next to [+voice] stops in all these languages, independent of whether the stops are prevoiced or have a short lag VOT. This supports the claim that prevoiced stops (as the voiced stops in Dutch) and stops with a short lag VOT (as the voiced stops in English) share a common feature [voice].

The third argument is that in all four languages, "stops (and other obstruents) assimilate in laryngeal articulation in clusters in both languages" (Kingston & Diehl, 1994: 428). Processes of voice assimilation in Dutch and English are discussed extensively in Chapters 7-10. Here are two examples:

Dutch:

(5) *zakdoek* ('handkerchief'): [ˈzɑkduk] → [ˈzɑgduk]

Voice spreads from the voiced stop /d/ to the preceding stop /k/, which is then realised as [g].

English:

(6) compare: *cats* /kæt+s/ → [kæts] vs. *dogs* /dɒg+s/ → [dɒgz]

These examples show that voice spreads from the word-final stop to the plural suffix[2]. The fact that such processes exist in the two languages points to the fact that the feature [voice] is indeed present in both languages.

If it is assumed that only one laryngeal feature, [voice], is active in Dutch and English, the representations of Dutch and English voiced and voiceless stops are as represented in Table 5 if [voice] is regarded as binary or as in Table 6 if [voice] is considered to be unary:

	Voicing Lead	Short lag VOT	Long lag VOT
Dutch	[+voice]	[–voice]	
English		[+voice]	[–voice]

Table 5. Laryngeal representations of Dutch and English stops, assuming binary [voice] (Kager et al., 2007).

Dutch stops produced with voicing lead are marked [+voice]. Stops produced with short lag VOT are marked [–voice]. In English, on the other hand, obstruents with a short lag VOT are [+voice]; those with a long lag VOT are [–voice].

	Voicing Lead	Short lag VOT	Long lag VOT
Dutch	[voice]	[ ]	
English		[voice]	[ ]

Table 6. Laryngeal representations of Dutch and English stops, assuming monovalent [voice].

In Table 6 Dutch stops produced with voicing lead are marked [voice]. Dutch stops with a long lag VOT are unmarked (symbolised by the empty brackets), in contrast to the same type of stops in English, which are marked [voice]. Finally, English stops produced with a long lag VOT are also underspecified for [voice].

2.4.2. Two or more laryngeal features

Multiple features

The feature theory proposed by Chomsky & Halle in *SPE* is a theory which assumes multiple laryngeal features which are binary in nature. Chomsky & Halle (1968: 327) argue that there are four different categories which need to be accounted for:

> "(1) onset of voicing precedes stop release,
> (2) onset of voicing substantially coincides with stop release,
> (3) onset of voicing lags moderately after stop release,
> (4) onset of voicing lags considerably after stop release" (Chomsky & Halle, 1968: 327)[3]

According to Chomsky & Halle (1968) these four categories can be explained by means of four features: voicing, tenseness, subglottal pressure and glottal constriction. Since in English there is intra-speaker variation in the realisation of voiced stops (in that most speakers produce stops in which voicing more or less coincides with the release, whereas other speakers produce prevoiced stops), English contains obstruents of type (1), (2) and (4). Dutch has a contrast between obstruents of type (1) and type (2). Three patterns are thus represented by Dutch and English: voicing lead, short-lag VOT, and long-lag VOT.

The binary laryngeal features proposed in *SPE* were not widely adopted. In 1971, Halle & Stevens proposed four other laryngeal features, which were used in many later studies, namely [stiff vocal folds], [slack vocal folds], [spread glottis] and [constricted glottis]. They argue that

> "[t]hese four features are not completely independent. The combinations [+spread, +constricted] and [+stiff, +slack], are, of course, logically and physiologically excluded. The 4 features proposed thus yield 9 distinct phonetic categories of segments" (Halle & Stevens, 1971: 202).

In order to represent Dutch and English obstruents, only four categories are needed. These are presented in Table 7.

	1	2	4	5
obstruents	p	p^h	b	b_1
spread glottis	–	+	–	–
constricted glottis	–	–	–	–
stiff vocal folds	+	+	–	–
slack vocal folds	–	–	+	–

Table 7. Classification of obstruents (based on Halle & Stevens, 1971: 203).

The first column in Table 7 represents the laryngeal specifications for the plain voiceless obstruent: the glottis is not spread or constricted (in contrast with glottalised consonants, which are specified for [constricted glottis]) and the vocal folds are stiff. This type of plosive is found in Dutch. In English, on the other hand, the voiceless aspirated plosive is found: for this segment, the vocal folds are also stiff, but the glottis is spread instead of neutral. The third category is that of the voiced stop, which is represented by [+slack vocal folds]. This is the type of voiced stop found in Dutch, but not in English, where voiced stops are usually phonetically voiceless. The last type of stop, which occurs in English and is symbolised as [b_1] is represented in the last column. For the production of this type of stop,

> "[t]he vocal cords are neither spread nor constricted, and the [–slack, –stiff] configuration results in a cessation of vocal cord vibration, particularly if there is little or no expansion of the supraglottal cavities" (Halle & Stevens, 1971: 206).

The feature [spread glottis]

The feature [spread glottis] refers to the opening of the glottis during the production of obstruents, which is responsible for aspiration. Iverson & Salmons (1995) argue that only two laryngeal features are needed: [voice] and [spread glottis][4]. These two features are able to explain the laryngeal differences between Dutch and English. Table 8 presents the laryngeal representations of Dutch and English, assuming monovalent [voice] and [spread glottis].

Language	Voicing Lead	Short lag VOT	Long lag VOT
Dutch	[voice]	[ ]	
English		[ ]	[spread glottis]

Table 8. Laryngeal representations of Dutch and English stops, assuming monovalent [voice] and [spread glottis] (Kager et al., 2007).

As Table 8 shows, the feature [voice] is active in Dutch: it is present in stops produced with voicing lead but absent in segments produced with short lag VOT. The former category corresponds to Dutch voiced obstruents; the latter to voiceless obstruents. In English, the feature [voice] is not active, but instead [spread glottis] accounts for the voice contrast: stops produced with a short lag VOT are unspecified; those produced with a long lag VOT are specified for [spread glottis]. The former category corresponds to the phonologically voiced stops in English, which are phonetically realised without vocal fold vibration. The latter category corresponds to the phonologically voiceless stops, which are realised with aspiration. In languages with a more complex laryngeal system, such as Thai and Hindi, both [voice] and [spread glottis] are active.

A comparison of the Single Feature Hypothesis with the Multiple Feature Hypothesis brings to light two main differences between Kingston & Diehl's (1994) proposal, in which it is argued that only one feature, [voice], is present in Dutch and English (see Section 2.4.1.), and Iverson & Salmons (1995)'s proposal that [voice] is present in Dutch and [spread glottis] in English. A first difference is related to their views on the degree of phonetic detail that should be present in features. Whereas Iverson & Salmons' (1995) features contain detailed phonetic information (for instance about the state of the glottis), Kingston & Diehl (1994) argue that it is not necessary for features to contain so much phonetic detail. A second difference is that the active feature in languages like English is [voice] in Kingston & Diehl's (1994) model, but [spread glottis] in Kager et al.'s (2007) model.

Iverson & Salmons' (1995) model is able to provide a unified account of the absence of aspiration in /s/+stop clusters and sonorant devoicing following voiceless obstruents by means of the feature [spread glottis] (discussed in Section 1.5.1.). This model assumes that the feature [spread glottis] is shared in consonant clusters in which the first consonant is an obstruent. If the /s/ and following voiceless consonant in a cluster share their [spread glottis] specification, there is only one peak of glottal opening. Since this peak occurs before the release phase of the obstruent, the glottis starts closing earlier than in a single obstruent and no aspiration occurs. Iverson & Salmons illustrate their point by means of Figure 4:

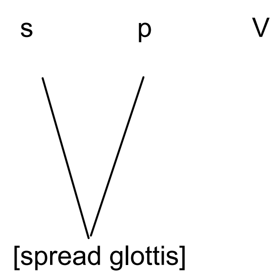


Figure 4. [spread glottis] in a consonant cluster (Iverson & Salmons, 1995: 372).

Iverson & Salmons (1995: 373) assume that the feature [spread glottis] is shared in consonant clusters, even if the second consonant is a sonorant consonant (as in, for instance, [pl], [kl], [tr]).The feature then causes the sonorant, which is normally spontaneously voiced, to be devoiced. This explains the process of sonorant consonant devoicing after voiceless obstruents.

Evidence from first language acquisition

Kager et al. (2007) (see also Van der Feest, 2007) test the validity of what they call the 'Single Feature Hypothesis' (only [voice] is necessary to explain the differences between voicing and aspirating languages) and the 'Multiple Feature Hypothesis' (both [voice] and [spread glottis] are necessary) on the basis of first language acquisition data from Dutch, German and English. They show that, if it is assumed that children make errors in the direction of the unmarked value (cf. e.g. Fikkert, 1994), the two hypotheses make different predictions about the error patterns of children learning a voicing language (such as Dutch) or an aspirating language (such as German or English). The argument is summarised here.

According to the Single Feature Hypothesis, the unmarked value is either [–voice] (if a binary feature is assumed) or unspecified (if monovalent [voice] is assumed). This hypothesis thus predicts that Dutch-, German- and English-speaking children would make errors of the type /b/ → [p], i.e. devoicing errors, since this is the unmarked value in all three languages and children are known to prefer unmarked over marked structures.

The Multiple Feature Hypothesis, by contrast, argues that two features are needed in order to account for the difference between voicing and aspirating languages. Whereas the feature [voice] is active in voicing languages, the feature [spread glottis] is active in aspirating languages. According to the Multiple Feature Hypothesis, the marked value in voicing languages is [voice]; the unmarked value is unspecified. This means that the predicted error pattern for children acquiring a voicing language such as Dutch is devoicing. The plosive /b/, for instance, is predicted to be produced as [p]. The Single Feature and the Multiple Feature Hypothesis thus make the same prediction as far as the acquisition of voicing languages is concerned. However, the Multiple Feature Hypothesis predicts a different error pattern for children acquiring an aspirating language. In an aspirating language, such as German or English, the marked value for obstruents is [spread glottis]; the unmarked value is the absence of [spread glottis]. This means that in German and English child language, an aspirated obstruent is predicted to be produced without [spread glottis]. The aspirated plosive [pʰ], for instance, is predicted to be produced as [b̥], which means that the error is a de-aspiration error.

Because the two hypotheses predict different error patterns for aspirating languages, an aspirating language such as German is a good testing ground. Kager et al. (2007) base their analysis on the productions of one child taken from the Nijmegen Database in CHILDES. It appeared that whereas this child produced hardly any devoicing errors, the number of voicing errors was relatively high. This analysis thus confirms the predictions of the Multiple Feature Hypothesis. The predictions made by the Single Feature Hypothesis are not borne out by the data.

Finally, Kager et al. (2007) tested the possibility that a purely phonetic account would also be able to explain the acquisition data. Both prevoicing and aspiration are argued to be articulatorily difficult, which would explain why children learning a voicing language omit prevoicing and thus make devoicing rather than voicing errors. It also explains why children learning an aspirating language omit aspiration and thus produce voicing rather than devoicing errors. However, a purely phonetic account cannot explain the English data of one English-speaking child (taken from the database by Wilson & Peters, 1988), which involves laryngeal harmony between the coda and the onset. An analysis of these data revealed that the voice character of word-initial plosives depended on the coda consonants. Words such as *bark*, *drink* and *geese* were all produced with a voiceless initial stop. Kager et al. (2007) explain this laryngeal harmony as a result of spreading of the feature [spread glottis] from the word-final to the word-initial consonant. Such laryngeal harmony cannot be explained in a phonetic account “due to its non-local nature and the abstractness of the specification involved” (Kager et al., 2007).

To conclude, Kager et al.’s (2007) analyses of child language data provide evidence for the Multiple Feature Hypothesis, which states that two features, [voice] and [spread glottis] are needed to account for the laryngeal contrasts in voicing and aspirating languages.

Evidence from historical phonology

Honeybone (2005) draws on diachronic phonology for evidence supporting the Multiple Feature Hypothesis. He discusses two phonological processes, the ‘Inner-German Consonant Weakening’ (a translation of ‘binnenhochdeutsche Konsonantenschwächung’, a term used by Lessiak, 1933) and the ‘English Initial Fricative Voicing’.

The Inner-German Consonant Weakening (IGCW) is a process of segmental merger, in which voiceless /p, t, k/ and voiced /b, d, g/ merge into only one category of stops, /b, d, g/. The process is thought to have occurred in Middle High German and is still present in many Central and Upper German Dialects. It occurs in all positions, i.e. word-initially, word-medially and word-finally. An example is the Standard German word *tief* (‘deep’) [t^hiːf], which in Waldau German is pronounced [diːf].

The English Initial Fricative Voicing (EIFV) is the process through which a voiceless fricative series in Old English changed into a voiced series in word-initial position in Middle English in dialects of the South of England and parts of the West Midlands. Honeybone notes that it is “a shift of, presumably first surface, and then underlying segments” (2005), leading to a laryngeal system which has only one series of fricatives, /v, ð, z/. An example is the Middle English word *uader* which evolved into the Modern English word *father*.

In a Single Feature approach, the IGCW and the EIFV can only be regarded as processes in which a series of voiceless obstruents (marked [–voice] or [ø]) changes into a series of corresponding voiced obstruents (marked either [+voice] or [voice]). The results are systems in which only one series of voiced obstruents remains in the laryngeal phonology: voiced stops in the varieties of German which have undergone the IGCW and voiced fricatives in the Middle English varieties which have been subject to the EIFV. Because voiced obstruents are more marked than voiceless ones, a phonological system containing a series of voiced obstruents but not the corresponding series of voiceless obstruents (and thereby violating the implicational universal '/b, d, g/ implies /p, t, k/') is predicted to be 'impossible' (Honeybone refers to e.g. Hyman, 1975 and Cohn, 2002). A sound change creating such a phonological system is therefore also predicted not to occur. Since the IGCW and the EIFV are exactly such processes – at least when described in the traditional way – they are highly problematic in the Single Feature approach. In contrast, a model which assumes that in aspirating languages, such as German or English, voiceless obstruents are marked for [spread glottis] and voiced obstruents are unmarked, can easily account for both the IGCW and the EIFV. The IGCW, instead of being a process merging voiced and voiceless stops into one series of voiced stops, can then be regarded as a process through which voiceless aspirated /p^h, t^h, k^h/, marked [spread glottis], and laryngeally neutral /p°, t°, k°/[5] merge into the neutral series /p°, t°, k°/. Similarly, the EIFV can be explained as a process changing aspirated voiceless fricatives, marked for [spread glottis], into the corresponding series of laryngeally neutral fricatives. Because a change from a laryngeally marked series of obstruents to a laryngeally neutral series (a process called 'delaryngealisation'), is entirely natural, the diachronic IGCW and EIFV data offer strong evidence for a Multiple Feature approach, involving the feature [spread glottis].

To conclude, Honeybone (2005) provides evidence for the [spread glottis] specification of voiceless stops in aspirating languages like German or English on the basis of historical processes.

In sum, there is appealing evidence for the Multiple Feature Hypothesis, coming from the study of first language acquisition as well as from historical phonology. In Chapter 11, it will be discussed how the study of the English interlanguage of native speakers of Dutch can be brought to bear on the issue of laryngeal representations in Dutch and English.

Dimensional Theory

In the approaches discussed above, the laryngeal features are always dependents of the Laryngeal node. Avery & Idsardi (2001), however, propose a different model of the organization of laryngeal features, which they dub Dimensional Theory. The basic claim of Dimensional Theory is that the terminal elements, which they call *gestures*, are not directly dependent on the Laryngeal node, but on three dimensions. Figure 5 presents the traditional model; the Dimensional Theory model is presented in Figure 6.

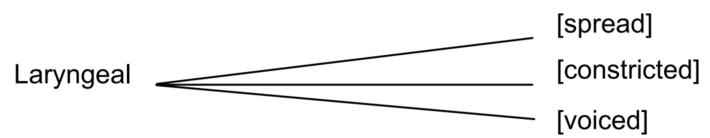


Figure 5. Standard model of laryngeal organization (Avery & Idsardi, 2001: 42).

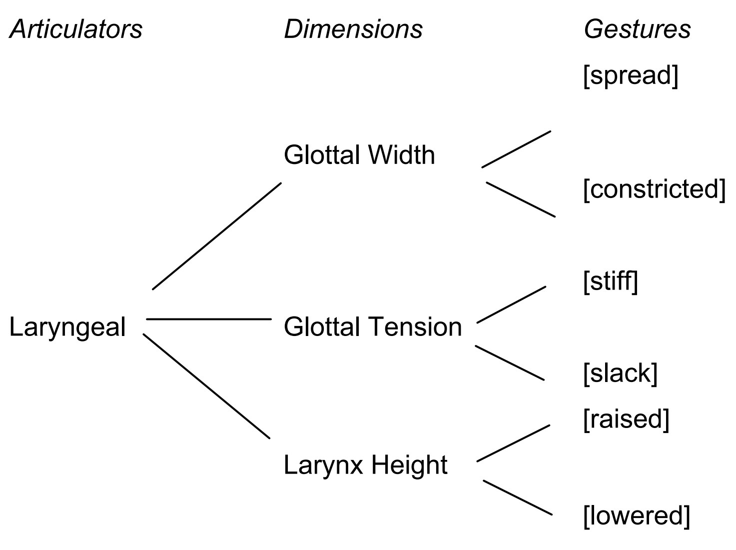


Figure 6. Dimensional Theory model of laryngeal organization (Avery & Idsardi, 2001: 42).

In Avery & Idsardi's model, the laryngeal node dominates three dimensions: Glottal Width, Glottal Tension and Larynx Height. These three dimensions form an intermediate layer between the articulator node Laryngeal and the gestures. Each dimension is linked to two antagonistic gestures. The gestures are antagonistic in the sense that they refer to the antagonistic actions of the muscles. The dimension Glottal Width, for example, is linked to the gestures [spread] and [constricted]. Since the glottis cannot be spread and constricted at the same time, the gestures are mutually exclusive. The same holds for the gestures [stiff] and [slack], which are dependents of Glottal Tension, and [raised] and [lowered], which depend on Larynx Height. Since Larynx Height is not contrastive in Dutch or English, it is not discussed further here.

It should be noted that Avery & Idsardi's gestures differ from traditional features in that gestures are direct "motor instructions to the articulators", rather than phonological units (Avery & Idsardi, 2001: 42). Avery & Idsardi define a gesture as "the smallest independent articulatory action, the action of a single muscle or muscle group". Whereas the dimensions belong to the phonological component, the gestures mostly belong to the phonetic component. The gestures cannot be binary "as the muscle is either activated or inhibited by the activation of its antagonistic partner" (Avery & Idsardi, 2001: 44). The gestures themselves are not normally contrastive. The contrastive burden is carried by the dimensions.

The process through which dimensions are mapped onto gestures is called *completion*. Avery & Idsardi note that

> "[e]ach bare dimension has a default completion, which is universal. For GT and GW the default completions are [slack] and [spread] respectively. This accords with the fact that in most languages with a two-way laryngeal contrast either a plain versus voiced distinction or a plain versus aspirated distinction is found" (Avery & Idsardi, 2001: 47).

Iverson & Salmons (2003) and Iverson & Ahn (2007) adopt Dimensional Theory to discuss the laryngeal phonologies of Dutch and English, respectively. Because their argumentation crucially refers to the assimilation patterns in both languages, their analyses are discussed in Section 2.5.2. on voice assimilation in Dutch and English.

2.5. Voice assimilation

2.5.1. Phonetic and phonological voice assimilation

Traditionally, a distinction has been made in the literature between assimilation and coarticulation (see, for instance, Dupuis, 1988: 6 and Collins & Mees, 1999: 203-204). Assimilation, also called phonemic variation, is defined by Collins & Mees (1999: 204) as the process through which a phoneme changes into another phoneme under the influence of a third phoneme. Coarticulation differs from assimilation in that it does not cause a phonemic change, but an allophonic one: an allophone is changed into another allophone "according to the phonetic context" (Collins & Mees, 1999: 203). Coarticulation is therefore also called *phonetic conditioning* or *allophonic variation*.

However, the borderline between phonological and phonetic assimilation is often thin and unclear and the definitions above, focusing on the *result* of the assimilations, are in a certain sense problematic, at least when applied to voice assimilations. The reason is that it is sometimes hard to determine whether a phoneme changes into another phoneme or whether it is a case of one allophone changing into another allophone of the same phoneme. When in a particular phrase a voiced stop /d/, for instance, causes a preceding voiceless stop /p/ to be partially realised with vocal fold vibration, is this a case of phonological or phonetic assimilation? It could be argued that it is an instance of phonetic assimilation, since the stop is realised as a partly voiced allophone [p̬] of the same phoneme /p/, but has not changed into the voiced phoneme /b/. However, it can also be argued that the stop is realised as a partly devoiced allophone [b̥] of the phoneme /b/, in which case one phoneme has changed into another phoneme. On the basis of the definitions presented above, it is thus equally possible to claim that phonological assimilation has taken place. Another interesting example is the Dutch phrase *zakdoek* 'handkerchief', which is realized as [ˈzɑɡduk] or [ˈzɑk̥duk] as the result of regressive voice assimilation. Since the voiced velar fricative /ɡ/ is not a native Dutch phoneme (see Section 1.2), this assimilation rule would thus trigger the production of a new phoneme /ɡ/, if the assimilation is considered to be phonological, but not if it is considered to be phonetic.

Another criterion to distinguish between phonological and phonetic assimilation or coarticulation is to look at what caused the assimilation to occur: if there is a phonological rule which is responsible for the assimilation, the assimilation is phonological; if the assimilation is the result of phonetic spill-over, it can be called phonetic. According to Jansen (2004, 2007a, 2007b), phonetic assimilations are gradient and phonological assimilations are discrete, which means that

> "there are no intermediate phonetic realisations between sequences that have not undergone a sandhi process and those that have, or only a finite number of such realisations" (Jansen, 2004: 102).

Jansen (2004: 35) also argues that a phonological approach to voice assimilation implies that the assimilation leads to complete neutralisation, which means that not only voice in its strict sense (i.e. vocal fold vibration), but also other cues (such as articulatory force and duration) spread from one segment to another. Phonetic assimilations, on the other hand, *can* lead to complete neutralisation "but only at the end point of a scale that contains many incompletely neutralised cases" (Jansen, 2004: 110). Phonetic assimilations are typically dependent on such factors as speech rate, speech style and intervening pauses.

2.5.2. Different approaches to voice assimilation

Rule-based accounts

In traditional generative phonology along the lines of Chomsky & Halle's *SPE* (1968), surface forms are derived from underlying forms by means of language-specific phonological rules. These rules have to apply in a fixed order, because the output of one rule serves as the input to the next rule. The model is therefore called serial. As traditional generative phonology works with binary features, rules describing voice assimilation patterns refer to [+voice] and [–voice]. The rules are language-specific and can thus describe all the specific assimilation patterns occurring in a particular language. Precisely because language-specific rules and exceptions do not cause problems in a traditional generative phonology, many studies on voice assimilation carried out in this framework offer a wealth of information on assimilation processes in different language varieties.

Another framework in which assimilation processes are expressed in the form of rules is Autosegmental Phonology, which was first presented by Goldsmith in 1976. In Autosegmental Phonology it is assumed that segments and features are positioned on different tiers and are connected to each other by means of association lines. A crucial difference between the autosegmental approach and the linear approach (used in *SPE*) is that in the autosegmental approach one feature can be associated with more than one segment. Features can, however, be delinked from segments (indicated by two horizontal bars through the association line), but they can also spread to another segment by means of a new association line (symbolised by means of a dotted line). Delinking and spreading are the basic means used in Autosegmental Phonology to account for voicing phenomena such as laryngeal neutralisation and voice assimilation.

In Autosegmental Phonology, final laryngeal neutralisation is regarded as a delinking process, through which the laryngeal specification is delinked from a segment in coda position. Figure 7, taken from Cho (1999: 109), illustrates this process:

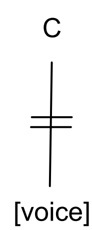


Figure 7. Delinking (Cho, 1999: 109).

Voice assimilation, on the other hand, is seen as a process through which the laryngeal specification of a segment spreads (leftward or rightward) to a neighbouring segment. Assimilation as a spreading process is illustrated by means of Figure 8 from Cho (1999: 110):

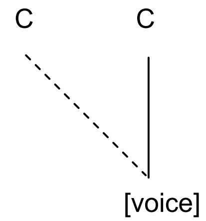


Figure 8. Spreading (Cho, 1999: 110).

If the segment to which the laryngeal specification is spread is also linked to a laryngeal specification (as is always the case in a binary framework, in which segments cannot be unspecified), a process of delinking has to precede the spreading process. As Wetzels & Mascaró argue for a binary laryngeal system (see 2.3.2.) they see assimilation as a process involving delinking and spreading:

> "Standard Autosegmental analyses derive surface forms from underlying voiced/voiceless distinctions with rules that change the voicing value through delinking (devoicing) and delinking cum spreading (assimilation)." (Wetzels & Mascaró, 2001: 208).

In a theory assuming privative features, the segment undergoing the change can also be laryngeally unspecified, in which case no delinking has to precede the spreading.

In autosegmental accounts of voice assimilation, two questions need to be addressed. Firstly, what exactly is delinked and/or spread: a feature or gesture, a dimension or the whole laryngeal node? Secondly, in which direction does the spreading take place?

Figures 7 and 8 above, illustrating delinking and spreading respectively, show that in Cho's analysis the *feature* [voice] is delinked and/or spread. In Avery and Idsardi's Dimensional Theory, however, assimilation means spreading of a *dimension*. They state that in their model "the gestures play a very reduced role in the phonology, being in general absent from the phonological representation" (Avery & Idsardi, 2001: 42). Gestures are thus phonologically underspecified, and do not participate in spreading processes.

Iverson & Salmons (2003) adopt Avery & Idsardi's model, but in their analysis it is not always clear 'what spreads'. In their account of regressive voice assimilation in Parisian French, for instance, they argue that the gesture [stiff] spreads from the second consonant to the first ("Postlexical regressive devoicing is then effected via the *leftward spread of [stiff]* from [t] into the Glottal Tension dimension of /b/, thus devoicing it to [p]" – Iverson & Salmons, 2003: 8, italics added). If Iverson & Salmons' gestures are defined in the same way as Avery & Idsardi's gestures, they should not be able to spread, as they are phonologically underspecified. In the Post-obstruent fricative neutralisation rule which Iverson & Salmons propose, however, it is the GT *dimension* which is delinked from the fricative (Iverson & Salmons, 2003: 13) and in the Dutch Progressive Assimilation rule which they propose (to account for progressive devoicing in, for instance, the Dutch past tense form *stap-de* [stɑp-tə] 'walked') the laryngeal node (Lar) spreads from the first to the second obstruent ("In inflectional syllables, Dutch Progressive Assimilation *abandons the Laryngeal articulator* of a suffix-initial voiced obstruent in favor of that which occurs in the preceding obstruent" – Iverson & Salmons, 2003: 15, italics added).

The second question which needs to be addressed in autosegmental approaches to voice assimilation is in which direction spreading takes place. Cho (1999: 46) posits a Directionality Parameter, which can take any of the following three values: (1) no specification of direction, (2) left-to-right or (3) right-to-left. Left-to-right spreading results in progressive voice assimilation; right-to-left spreading in regressive voice assimilation. The rules in autosegmental phonology thus take the form: 'Spread X to left/right'.

Constraint-based accounts

In Optimality Theory (henceforth OT), a theory which has its origin in a manuscript by Prince and Smolensky in 1993, the language-particular rules of *SPE* are replaced by universal constraints on language. In Standard OT two main types of constraints can be identified: faithfulness constraints and markedness constraints (see Section 2.2. above).

An important difference between the language-particular rules of traditional generative phonology and the universal constraints of OT is that, whereas phonological rules always apply whenever their structural description is met, constraints in OT are violable. Each language and language variety has a different constraint-ranking, so that the effect of a particular constraint can be undone by the activity of a higher ranked constraint.

OT also differs from traditional generative phonology in that it is a parallelist framework rather than a serialist one. This means that, in contrast to rules, which apply serially, all constraints work upon the input at the same time. As a consequence, there are no intermediary forms in OT. Kager (1999: 58) therefore refers to OT as an output-oriented framework: constraints work either on the output alone (markedness constraints) or on the relation between the input and the output (faithfulness constraints). This absence of an abstract, intermediary level is seen as an advantage of OT over traditional generative phonology.[6]

In OT, voice assimilations are seen as resulting from constraints which require adjacent segments to agree in voicing. Since there are no rules in OT, there is also no directionality. Lombardi (1995a: 2), for instance, proposes the following constraint:

AGREE: Obstruent clusters should agree in voicing.

A faithfulness constraint relating to [voice] (often encountered in OT analyses of voice assimilation) is the following:

> IDENT-IO (voice): "The specification for the feature [voice] of an input segment must be preserved in its output correspondent" (Kager, 1999: 14).

The constraint prevents voice specifications from changing between the input and the output. It is violated whenever voice assimilation takes place. AGREE or S-IDENT lead to the production of voicing assimilation whenever it is not dominated by another constraint which blocks laryngeal changes between input and output segments, such as IDENT-IO(voice).

(Functional-) Phonetic approaches

A different strand of research looks at voice assimilation and neutralisation from a phonetic or articulatory point of view.

In Articulatory Phonology, which originated with the work by Browman & Goldstein (1986), the phonological and phonetic components, which are traditionally separated, are merged into one component. The basic idea is that the vocal tract can be decomposed into six organs: lips, tongue tip, tongue body, tongue root, velum, and larynx. The constrictions made by these organs are the gestures, which can have a contrastive function in language and which replace the traditional features. For instance, the words *pack* and *tack* differ from one another because the former contains a lip gesture and the latter a tongue tip gesture (Goldstein & Fowler, 2003: 4). Goldstein & Fowler state the following:

> "While traditional theories of phonology hypothesize that the primitive units combine by forming linear sequences, Articulatory Phonology hypothesizes that gestures are coordinated into more elaborated 'molecular' structures in which gestures can overlap in time" (Goldstein & Fowler, 2003: 5).

In Articulatory Phonology, assimilation is seen as resulting purely from a different timing of gestures: the glottal constriction occurs earlier or later on the time axis as the result of a neighbouring sound.

Jansen (2004) notes that phonetic approaches to voice assimilation do not need rules or constraints to trigger assimilation processes, as these are supposed to be the automatic result of coarticulation:

> "(…) [A]ccording to a coarticulation-based theory, RVA [i.e. Regressive Voice Assimilation] at word boundaries occurs automatically as part of a much more general process of sound co-production every time an actively (de)voiced obstruent is juxtaposed with another obstruent: a specific

voicing coarticulation rule does not have to be postulated" (Jansen, 2004: 108).

Phonetic studies of voice assimilation have been conducted by, among others, Slis (1985), Ernestus (2000) and Jansen (2004). Slis investigated which factors influence the production of voice assimilation. He showed that various factors exerted an influence on the degree and extent of voice assimilation, among which speech rate, sex of the speaker, voice quality of the speaker and stress conditions (Slis, 1985: 13). Both Ernestus (2000) and Jansen (2004) approach voice assimilation from a functional-phonetic point of view. Jansen states that

> "[f]unctionalist models derive the set of possible, or rather *probable*, rules from external, 'ecological', factors, such as need for robustly perceptible cues to phonological distinctions." (Jansen, 2004: 9).

The speaker's tendency to reduce articulatory effort is the driving force behind neutralisation and assimilation processes and is restricted only by the need to arrive at an equilibrium between ease of production and ease of perception.

2.6. Summary

This chapter has discussed a number of concepts which are relevant for the analysis of the empirical data on L1 Dutch and DLE in Chapters 4-10. First, different criteria for defining the notion of markedness were discussed, including cross-linguistic frequency and phonetic groundedness. The concept of markedness will prove to be essential in the analysis of the learner data, which will be explained as resulting from cross-linguistic influence as well as from universal principles of markedness. Secondly, various interpretations of the notion of underspecification were discussed. This discussion served as a basis for a critical approach to the question of the unary or binary nature of laryngeal features. It also forms the necessary background for the analysis of regressive voice assimilation before sonorant consonants in Chapter 8. Finally, a number of approaches to voice assimilation were compared. In the remainder of this volume, attention is devoted to the question to what extent these different frameworks can or cannot account for the empirical findings on Dutch and Dutch Learner English conversational speech (see especially Chapters 6-11).

Notes

1. A comprehensive overview of the origins and basic characteristics of Lexical Phonology is provided by Kaisse & Shaw (1985).
2. In Optimality Theory the alternation of the English plural morpheme is considered to be the result of a phonotactic constraint in English which prohibits obstruent clusters in which the members differ in their voice realisation (see Hayes, 2004: 163).

3. Lisker & Abramson (1964) and Kager et al. (2007) distinguish only three categories: voicing lead, short voicing lag and long voicing lag. In these accounts, Chomsky & Halle's (1968) categories 'voicing coincides substantially' and 'voicing lags moderately' are merged into one category.

4. The feature [spread glottis] had already been proposed by Halle & Stevens (1971).

5. Honeybone (2005) uses the diacritic ° to indicate that the obstruent is laryngeally unmarked.

6. Other advantages of OT over traditional generative phonology are that OT does not run into the duplication problem (the co-occurrence of rules and constraints which are basically saying the same thing) or in the conspiracy-problem (the name used to refer to the phenomenon that different phonological rules which serve the same purpose cannot be formally related). For details, see, among others, Gussenhoven & Jacobs, 1998, Kager, 1999, McCarthy, 2002 and Kager, Pater & Zonneveld (2004). OT analyses have been criticised by, for instance, Van der Hulst & Ritter (2000) for the ad-hoc nature of many constraints.

Chapter 3
A database of Spoken Dutch Learner English

3.1. Introduction

This chapter provides information on the data which were used for the empirical study. The aim of the research is to examine the laryngeal system in the English speech of native speakers of Dutch. By investigating the production of stops and fricatives in different contexts, and by comparing the production of various voice assimilation patterns in Dutch, English, and Dutch Learner English, the study aims to gain insight into the laryngeal representations of obstruents and the laryngeal systems of these three languages, and in the role of transfer and markedness in the formation of an interlanguage system. The aim of the research, to examine voicing contrasts in Dutch Learner English, requires a sufficient amount of speech produced by learners of English who have Dutch as their mother tongue. In addition, since there is considerable regional variation in Dutch as spoken in Belgium, it is necessary to have precise information on the informants' variety of Dutch. The compilation of the database and the reasons behind it are explained in this chapter. The methodology adopted for the coding of the data is set out in detail.

3.2. Compiling a database of spoken Dutch Learner English

At the time when this research was carried out no spoken corpora of Dutch Learner English were available[1]. It was therefore necessary to collect data for this study. In designing the corpus a number of considerations were taken into account.

First, the interest in voicing contrasts and voice assimilations requires longer stretches of speech which is as spontaneous and informal as possible. If speakers introduce unnatural pauses between different words within the same intonation groups because they are for instance, paying attention to their pronunciation or language in general, potential assimilation sites naturally disappear. Recording conversational data produced in maximally informal settings was therefore an important consideration.

Secondly, in order to examine in detail specific phonological environments experimental data were considered an essential complement to the spontaneous data. These controlled data were gathered in a reading task.

Thirdly, in order to examine the possible influence of voicing contrasts in the informants' first language on their second language production it was essential to have information on the variety of Dutch they spoke. Both the natural conversations and the reading task were therefore also conducted in the informants' L1. The design of the corpus is illustrated in Figure 9.

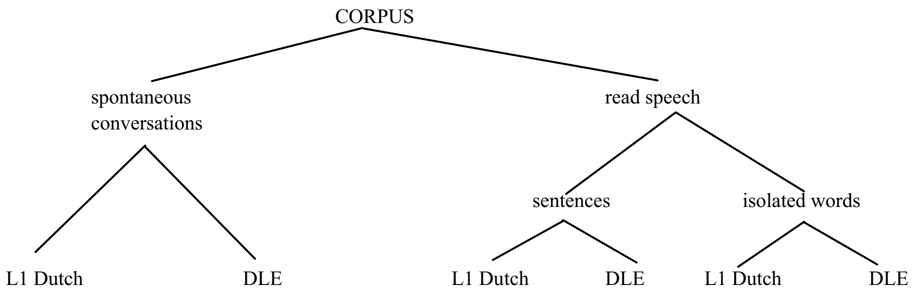


Figure 9. Design of the database.

It was considered crucial to design the recording of the Dutch conversations in such a way that they would contain the informants' most natural variety of Dutch. These conversations do not represent Standard Dutch, but varieties of vernacular Belgian Dutch, as it is spoken by young native speakers of Dutch living in East- and West-Flanders. The Spoken Dutch Corpus (*CGN, Corpus Gesproken Nederlands*)[2], which was completed in 2004, contains 9 million words of contemporary Standard Dutch spoken by native speakers of Dutch in different regions in the Netherlands and Flanders. The *CGN* also contains spontaneous conversations between dyads of speakers, but these conversations differ from the conversations in the corpus compiled for this study, in that in the former corpus the informants were asked to speak Standard Dutch to each other. The informants were told that the corpus was meant to reflect spoken present-day Standard Dutch and that they should not communicate with each other in their dialects. Even though not all informants followed this instruction equally strictly, they were aware of the requirement to speak Standard Dutch and frequently commented on this during the conversations (e.g. when discussing the 'correctness' of certain words or structures in Standard Dutch)[3]. The corpus does, however, not contain broad dialectal speech. In the corpus compiled for the present study, the informants were told they could speak whatever variety of Dutch they felt most comfortable with. The varieties of Dutch spoken in the conversations are discussed in more detail in Section 3.4.6. The corpus is thus unique in that it contains spontaneous Belgian Dutch conversations, which approximate Standard Dutch to varying degrees, and contains both Dutch and English data from the same participants.

3.3. Participants

The corpus contains data from sixteen participants. At the time of the recordings, the participants were all second-year students of English at Ghent University, who mainly knew each other from taking courses together, though some were also close friends. They were not paid for their participation, but were given a voucher from a bookstore. All had Dutch as their mother tongue and were aged between 19 and 21.

Because the phonologies of different Flemish regiolects differ considerably, it was decided to select informants from two different dialect areas: eight informants came from East-Flanders, the other eight informants came from West-Flanders. (See Chapter 8 for an explanation why precisely these two areas were chosen.) Each region was represented by an equal number of male and female speakers. Figure 10 shows the composition of the group of informants:

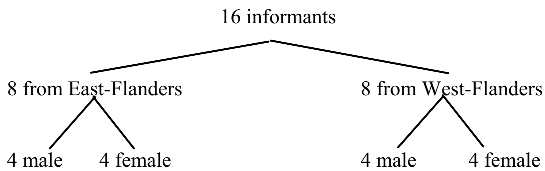


Figure 10. Composition of the group of informants.

East- and West-Flanders are dialect areas situated in the north-western part of Belgium. They are adjacent to each other.

Tables 9 and 10 provide lists of the places of origin of the informants. The regions in which these places are situated are given in bracket. In the tables, the informants are paired in the way they were paired for the conversations. For future reference all informants are given a number.

inf. no.	Male	inf. no.	Female
1	Eeklo (Meetjesland)	2	Zelzate (Ghent North)
3	Oostakker (Gent North)	4	Mater (Region of Zottegem)
5	Sint-Gillis Waas (Waasland)	6	Lokeren (Region of Dendermonde)
7	Nukerke (the region of Oudenaarde – Ronse)	8	Erwetegem (Region of Zottegem)

Table 9. List of places in East-Flanders.

inf. no.	Male	inf. no.	Female
9	Oostduinkerke (Veurne-Ambacht)	10	Sint-Lodewijk (West-Flanders south-east)
11	Bredene (West-Flemish Polders)	12	Oostende (West-Flemish Polders)
13	Kortemark (West-Flemish Houtland)	14	Poperinge (Region of Ieper-Poperinge)
15	Westouter (Region of Ieper-Poperinge)	16	Menen (West-Flanders south-east)

Table 10. List of places in West-Flanders.

All informants filled out a questionnaire, including questions about their language background, their contact with native English, and their views on the importance of a native-like competence in English and a native-like pronunciation of the language.

Three technical questions were asked, probing the informants' knowledge of the phonological processes of assimilation, aspiration and final devoicing. The questionnaire with the participants' answers can be found in appendix A.

3.4. Conversational speech

3.4.1. The set-up

The central part of the corpus consists of spontaneous Dutch and English conversations between dyads of informants. In the Dutch conversations the participants use an informal register, which strongly affects their pronunciation. As the pronunciation of formal (Standard) Dutch is very different from the pronunciation of informal, vernacular Dutch and as the Dutch and English data were meant to be comparable, the spontaneous Dutch conversations were matched to spontaneous English conversations by the same Dutch-speaking informants. Because English is a foreign language to the informants, they do not master different registers in English in the same way they do in Dutch. Moreover, at school and university students mainly come into contact with a formal register of English, in which the model used is mostly Standard British English. More particularly, the university textbooks used in pronunciation courses and the practical pronunciation guides used by the students offer RP as the model. On the other hand, students pick up the informal register and various accents from pop music and films, in which vernacular American English is frequently used. Whereas the informants use an informal register in the Dutch conversations, the register in the DLE conversations thus ranges from formal (British) English to informal (American) English, as is schematised in Figure 11:

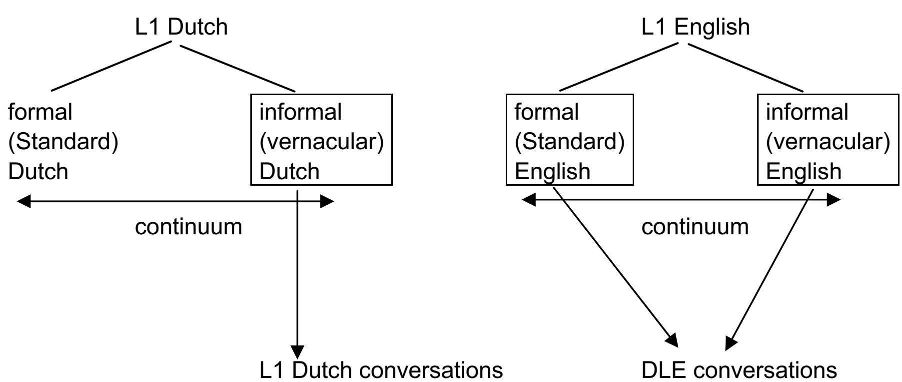


Figure 11. Influence of register on pronunciation.

It was expected that in maximally natural conversations the production of (optional) voice assimilations across word boundaries would be most frequent. Further, the corpus would offer the opportunity to investigate the influence of the informants' regional accent on their English speech.

Eight dyads of informants were asked to talk to each other for about 30 to 45 minutes about any subject they liked. Recordings were made in a sound-attenuated room and recorded on minidisk. The informants were seated at a table facing each other with the microphone positioned between them.

The English conversations were recorded either immediately after the Dutch ones or a week later. For each dyad two conversations were recorded: the first conversation was in Dutch, the second one was in English. The conversations took place in this order because the Dutch conversations offered the informants the opportunity to get used to the setting in which the recordings took place and to get to know each other a little better, so that the threshold to speak English to each other in the second recording session was lowered. In total, about ten hours of spontaneous speech were recorded (about five hours in each of the two languages).

The informants were paired in such a way that each time two participants from the same region (East- or West-Flanders) talked to each other. This was to prevent the participants from adjusting their speech in the direction of their interlocutors' regiolects. The conversations were always between a male and a female speaker, for the purely practical reason that it is easier to distinguish the voices of two speakers when they belong to different sexes[4]. The different types of conversations are schematised in Figure 12.

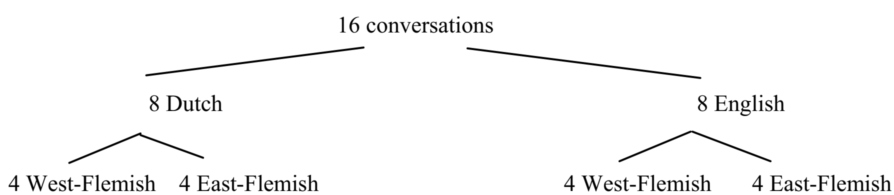


Figure 12. Structure of the spontaneous conversations.

Although the informants knew that their speech was being recorded, they were not told the exact purpose of the recordings, so as to prevent them from paying special attention to their pronunciation. They knew the recordings were going to be used for linguistic research purposes but it was not disclosed to them that their pronunciation was the focus of attention. In order to elicit maximally natural speech, no third person was present during the recordings[5].

Since the aim was to elicit informal and comparable data, it is important to point out the extent to which the Dutch and English conversations showed features of conversational style. Crystal & Davy (1969) mention, among other things, (1) conversational topics, (2) paralinguistic features and (3) the vocabulary used. These three characteristics are briefly discussed below.

3.4.2. Conversational topics

As the participants were free to talk about anything they wished, the topics they talked about varied and frequently shifted in the course of the conversation. Crystal and Davy indeed mention "randomness of subject matter and a general lack of planning" as one of the characteristics of conversational language (1969: 102). Favourite topics were exams and courses, teachers, summer jobs, holidays, hobbies, festivals, pubs, films and books. The fact that some participants gossip about teachers and fellow students indicates that they are not paying attention to the fact that their speech is being recorded or that they are not hindered by this. In some conversations, it seems that the informants deliberately gossip a lot about teachers, because they know this is risky (cf. a study by Rampton, 2003, who notes that his London adolescent informants in his study deliberately play with "risqué sexual topics", because they are conscious that their speech is being recorded).

Similar topics are discussed in the Dutch and in the English conversations, but in some English conversations the topic shifts are less natural than in the Dutch conversations. Some informants apparently notice this themselves and comment on it, as in the following fragment:

> A: yeah, but yes, uhm, it's quite weird, because when you have to talk English, it's like O.K., focussing on talking English, oh, O.K., focussing on finding subjects
> B: yeah, it's very difficult

An explanation may be that, although the informants are proficient in English, they sometimes still select conversational topics that they are able to deal with in English. At the same time, the disfluent topic shifts may also result from the nature of the task, which required two native speakers of Dutch to chat in English, for no other reason than that they volunteered to collaborate in a research project. Another fragment shows that some informants feel slightly uneasy because they have to speak English to each other:

> A: But I was I was more nervous for the English presentations.
> B: Yeah?
> A: Yeah.
> B: How come?
> A: Because it's in English.
> B: (LAUGHING) Are you nervous now?
> A: (LAUGHING) Well no, but I'm not really that comfortable.

Although the informants are proficient in English (see Section 3.4.5.), and have a great deal of receptive contact with native English (e.g. via the media, reading, lectures), they have few opportunities for practising it. One of the questions in the questionnaire was whether the informants had ever been in an English-speaking country. Two of the 16 informants had never been in an English-speaking country; the other 14 informants reported stays varying in length from one day up to nine weeks in total. Most informants also reported having little contact with native speakers of English (see question 10, Appendix A).

3.4.3. Paralinguistic features

In some conversations, there is a considerable amount of laughter, which points to the informality of the conversation. Laughter is one of Labov's channel cues for informality of speech (1972: 95). Schilling-Estes (2002: 382) refers to Wolfram (1969: 58-59), who criticises Labov's channel cues and shows that laughter can just as well be associated with nervousness and self-consciousness as with casualness. However, if one has access to the spoken data (as is the case here), it is relatively easy to decide on the basis of the context and the way of laughing whether the laughter is a signal of increased casualness or increased nervousness. In the conversations studied here, the laughter clearly indicates casualness and informality.

3.4.4. Vocabulary

Biber et al. (1999) mention the use of "a vernacular range of expression" as one of the characteristics of conversations. It is clear that the informants create a casual, informal style by their selection of lexis. Whereas this is certainly a conscious decision in some cases, it might also be the case that the informants cannot always come up with a more formal expression[6]. Only a few examples from the English conversations are provided here to illustrate the choice of vocabulary items typical of casual, informal speech, but examples are abundant in the corpus.

Nouns

– yeah, the the the one, the *weirdo* with his sunglasses, oh my god

Verbs

– and how she wanted to *bitch* him and stuff like that

Adjectives

– I thought, yeah, that's *cool*, that's *cool*

Intensifying adverbs

– Lonsdale, oh, it's like *fucking* expensive

Pragmatic elements

– and then my eldest sister, *oh my god,* she wouldn't even think about it (expletive)

– I really don't like to hear that, *you know* (discourse marker)
– she could not drink *like* one drip of alcohol, she was *like* 'oh, god' (hedge)
– it's really pathetic, *Jesus*, and I've I've told them *dozens of times*: 'you should go out', *I mean*, you're only young once (*Jesus*: expletive; *dozens of times*: lexical hyperbole; *I mean*: discourse marker)

In sum, it is clear that – given the artificial circumstances in which the recordings took place – the conversations are maximally natural.

3.4.5. Proficiency in English

As all informants are second-year university students of English language and literature, their proficiency in English is high. At the start of their university studies they had had five years of English classes at secondary school (usually two or three 50-minute classes a week). Although the English conversations reveal differences in the speakers' command of English, all informants have attained the level at which they can express themselves fluently in the foreign language (at least when they are free to choose the conversational topics). Also the quality of the informants' English pronunciation varies but all have an advanced pronunciation as defined by Fraser as a

> "pronunciation [which is] easy for a person with moderate goodwill to understand, though with a noticeable foreign accent and the occasional mispronounced word" (Fraser, 2001: 72).

3.4.6. The varieties of Dutch spoken in the conversations

The informants were asked to talk to each other in a natural, casual way. As a result, their speech deviates from Standard Dutch to varying degrees. Many informants explicitly asked whether they had to speak Standard Dutch, in which case they were told they could speak whatever variety of Dutch they felt most comfortable in. The informants' question itself is indicative of the linguistic situation in Flanders, where in informal settings only a very small minority of people speak the variety of Dutch which is regarded as Standard Dutch. The majority of native speakers of Dutch in Belgium either speak a dialect or a vernacular variety of Dutch, which is commonly referred to in the literature as an 'in-between language' (Dutch *tussentaal*).

Jaspers defines this variety as "the spoken language variety of (some) Flemings which cannot be called 'Standard Dutch', nor purely dialectal, but which lies 'in-between'" (Jaspers, 2001: 129). Since the early 1990s, there has been a fierce debate about the status of 'tussentaal', its origin, and its effects on dialects and the standard variety (cf. Taeldeman, 1992). 'Tussentaal' was stigmatised (and still is by some authors, cf. e.g. Van Istendael, 1989; De Schutter, 1998) as a poor language variety, which lacks both the prestige of a standard variety and the authenticity of a dialect. Only recently have voices arisen which describe the Flemish 'tussentaal' as a natural language variety, which is the home language in many families and has become the mother tongue of many young people in Flanders (cf. Cajot, 2000; Jaspers, 2001; De Caluwe, 2002; Slembrouck & Van Herreweghe, 2004). Slembrouck & Van Herreweghe (2004) note that, because 'tussentaal' is itself a continuum of language varieties, which is not only dependent on individual, regional and social factors, but which is also sensitive to the situational context, it is extremely difficult to define it in formal terms. Though attempts have been made (by, for instance, Geeraerts, Penne & Vanswegenoven, 2000) to provide a list of characteristics typical of the Flemish 'tussentaal', it is hard to pin down this extremely variable variety on formal grounds.

Given the polemic about this language variety (of which most of the informants were very much aware, since most of them took courses in Dutch Linguistics, in which this topic is discussed and in which students are encouraged to speak Standard Dutch in university settings), it is understandable that some informants asked additional questions about 'what sort of Dutch' they had to speak. Since the answer to questions such as 'Do we have to speak Standard Dutch?' and 'Can we really speak our own broad dialect?' was invariably that they could speak whatever variety of Dutch they felt most comfortable with, the varieties of Dutch spoken in the conversations vary considerably, ranging from strongly dialectal to close to Standard Dutch. Because there are no clear boundaries between dialect, vernacular[7] ('tussentaal') and Standard Dutch, it is hard to define what variety of Dutch is actually spoken in the different conversations which are part of the corpus. One of the questions in the questionnaires (see Appendix A) was the following:

> Do you consider yourself to be a speaker of
> (a) a dialect
> (b) Standard Dutch
> (c) Standard Dutch with some regional characteristics ('tussentaal')?

It is interesting to note that all eight East-Flemish informants ticked option (c). Option (a), 'a dialect', was chosen by five West-Flemish informants. Two West-Flemish informants chose (c) and one ticked both (a) and (c). No informant ticked option (b). The answers signal a difference between the East-and West-Flemish informants in the way they perceive their own variety of Dutch. There are three factors which may explain this difference.

First, the use of dialects is more persistent in West-Flanders than in East-Flanders. The fact that five out of eight West-Flemish informants reported that they spoke 'a dialect', whereas none of the East-Flemish informants reported this, may reflect this situation.

Secondly, West-Flanders is further away from the central Brabantine region around Brussels than East-Flanders. The vernacular of the Brabantine region is often regarded as being closer to Standard Dutch than the accents spoken in more 'peripheral' regions such as West-Flanders (in the west) and Limburg (in the east) (cf. e.g.

Slembrouck & Van Herreweghe, 2004: 861). The West-Flemish informants are therefore more likely to classify their own speech as more dialectal than the East-Flemish informants.

Thirdly, although there are many West-Flemish dialects, which are all very different from each other, the West-Flemish informants tend to perceive 'West-Flemish' as a unity, while the East-Flemish informants do not regard the regiolect 'East-Flemish' as a single unit. This is evident from the informants' answers to question (5) in the questionnaire: 'Which dialect/accent do you think has influenced your Dutch most?' (cf. Appendix A). Apart from two informants who live very close to the French border and answered 'French', all other West-Flemish informants noted that 'West-Flemish' is the accent that has the greatest influence on their Dutch. In contrast, none of the East-Flemish informants responded 'East-Flemish'; they all mentioned a dialect from a specific region. This points to a different sense of identity between the East- and West-Flemish informants: whereas the former do not regard their variety of Dutch as 'East-Flemish', the West-Flemish informants more readily identify their accents as 'West-Flemish', despite the differences between West-Flemish accents. As a result, they use their dialects more often in conversations with West-Flemish informants from other towns or villages in West-Flanders and are more likely to perceive themselves as dialect speakers.

Although the Dutch conversations are thus not 'homogeneous' as far as the variety of Dutch that is spoken is concerned, this variation was preferred to an imposed Standard Dutch variety because this factor made it possible to study the influence of the regional varieties on the L2 production. Moreover, exactly which variety of Dutch (whether broad dialect or a regional approximation to Standard Dutch) the informants speak is irrelevant for the present study. It is known from the literature that different voice assimilation patterns occur in the two regiolects concerned (see also Chapter 8).

3.5. Word reading task

Ten informants who participated in the conversations also took part in a word reading task. The word reading task took place about one year (for seven informants) or two years (for three informants) after the spontaneous conversations.[8] The informants were asked to read aloud 37 monomorphemic isolated words in Dutch and 38 words in English. The informants were seated at a table with a computer in front of them. The words appeared on the computer screen one at a time, with intervals of three seconds. The informants were thus able to read at a comfortable pace.

The word reading task was set up mainly to study the production of prevoicing and pre-obstruent vowel length in the Dutch and DLE speech of the informants[9]. Isolated words were added to the reading task because prevoicing of word-initial stops is almost impossible to perceive and cannot easily be measured when the preceding word ends in a voiced consonant or vowel. The Dutch and English words are listed in Appendix B, which also provides the translations and transcriptions of the Dutch words.

The English part of the word reading task was also performed by ten native speakers of English. This made a comparison between DLE and L1 English possible. The L1 speakers were speakers of British or Irish English who lived in Belgium at the time of the recording. They were asked a few questions on such matters as their accent and their knowledge of other languages, as these are factors which might influence their pronunciation. A summary of their answers can be found in Appendix C[10].

3.6. Methodology: Data analysis

3.6.1. Orthographic transcriptions

Approximately 15 minutes of each of the 16 spontaneous conversations were orthographically transcribed and coded in Praat (Boersma & Weenink, 2009). Pragmatic information such as hesitation markers (transcribed as *euh* or *euhm* in the Dutch conversations; *uh*, or *uhm* in the English conversations), exclamations (of the type *oh* and *ah*), pauses (marked with one or more dots depending on the length of the pause) and laughter (marked as a capital L between brackets) was included. If parts of a sentence or utterance could not be identified (sometimes because of overlapping speech or laughter), this was marked with empty brackets (e.g. *yeah, it's like the niece of E(); it's like...*).

The orthographic transcriptions reflect deviations from Standard Dutch to some extent. An example is the following (the transcriptions which do not conform to Standard Dutch are in boldface):

– **ma** 'k 'k 'k **hoordege** mijn **zuster** op **den** achtergrond, dus 'k **peinze** dat ze zo **just** thuisgekomen was, dat ze zo **gezeid** had van: 'ah ja, 'k **hen** kaarten'
  (Standard Dutch transcription: maar 'k 'k 'k hoorde mijn zus op de achtergrond, dus 'k denk dat ze zo juist thuisgekomen was, dat ze zo gezegd had: 'ah ja, 'k heb kaarten')
  'but I I I heard my sister in the background, so I think she'd just come home, that she'd said like: 'oh yeah, I've got tickets'

As a Standard Dutch transcription would in many cases deviate too much from what was actually produced by the informants and would thus be artificial, the orthographic transcriptions reflect some dialectal characteristics. They do, however, not reflect all of them (e.g. in the example, *mijn* 'my' is actually pronounced as [mə] instead of as [mɛⁱn]), as this would make it more difficult to search for certain strings in the conversations later on. The same problem did not pose itself for English, as the informants' informal English does not significantly deviate from formal Standard English (except in their choice of lexis).

3.6.2. Coding

After the conversations had been orthographically transcribed, they were coded on the presence or absence of aspirations and assimilations[11]. The codings were based on the sound files and not on the orthographic transcriptions.

Auditory judgements

The coding was done on the basis of auditory judgements. Boundaries were placed around each word or group of words that needed to be coded, which made it easy to listen to the segments several times before assigning a code. It is sometimes argued that phonetic transcriptions on the basis of perception are inaccurate. An undeniable disadvantage of basing the coding on human perception is, for instance, that the transcriber might be biased by his/her expectations (Cucchiarini, 1993: 9). In the present study, this would mean that the transcriber's semantic knowledge and expectations about aspirations and assimilations might have an undesirable influence on the coding. On the other hand, research has shown that the influence of these expectations can be minimised when transcribers shift their attention from the semantic to the segmental level (cf. Cucchiarini, 1993: 45 and references therein). There are three reasons why the codings were mainly based on auditory judgements.

First, coding the tokens on the basis of perception rather than on acoustic measurements has the advantage of being closer to the process that happens in normal communication, in which listeners do not have access to, for instance, exact voice onset time durations.

Secondly, the main part of the data used for this study is formed by spontaneous conversations. Whereas the acoustic analysis of isolated words is straightforward (which is why most studies deal with these), it is much more complicated to measure running speech acoustically. It is also unclear to what extent analysis programmes (such as Praat, which has been used for the present study) are able to cope with the complexity of running speech. Moreover, although the quality of the recordings is generally good, some background noise (e.g. informants tapping their fingers on the table) might be problematic for carrying out reliable acoustic measurements. The voiced/voiceless-distinction has, for instance, proven to be one of the problem areas in automatic transcription. A study by Binnenpoorte et al. (2004), in which an automatically generated phonetic transcription of spontaneous Dutch speech (from the Spoken Dutch Corpus) is compared with a human phonetic transcription, shows that the automatic transcriber did not approximate human-like performance in distinguishing voiced from voiceless segments.

Thirdly, one tenth of the tokens was also coded by a second transcriber. The results of the first and the second transcriber's codings were compared to each other and the rater agreement turned out to be very high for nearly all categories (see below for more information about the second transcriber and the rater agreement). In those cases where the rater agreement was low, acoustic measurements were carried out.

The coding of the tokens is based on a classification of the segments involved as voiced or voiceless, which is of course a simplification. Docherty notes:

> "[I]n this study, I identify intervals of speech as being either voiced or voiceless. This requires the imposition of a threshold on the voiceless-voiced 'continuum'. Of course, this is a characteristic of all the work which has been carried out on the timing of voicing, but the fact that this leads to a somewhat simplified view of laryngeal activity is not a factor which is explicitly recognised in the majority of studies" (Docherty, 1992: 6)

When repeated listening did not help to make a decision, the token was rejected.

The coding system

Obstruents in two positions were coded: in word-initial position and in word-final position. Word-medial obstruents were not coded and are not discussed in the present study, since the contrast between voicing and aspirating languages is less clear in medial position, i.e. voiceless stops in aspirating languages are typically unaspirated in this context (see Section 1.5.1.) and voiced stops are produced with vocal fold vibration throughout their realisation, as in voicing languages.

All word-initial plosives occurring in a stressed syllable in the English conversations were coded for presence or absence of aspiration. Four codes were used:
(1) ASP-0 : no aspiration
(2) ASP-1 : light aspiration
(3) ASP-2 : heavy aspiration
(4) ASP-C : compensation for aspiration

The first three codes reflect different degrees of aspiration: when not a hint of aspiration could be heard, the code ASP-0 was used; when aspiration could be heard, but only lightly, the code ASP-1 was used, and when the aspiration was very clear, the plosive was coded ASP-2. The last category, ASP-C, was used for those cases in which a word-initial plosive was not accompanied by aspiration, but by affrication (e.g. *talking* pronounced [ˈtˢɔːkɪŋ] instead of [ˈtʰɔːkɪŋ]) (see Section 4.2.1.).

All word-final obstruents were also coded. The six categories which were used are briefly discussed below. The examples are taken from the conversations.

(1) RVA: regressive voice assimilation

Examples:
Dutch: wa**s** **d**at [wɑz dɑt] ‘was that’: RVA
English: no**t** **b**y [nɒd baɪ]: RVA

Two remarks are in order here. First, the code RVA nearly always meant assimilation through which a voiceless phoneme became voiced. Regressive voice assimilation to voicelessness does not normally occur in Dutch (in which word-final obstruents are always voiceless except when followed by a voiced stop) or English. The auxiliaries *have to* and *used to* form an exception, as RVA to voicelessness is obligatory in these cases. If this devoicing is produced by the informants in these phrases, it was also coded RVA, although it is RVA to voicelessness.

Seconly, a phrase in which a word-final, underlying voiced obstruent was devoiced was coded FIN (Final Devoicing), even if the following, word-initial obstruent is voiceless and the devoicing could thus also be the result of regressive voice assimilation to voicelessness. In the analysis of the data, the cases of final devoicing before a pause and those of final devoicing preceding a voiceless obstruent will therefore be dealt with separately (see Sections 6.3.1 and 6.3.2).

Example:
English: han**d** **c**ould [hænt kʊd]: FIN

(iii) If a particular English phoneme was realised as another English phoneme by a speaker (e.g. /ð/ is realised as /d/), which then triggered voice assimilation, this was mentioned in the Notes section in the database.

Example:
English: u**p** **th**e [ʌb də]: RVA (Note: /ð/ is realised as [d].)

(iv) The phoneme /h/ posed a problem in the coding of the Dutch conversations. Collins &Mees (1999: 192) note that /h/ is usually voiced ([ɦ]) in Dutch. The very frequent realisation of word-final /x/ as [ɦ] before voiced sounds is coded RVA, as it involves a change from a voiceless to a voiced segment.

Example:
Dutch: to**ch** **w**el [tɒɦ wɛl] (intensifier): RVA

However, both /x/ and /ɣ/ are also realised as [ɦ] in many contexts where it cannot be the result of regressive assimilation (e.g. in word initial position, as in *da's wel grappig* [ˈɦrɑpəh] ‘that's quite funny’, see Section 1.2.).

(2) DEL: deletion. The coda obstruent is not audibly realised.[12]

Examples:
Dutch: da**t** was ‘that was’[dɑ wɑs]

English: i**t** was [ɪ wəz] (If the stop was replaced by a glottal stop, the token was coded GLOT, cf. (4) below.)

(3) PVA: progressive voice assimilation

Examples:
Dutch: laa**t** **v**allen 'let + drop' [lat ˈfɑlə]
English: no**t** **v**ery [nɒt ˈferi]

If the final consonant was deleted, but progressive voice assimilation occurred, this was coded PVA, but '+ DEL' was written in the Notes section. This type of process only occurs in the Dutch conversations.

Examples:
– da**t** **v**erwondert mij 'that surprises me' [dɑ fərˈwɒndərt]
– hij kom**t** **v**riendelijk over 'he seems friendly' [kɒm ˈfriːndələk]

(4) GLOT: glottal replacement: The coda obstruent is replaced by a glottal stop

Glottal replacement only occurs in the English conversations.

Example:
– bu**t** **r**eally [bʌʔ ˈrɪəli]

(5) FIN: final devoicing. The word-final, underlying voiced obstruent is devoiced.

Examples:
Dutch: hon**d** ook 'dog also' [hɒnt oːk]
English: do**g** is [dɒk ɪz]

(6) UNM: unmodified. No RVA, DEL, PVA, GLOT or FIN is produced; the phonemes are realised according to their underlying voice character.

Examples:
Dutch: gedraai**d** heeft [ɣəˈdrajd eft] 'has turned' (The deletion of the /h/ is mentioned in the Notes section of the database.)
English: goo**d** idea [gʊd ˈaɪdɪə]

In order to determine the underlying form of a phoneme, two criteria were used. First, a phoneme was considered to be underlying if it occurred on the surface as the result of derivation or inflection.

Examples:
– derivation: *hond* 'dog': underlying /d/, because of the plural form *honden* 'dogs' [d]
– inflection: *Ik geef* 'I give': underlying /v/, because of the plural form *wij geven* 'we give' [v]

Secondly, assimilation data were taken into account as well. An example is the word *altijd* 'always', which does not have inflected forms. It therefore always surfaces with [t], except if it is subject to assimilation (e.g. *altijd aan* 'always on' is realised with [d] in certain varieties of Dutch). The word *altijd* was thus, just as the word *tijd* 'time' (plural: *tijden* [d]), coded with an underlying [d].

Interrater agreement: the first and the second transcriber's codings

In order to check the reliability of the codings, part of the data was coded by a second, phonetically trained transcriber, who is a native speaker of Dutch and has a native-like competence in English. This second transcriber coded 1024 tokens independently of the first transcriber, which is 9.2% of the total number of tokens coded. The codes given by the second transcriber were then compared with those assigned by the first transcriber. The second transcriber coded 512 Dutch tokens (32 tokens x 16 informants). Eleven tokens had to be rejected because they were coded for a different process by the first and the second transcriber. Of the remaining 501 tokens, 30 (i.e. 5.9%) were coded differently by the two transcribers. In order to determine the rater agreement, the coefficient kappa (κ) was calculated. The method for calculating rater agreement on the basis of the coefficient kappa and the formulae discussed below are based on Eggen & Sanders (1993). The coefficient κ is a value between minus 1 and 1 which reflects the extent to which different raters agree in their judgements. It is based on tables of agreement, in which the first and the second rater's judgements are presented.

Figure 13 is a schematic representation of an agreement table showing the values given by two raters:

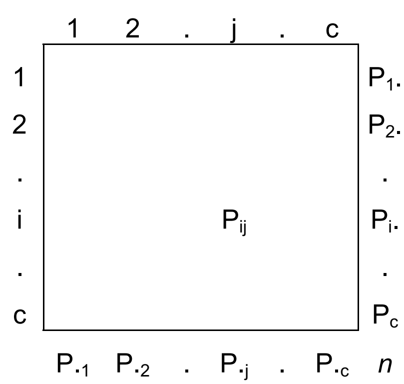


Figure 13. Rater agreement table (based on Eggen & Sanders, 1993: 448).

c = the number of rater categories
i = category index for rater 1, with i = 1, …, c.
j = category index for rater 2, with j = 2, …, c.

$P_{i\cdot}$ = proportion of tokens assigned to category i by rater 1
$P_{\cdot i}$ = proportion of tokens assigned to category i by rater 2
P_{ij} = The proportion of objects assigned to category i by rater 1 and to category j by rater 2.

The coefficient κ makes use of two values: P_o and P_e. P_o is the sum of all the tokens on which the two raters agreed over the total number of tokens rated. It is calculated as follows:

$$P_o = \sum_{i=1}^{c} P_{ii} .$$

The other value necessary to calculate the coefficient kappa is P_e:

$$P_e = \sum_{i=1}^{c} P_i . P_i .$$

The coefficient κ is then calculated with the following formula:

$$\kappa = (P_o - P_e)/(1 - P_e) .$$

Eggen & Sanders (1993) note that coefficient κ is 1 if there is perfect agreement between the two (or more) raters. If κ is 0, the agreement between the raters is equal to chance. A negative κ means that the raters agree on fewer tokens than would be expected by chance and a κ of -1 means that there is no agreement at all between the raters. Eggen & Sanders (1993) refer to the following table by Landis & Koch (1977), which is often used for the interpretation of the coefficient κ.

κ			**Interpretation**
<.00			'poor'
.00	-	.20	'slight'
.21	-	.40	'fair'
.41	-	.60	'moderate'
.61	-	.80	'substantial'
.81	-	1.00	'almost perfect'

Table 11. Interpretation of the coefficient κ (Landis & Koch, 1977).

Table 12 is the agreement table representing the first and the second transcriber's codings for the Dutch tokens.

	1st	1	2	3	4	5	6		
2nd		RVA	DEL	PVA	GLOT	FIN	UNM		
1	RVA	0,163673	0,001996	0,001996			0,007984	0,175649	P1.
2	DEL		0,207585				0,003992	0,211577	P2.
3	PVA		0,001996	0,233533			0,015968	0,251497	P3.
4	GLOT		0,001996				0,003992	0,005988	P4.
5	FIN	0,003992				0,043912		0,047904	P5.
6	UNM	0,00998	0,003992	0,001996			0,291417	0,307385	P6.
		0,177645	0,217565	0,237525	0	0,043912	0,323353	1	
		P.1	P.2	P.3	P.4	P.5	P.6		

Table 12. Agreement table for the Dutch tokens coded by the two transcribers.

Po = the sum of the values in the shaded cells = 0.94012

Pe = $(P_1. \times P._1) + (P_2. \times P._2) + (P_3. \times P._3) + (P_4. \times P._4) + (P_5. \times P._5) + (P_6. \times P._6) = 0.238469$

κ = 0.921369

The coefficient κ is 0.93, which means that the rater agreement between the two transcribers for the Dutch conversations is "almost perfect" (see Table 11).

In codings of the English tokens, four tokens were coded for a different phenomenon by the two transcribers. This means that 508 English tokens (i.e. 32 × 16 – 4) were coded by the two transcribers. A comparison between the first and the second transcriber's codings of these tokens revealed that 79 out of these 508 tokens received a different coding (15.6%). These results are similar to the results in Ernestus' (2000) study, in which three trained phoneticians judged the voice character of intervocalic stops drawn from a corpus of casual Dutch. She found that 15.1% of the tokens (322 out of a total of 2136) were not unanimously classified as voiced or voiceless.

A closer look at the tokens which were classified differently by the two transcribers showed that the category of aspirations (ASP-0, ASP-1, ASP-2 and ASP-C) was to a large extent responsible for the variation in the codings. Of the 508 tokens coded by the two transcribers, 51 were coded for aspiration, of which 26 were coded differently by the two transcribers. When the distinction between light (ASP-1) and heavy (ASP-2) aspiration was not considered, 18 out of 51 tokens were still coded differently.

Because there was interrater variation in the codings of the aspirations, the coefficient κ was calculated separately for the codings of the aspirations by the two transcribers. The coefficient κ is .27 for the codings of word-initial voiceless stops for the presence or absence of different degrees of aspiration. A coefficient κ of .27 means that the rater agreement is still 'fair', though somewhat close to being only 'slight'. It was therefore decided to measure the VOTs of all word-initial voiceless stops followed by a vowel. These VOTs (in milliseconds) were fed into the database.

Table 13 shows the agreement between the first and the second rater's codings of the English tokens, without the codings of the aspirations.

	1st	1	2	3	4	5	6		
2nd		RVA	DEL	PVA	GLOT	FIN	UNM		
1	RVA	0,133479	0,004376				0,015317	0,153173	P1.
2	DEL	0,006565	0,089716	0,004376		0,002188	0,02407	0,126915	P2.
3	PVA			0,017505			0,002188	0,019694	P3.
4	GLOT				0,04814		0,008753	0,056893	P4.
5	FIN					0,166302	0,021882	0,188184	P5.
6	UNM	0,019694	0,002188	0,002188	0,002188		0,428884	0,455142	P6.
		0,159737	0,09628	0,02407	0,050328	0,16849	0,501094	1	
		P.1	P.2	P.3	P.4	P.5	P.6		

Table 13. Agreement table for the English tokens coded by the two transcribers (except aspirations).

Po = 0.884026
Pe = 0.2998
κ = 0.83437

The coefficient κ for the English codings is .83, which is lower than for the Dutch codings, but the rater agreement is still 'almost perfect' according to Landis & Koch' table (Table 11).

In conclusion, the rater agreement value (expressed as the coefficient κ) proved to be very high for the codings of both the Dutch and the English tokens (when the codings of the aspirations are left out of consideration) by the first and second transcriber. It was therefore decided that the codings are sufficiently reliable for the purpose of this study and that (except for the aspirations) no acoustic measurements needed to be carried out. The fact that the agreement rate was higher for the Dutch tokens than for the English ones can probably be explained by the fact that both the first and the second transcriber have Dutch as their mother tongue. The observation that a high number of aspirations were coded differently by the two raters might be due to the use of a different scale of degree of aspiration. Because of the low rater agreement, it was decided to acoustically measure all the aspirations in the spontaneous conversations as well as in the reading tasks (see Sections 4.2.1. and 4.2.2.).

3.6.3. Number of tokens in the database

All codes were fed into an Access-database. The database contains 9439 tokens in total. The number of tokens per language is presented in the following table according to the position in the word:

	Dutch	English
word-initial (possible aspiration sites)	--	543
word-final	4931	3965
total per language	4931	4508
total number of tokens coded	9439	

Table 14. Composition of the database.

Because the conversations are spontaneous, the number of tokens coded for each informant differs considerably. Some informants simply talked much more than their interlocutors and thus produced more possible aspiration and assimilation sites. In addition, some speakers produced more tokens that could not be coded, because they were uttered very softly or were not well articulated. The numbers of coded tokens for each informant in the Dutch and DLE conversations are provided in Appendix D.

3.7. Summary

The data used for the empirical part of this study are of two main types: casual conversations and reading speech. These two kinds of data are complementary and both have their own specific function. The use of natural conversations is unusual in phonological research because of the impossibility of controlling the relevant variables (but see e.g. Ernestus, 2000 for a similar approach). Nevertheless it was argued in this chapter that for the specific task of examining voicing and voicing assimilations connected speech as produced in conversation has great value. The disadvantages (in particular the fact that speech rate and the phonological context in which the target obstruents occur are uncontrolled) are outweighed by the advantages for the purposes of this particular study. Further, the problems of coding on the basis of auditory perception are also recognised but cogent arguments for its preference over acoustic measurements have been given. As the sound files of all examples are available on the CD accompanying this book, the analyses of the examples are verifiable and moreover the data can be used by other researchers for future linguistic analyses.

Notes

1. The *Louvain International Database of Spoken English Interlanguage* (*LINDSEI*) is of immense value for future research (see Granger 1993, 1994). It now also contains interviews with native speakers of Dutch in Flanders. These interviews were conducted at Ghent University and recordings and transcriptions were in progress at the time this research was carried out. The *LINDSEI* CD-rom and accompanying handbook are in press.

2. More information on the Spoken Dutch Corpus can be found on the following website: http://lands.let.ru.nl/ cgn/ehome.htm [accessed 4th August 2009].

3. Reinhild Vandekerkhove, p.c.

4. While the sex of the speaker has been shown to have some influence on VOT (Slis, 1985; Ernestus, 2004), the difference tends to be minimal (e.g. the difference between male and female participants in the production of prevoicing did not reach significance in Ernestus' 2004 study, see Section 2.5.1). It is therefore assumed to be unlikely that, if male speakers adjusted their speech to that of female speakers or vice versa, this would have affected the laryngeal realizations of their obstruents. Since all participants were 19-21 years old (see Section 3.3), no interference from accommodation from younger to older speakers, or vice versa was possible.

5. In a pilot experiment, six informants were interviewed by the researcher, once in Dutch and once in English. The two interviews together lasted about 15 minutes. Although the informants did not know the researcher personally, they knew she was working at the English Department. It appeared that this knowledge had an effect on the naturalness of the data. The informants seemed to pay extra attention to grammar, vocabulary choice and pronunciation. In order to solve the problem of Labov's Observer's Paradox (Labov, 1972: 61), it was therefore decided not to interview the informants, but to let them talk to each other in a room with no third person present. It was also decided to record much longer conversations (lasting 30 to 45 minutes) for the final corpus than was done for the pilot experiment, as it appeared that the informants got really engaged in the conversations after a while and because the presence of recording equipment might make them self-conscious at the beginning of the session (cf. e.g. Coates, 2003). For these same reasons, the first five minutes of each conversation were not used in the analysis.

6. As the informants hear a more formal register of English in their lectures every day, they are certainly familiar with it. However, many students tend to write very informal English when they are asked to write academic texts, which points to the fact that they do not actively master a more formal register. Keeping formal and informal registers apart is a problem for many students.

7. The tem *vernacular* is used by Labov (1972) to refer to the variety used by informants in the most casual contexts, i.e. when they pay least attention to their speech. In the data for this study the 'tussentaal' used by the students can be called their 'vernacular' in the Labovian sense. However, that the situation is more complex than the use of the label 'vernacular' might suggest, is discussed in Section 3.4.6.

8. The reading task data were collected at least one year after the conversational data, when it turned out that more controlled data would provide an added value to the analysis of the semi-spontaneous data in the conversations. Because of this time gap between the two tasks, it is possible that the informants were somewhat more proficient in English when performing the reading tasks than when participating in the conversations.

9. Labov (1972: 99) found that informants tend to style-shift on the continuum of contextual styles from casual speech to formal speech to three reading styles (passage reading, word lists, minimal word pairs). Informants pay least attention to their speech in casual, spontaneous con-

versations and most when reading minimal word pairs. The more attention they pay to their speech, the closer their speech comes to the prestige variety. It is therefore to be expected that the informants in the present study also style-shift in the same way, using varieties that approximate Standard Dutch to different degrees.

10. While no data were collected on the length of residence in Belgium of the L1 English participants in the control group, they were all working in English-speaking environments and thus spoke English on a daily basis. They all reported to speak one or more languages besides their native language, English, but none of them reported to be bilingual (see Appendix C, question 6).

11. The first four conversations were also transcribed phonetically. Because this proved not to be necessary for the coding of the aspirations and assimilations afterwards, the other 12 conversations were only transcribed orthographically.

12. A token was coded DEL whenever the stop was not audibly released. This does not necessarily mean that the stop was altogether absent, i.e. the articulators may still have approached each other to form a constriction, but rather that it could no longer be perceived. Since the codings were based on auditory judgments, no distinction could be made between a stop which was completely deleted and one which was not audible.

Chapter 4

Acquiring stops: Aspiration and prevoicing

4.1. Introduction

This chapter discusses the target realisation of word-initial voiceless and voiced stops in L1 Dutch and L2 English and the realisations produced by the informants in the conversations and the reading tasks described in Chapter 3. The discussion of voiceless stops focuses on three processes which occur in L1 English, but not in L1 Dutch: aspiration, sonorant consonant devoicing and glottal replacement. The question is to what extent these three processes appear in the English speech of the Dutch-speaking informants. The examination of the production of voiced stops focuses on an analysis of prevoicing in word-initial stops in the word reading task. Both the Dutch and the DLE words are analysed. The presence or absence of prevoicing is also examined in the same words produced by native speakers of English. It is investigated to what extent the participants produce prevoicing in their Belgian Dutch variety and how they deal with the variation between prevoiced and unprevoiced stops in English. The findings are summarised and conclusions are formulated which place these findings in the larger context of what is known about laryngeal acquisition.

4.2. Aspiration

4.2.1. VOT in conversational speech

English voiceless stops are usually aspirated and this aspiration is strongest in word-initial position in a stressed syllable (see Section 1.5.1). In Dutch, on the other hand, voiceless stops are unaspirated. In order to find out to what extent the informants aspirate in English, all word-initial voiceless stops occurring initially in a stressed syllable in the spontaneous conversations were coded for presence or absence of aspiration. Stops were classified in four categories (ASP-0, ASP-1, ASP-2 and ASP-C, see Section 3.6.2.). Because the rater agreement for the codings of aspirations by the first and second transcriber was low (see Section 3.6.2) it was decided to measure the VOTs of all word-initial voiceless stops on the basis of the oscillograms and spectrograms. The VOT was taken to be the period from the burst up till the first periodic wave. In total, the VOTs of 525 word-initial voiceless stops in stressed syllables were measured. The analysis of aspiration is based on the VOT measurements[1].

Only 16 out of a total of 525 word-initial voiceless stops were produced with friction instead of aspiration (i.e. the category that was coded ASP-C). Seven of these occurred in the speech of one informant. This type of friction only occurred after initial /t/, not after /p/ or /k/. Out of these 16 words, nine were either *two* or *too*, both realised as [t^{s}uː] and five were *talk* [t^{s}ɔːk] or *talking* [ˈt^{s}ɔːkɪŋ]. The spectrogram on the left of Figure 14 below shows the realisation of the word *two* with friction of the stop by a male, East-Flemish speaker (no. 1). In order to allow comparison, the spectrogram on the right shows the production of the stop /t/ with normal aspiration in the word *time*, also produced by a male, East-Flemish informant (no. 3). (Only the stop and part of the vowel are presented.)

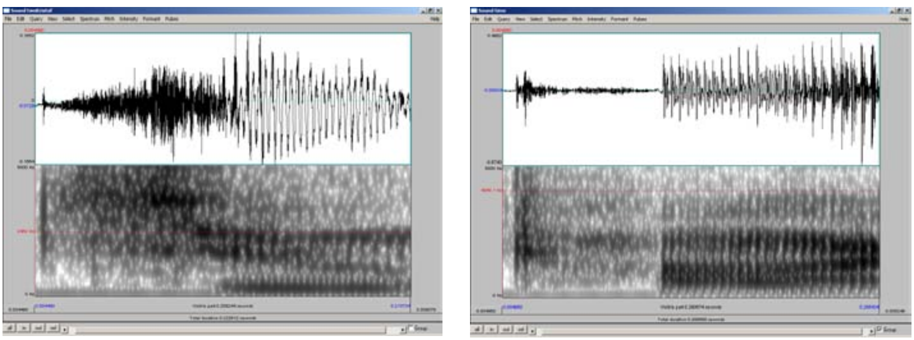


Figure 14. left: *two* realised with friction, as [t^{s}uː] (a); compare: right: *time* realised without friction, as [t^{h}aɪm] (b).

In the figure on the left, the burst of the /t/ is followed by a period of heavy friction, caused by the airstream which hits the tongue and the teeth. As can be seen, the friction gradually increases and then decreases again before the vowel is produced. In the figure on the right, on the other hand, the burst is followed by a period of very low friction, caused by the air which is released. Because the air does not hit a baffle, the friction caused by this airstream is minimal.

The production of friction after an initial /t/ might be the result of influence from L1 English, in which it also sometimes occurs (such as in Australian English and in varieties of English spoken in Dublin and Middlesbrough, cf. Jones & McDougall, 2005; Jones & Llamas, to appear). On the other hand, it might also be the result of an attempt to produce aspiration. When the air behind the closure for the production of the /t/ is released while the teeth are still close together, some friction is automatically produced. The production of word-initial /t^{s}/ rather than /t^{h}/ might hence be the result of imperfect timing. Because the production of such a friction noise after an initial /t/ is not a normal case of aspiration, the following discussion does not deal with the tokens which were coded ASP-C.

The average VOT after voiceless stops in the spontaneous conversations for all informants together was 48 ms. Nearly all studies in which VOT values are measured in L1 English are based on laboratory speech (e.g. Lisker & Abramson, 1964; Klatt, 1975; Docherty, 1992) (see Section 1.5.1.). As it has been shown that there is a positive correlation between speech rate and VOT and as speech rate is generally higher in spontaneous conversations than in words read in isolation or in a carrier phrase in a laboratory environment, the mean VOT in the DLE conversations cannot be compared to a value in L1 English.

The graph in Figure 15 presents the average VOTs for word-initial /p, t, k/ in the spontaneous DLE conversations per participant. The participants are presented in order of increasing VOT from left to right.

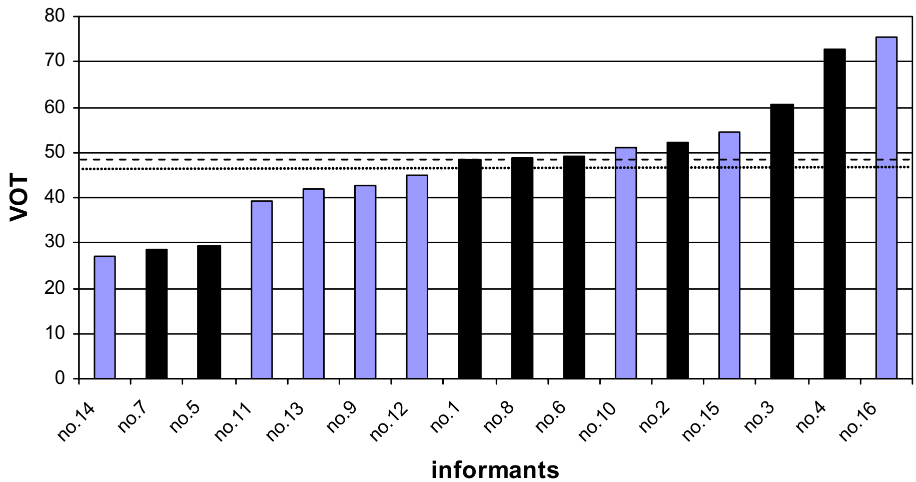


Figure 15. Average VOT per informant in the spontaneous conversations (East-Flemish: black bars; West-Flemish: grey bars; high dashed line: average VOT for the WF informants; lower dotted line: average VOT for the EF informants).

Figure 15 shows that there are considerable differences in average VOT between the 16 informants. As the graph shows, there is no correlation between the VOT of an informant and the region where s/he is from, as the mean VOTs for all West-Flemish and East-Flemish informants are very similar (47 ms for the East-Flemish and 49 ms for the West-Flemish group).

4.2.2. VOT in isolated words

The results of the spontaneous conversations can be compared with the production of aspiration in the isolated words read by ten of the 16 informants. The Dutch and English word lists contained three words starting with /p, t, k/ in Dutch (namely *paar* 'pair', *test* 'test', *kaak* 'cheek') and three in English (*pie*, *take*, *cake*).[2] The graph in Figure 16 presents the average VOTs in the Dutch and English words per participant and in the English spontaneous conversations. (Informant no. 1 produced the word *talk* with a fricated [t]. The VOT value of this token (107 ms) is not considered in the graph in Figure 16.)

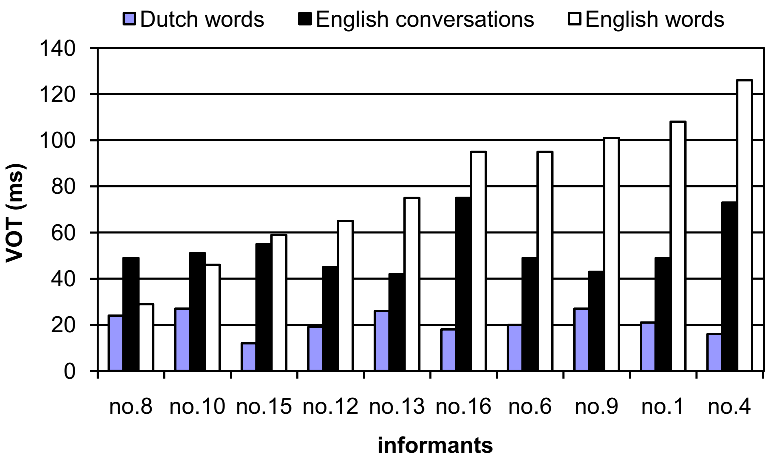


Figure 16. Average VOT per informant.

As expected, the differences in VOT values between the informants are much less significant for the Dutch than for the English words. The VOT values for the Dutch words all lie between 12 and 27 ms, with an average of 21 ms for all informants together. This is similar to the average VOT noted by Lisker & Abramson (1964) and Flege & Eeftink (1987)[3].

The average VOT in the isolated English words was 80 ms, which is considerably higher than the average VOT for these ten informants in the spontaneous conversations, which was 53 ms. Of the ten informants whose readings were analysed, four were East-Flemish; the other six were West-Flemish. The average VOT for the East-Flemish informants was 90 ms, which is not significantly different from the average VOT value for the West-Flemish informants, which was 74 ms.

For all but two informants, the average VOT was lowest in the Dutch isolated words (mean VOT for all informants: 21 ms), considerably higher in the English spontaneous conversations (mean VOT: 53 ms) and even higher in the English isolated words (mean VOT: 80 ms). The difference in VOTs between the spontaneous conversations and the word reading task is probably for a large part due to different speaking rates in the two genres, as an increase in speech rate implies a decrease in VOT. Kessinger & Blumstein (1998), for instance, found that both the VOTs and the vowel lengths of English words starting with /pi/ and /pæ/ increased considerably when four native speakers of American English were asked to produce these words (embedded in a carrier phrase) in a slow speaking mode. However, it should also be kept in mind that the reading task data were collected one to two years after the conversational data and that the participants may thus have been in a later developmental stage when performing the reading tasks (see Chapter 3, footnote 7).

In order to compare the average VOTs produced by the Dutch-speaking informants to VOT values of native speakers of English, comparable data are needed. In Docherty's (1992) experiment, in which five native speakers of British English read words in a phrasal context, the mean VOT was 63 ms. This value lies between the VOTs produced by the Dutch-speaking informants in the English isolated words (82 ms) and those produced in the spontaneous conversations (48 ms). Klatt (1975) conducted a similar experiment with three native speakers of American English. The average VOT after word-initial voiceless stops in prevocalic context across speakers was 61 ms, which is thus very close to Docherty's average VOT for native speakers of British English. However, in both Docherty's and Klatt's study, the words were embedded in a carrier phrase. This might (partly) explain why the values in the DLE reading task are higher than in Docherty's and Klatt's study on L1 English. In order to have VOT values produced by native speakers of English in isolated words, ten native speakers of English were also asked to perform the reading task. The average VOT in these informants' readings was 76 ms, which is slightly lower than the average VOT produced by the native speakers of Dutch who participated in the word reading task. The graph in Figure 17 presents the average VOT in the English isolated words read by the native speakers of English. The dotted line presents the average VOT for all L1 English participants together (76 ms).

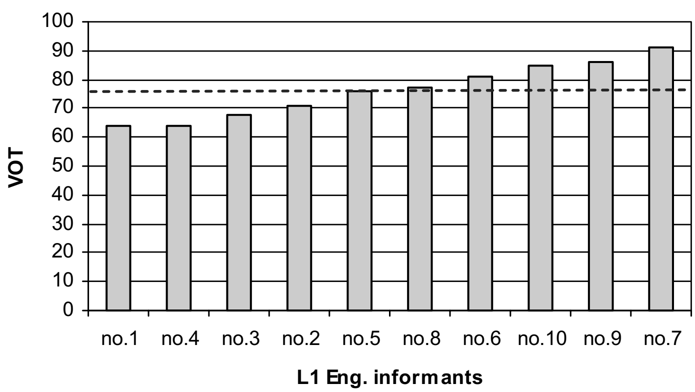


Figure 17. Average VOT per L1 English informant in the word reading task (dotted line: average VOT for all L1 English participants together).

A comparison between Figures 16 and 17 reveals that the differences between the lowest and the highest average VOT are much smaller in the English words read by the L1 English speakers than in the English words read by the native speakers of Dutch.

We compare our results with the results found by Flege & Eeftink (1987), who conducted a study on VOTs of voiceless /t/ in DLE. Forty of their Dutch-speaking informants were students majoring in English at the University of Utrecht; the other ten were studying engineering at a technical college in Delft. The same words were also read by five native speakers of British English (who at the time of the recordings were all living in the Netherlands and all spoke at least some Dutch). Flege & Eeftink's analysis shows that the average VOT in the English words read by the native speakers of English was 90 ms, which is considerably higher than the average VOTs for /t/ in Docherty's (1992) study on British English (average VOT: 76 ms) and in Klatt's (1975) study on American English (average VOT: 65 ms), as well as those in the present study (average VOT: 76 ms). This difference might again be due to the fact that both in Docherty's and in Klatt's study the stimuli were embedded in a carrier phrase, whereas in Flege & Eeftink's study they were produced in isolation. The results also revealed that the Dutch engineering students produced much lower VOTs in English than the students of English, who produced VOTs of 69 ms on average, which is very close to the average VOT produced by the students of English in the present study (who had a mean value of 73 ms for /t/). Flege & Eeftink (1987) also found that

> "[a] few (6%) of the Dutch subjects actually produced English /t/ with mean VOT values that exceeded the native English mean by more than one standard deviation" (Flege & Eeftink, 1987: 194).

Flege & Eeftink (1987) link the high VOT values of the Dutch-speaking university students of English in their study to the fact that these students had been explicitly told that English voiceless stops are aspirated:

> "They are likely to have received explicit instruction pertaining to the VOT difference distinguishing English versus Dutch stops. It is therefore possible that they exaggerated VOT in producing English /t/. This hypothesis was supported by the observation that several Dutch subjects 'overshot' the English VOT norm for /t/" (Flege & Eeftink, 1987: 197).

The same explanation seems to apply in the present study for some native speakers of Dutch. Participant no. 4, for instance, reported in a conversation that took place after all recordings had been made, that she made a conscious attempt to produce aspiration, in order to sound native-like. This participant produced a mean VOT value of 126 ms in the isolated words, which is the highest average value produced by any of the informants and probably the result of hypercorrection. The high VOTs in the isolated words read by some informants indicate that these informants are (whether subconsciously or not) aware of the fact that – in order to sound native-like in English – they have to aspirate. It should in this context be remembered that all informants are advanced students of English at university level and their attention has explicitly been drawn to the process of aspiration in their pronunciation classes. When asked to define aspiration and to give an example, five out of nine informants who participated in the reading task could provide a more or less adequate definition or example (cf. Appendix A, question 15).

Some informants also seem to associate aspiration with a posh native accent, as can be illustrated with a fragment from one of the spontaneous conversations, in which an informant (no. 4) is retelling a conversation she and her fellow students had with one of their teachers of their poetry classes:

(7)[4]

(1) A: – we asked what we were supposed to do with uh the reading list
(2) and uh
(3) B: – read it (LAUGHING)
(4) A: – 'well, perhaps you can read them and
(5) B: – [LAUGHING
(6) A: – 'maybe I'll I'll give you a question on your exam'
– 'yes, but how are we supposed to read them and uhm…won't you give any uh details?'
(8) – 'No, I won't, I won't discuss them in class.
(9) I I..I personally emphasise *poetry*,
(10) yes *poetry'*
(11) B: – *'poetry'*
(12) A: – *'poetry*, yes, *poetry* by John Donne'
(13) B: – oh yeah
(14) A: – 'and the Metaphysical Poets', oh my god, ugh
(15) B: – boring

In the lines in which A quotes this particular teacher, she slows down the speech rate considerably (cf. lines 4, 6, 8) and when she comes to the subject of poetry, she starts imitating a posh British accent, which she does by clearly over-aspirating the initial /p/ in the word 'poetry'. The VOTs of the word 'poetry' in lines 9, 10 and 12 (2x), are, respectively, 115, 92, 93 and 116 ms. The fragment shows how this informant associates extreme aspiration with a posh accent and how she successfully manipulates VOT for humorous purposes.

Place of Articulation

It has often been argued in the literature that the place of articulation of a voiceless stop has a significant effect on its VOT. More specifically, it has been argued that the further backward the place of articulation, the longer the VOT (cf. Docherty, 1992: 25, for an overview of studies dealing with this issue). The VOT for the velar (/k/) would thus be longer than for the alveolar (/t/), which in its turn would be longer than the VOT for the bilabial (/p/). Cho & Ladefoged (1999) conducted an experiment with speakers of 18 different languages from 12 different language families. It indeed appeared that in all but one of the 13 languages which had no contrast between velars and uvulars, the velar stops had the longest VOTs[5]. One of the reasons for a longer VOT after velars is that the cavity behind the constriction is relatively small for velars in comparison to alveolars and labials. When the air coming from the lungs is compressed behind the constriction by the action of the muscles, the air pressure increases. This increase in air pressure is higher in a small cavity than in a larger one, leading to longer VOTs in velars than in alveolars or labials. Another aerodynamic reason is that the oral cavity in front of the constriction is larger in velars than in alveolars and labials. This means that, when the glottis opens, the body of air that has to leave the oral cavity before voicing can begin is larger for velars than for alveolars and labials, again leading to a longer VOT (Cho & Ladefoged, 1999: 209-210)[6].

Table 15 shows the average VOT for /p,t,k/ in the word reading task in L1 Dutch (ten native speakers of Dutch), L1 English (ten native speakers of English) and DLE (the same ten native speakers of Dutch).

	L1 Dutch (10 informants)	**L1 English (10 informants)**	**DLE (10 informants)**
p	12	80	80
t	23	73	64
k	29	76	86

Table 15. Mean VOT in word-initial /p,t,k/ in isolated words (in ms).

In the L1 Dutch and DLE isolated words, velar /k/ was realised with a longer mean VOT than /p/ or /t/, a finding which is in line with the literature. In the L1 English words, however, /p/ was realised with a slightly longer average VOT than /k/. The alveolar /t/ was also longer than the bilabial /p/ in the L1 Dutch words, but not in the L1 English or DLE data. When we compare the results from the present study with the results in Docherty's (1992) and Klatt's (1975) studies, we see that in Docherty's study, VOT does not vary with place of articulation in the way described in the literature, though the labial has the shortest VOT. In Klatt's (1975) study, on the other hand, the VOT increases as the place of articulation of the stop is further backwards.

4.3. Sonorant consonant devoicing

When a word-initial voiceless plosive is followed by a sonorant consonant in English (e.g. *play*), the sonorant is devoiced. Sonorant devoicing in English is – just like aspiration – the result of the wide open state of the glottis at the time the plosive is released. Because the glottis size is smaller during voiceless stops in Dutch, sonorant consonants remain voiced when following a voiceless stop (see Section 1.5.1.). As sonorant consonant devoicing occurs in English, but not in Dutch, and reflects the laryngeal realisation of voiceless stops, it will be investigated to what extent this type of devoicing occurs in the DLE of the informants.

Sonorant consonant devoicing has only been coded systematically in the spontaneous conversations between the informants in word-initial /pl/-clusters. In the English conversations, all words containing an initial /pl/- cluster (49 in total) were cut out (e.g. *play(ing), please, place(s), planning*). On the basis of the sound files and the spectrograms, the clusters were classified on the presence or absence of devoicing of the /l/. The words and spectrograms were inspected by two phonetically trained transcribers (see Section 3.6). Six clusters were rejected, because it was too difficult to make a judgement on the voice character of the sonorant. Of the remaining 43 clusters only 11 were produced with devoicing of the sonorant, six of which were produced by East-Flemish informants and five by West-Flemish informants.

In the word lists read by ten informants, five Dutch and five English words occurred which had a voiceless stop + sonorant consonant in the onset. The English words were *try, clean, crew, play* and *pray*; the Dutch words were *trui* 'jumper', *klok* 'clock', *kreeft* 'lobster', *plek* 'place' and *pruim* 'plum'. For each of these words, the VOT was measured (in ms) and taken to be the period from the release of the plosive up till the first periodic wave. Figure 18 presents the average VOT for the Dutch and English words per participant[7]. The informants are presented on the X-axis in the same order as in Figure 17 on aspiration.

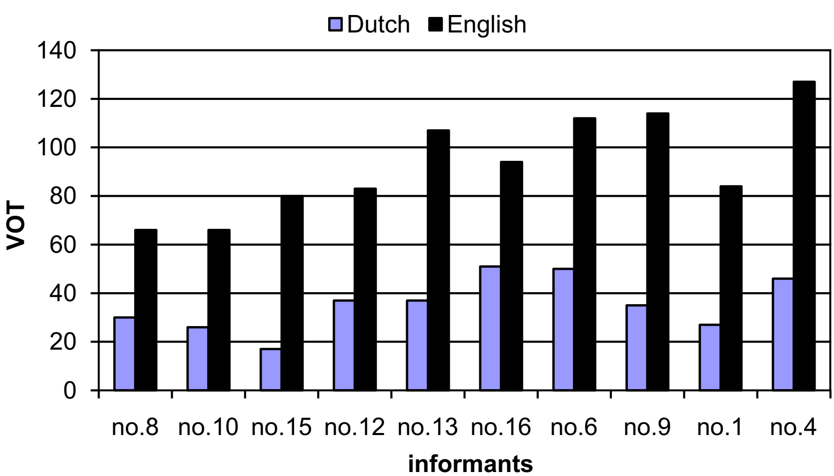


Figure 18. Sonorant consonant devoicing.

For all informants, the average VOT in the Dutch clusters was considerably lower than in the English clusters, which indicates that – when reading aloud – the informants produced voiceless stops in English differently from voiceless stops in Dutch. The average VOT for all informants together was 36 ms for the Dutch words and 93 ms for the English words. Since in the spontaneous conversations only one fourth of the /pl/-clusters were classified as having a devoiced /l/, the results seem to indicate that the informants may be able to produce voiceless stops with a spread glottis in

English in isolated words, but fail to phonetically implement this knowledge in spontaneous conversations. Generally, participants who produced long VOTs in stop + vowel clusters also produced long VOTs in stop + sonorant consonant clusters (with a correlation of 0.8).

Table 16 compares the results of the Dutch-speaking informants with the results of the native speakers of English in the present study and in Docherty's (1992) and Klatt's (1975) studies, in which respectively ten and five native speakers of British (and Irish) English and three native speakers of American English read words starting with /tr, kl, kr, pl, pr/ clusters.

	L1 Dutch present study	**DLE present study**	**L1 (BrE+ Irish E.) present study**	**L1 BrE Docherty (1992)**	**L1 AmE Klatt (1975)**
/tr/	37	95	104	105	93
/kl/	49	107	95	68	77
/kr/	45	118	110	88	84
/pl/	24	69	84	48	61
/pr/	24	78	90	88	59
mean	36	93	97	74	75

Table 16. Sonorant consonant devoicing in Docherty, 1992 (L1 English) and present study (DLE).

As was the case for the VOT values reflecting the degrees of aspiration in voiceless stop + vowel clusters, the mean VOT value in voiceless stop + sonorant consonant cluster is higher in the English speech of the Dutch informants than in that of the native speakers of English in Docherty (1992) and Klatt (1975). It is, however, slightly lower than the mean VOT value produced by the ten L1 English speakers in the present study (97 ms). This may be due to the fact that the words in these two studies were embedded in carrier phrases, whereas the words in the present study occurred in isolation. The high VOT values in the DLE words indicate that the informants have acquired the realisation of voiceless stops followed by sonorant consonants in English. Because sonorant consonant devoicing is much less salient than aspiration, the process of sonorant devoicing had been mentioned in the informants' phonology course in the context of allophonic variation of /l/ in English (clear [l] in e.g. *like*, dark [ɫ] in e.g. *well*, and devoiced [l̥] in e.g. *play*), but it had not been dealt with or practised in the pronunciation sessions.

4.4. Glottal replacement

In many varieties of English (including RP, cf. e.g. Collins & Mees, 1996), word-final voiceless stops are sometimes replaced by glottal stops (see Section 1.5.4.). Whereas glottal replacement most frequently occurs when it is followed by a homorganic consonant, it is also possible before other consonants and before vowels. Glottal replacement of voiceless stops does not normally occur in Standard Dutch. In the English conversations, 196 tokens were coded GLOT, meaning that the word-final consonant was replaced by a glottal stop[8]. Of these 196 tokens, 185 involved replacement of word-final /t/, nine of /d/, one of /ð/ and one of /k/.

Glottal replacement of /t/ frequently occurred in utterance-final position (52 tokens), but also before a vowel (26 tokens) or a non-homorganic consonant (such as /j/, /r/, /w/). Here are some examples:

(8) too much of i*t*, too much [ɪˀ] (WF)
(9) we go*t* a statement [gɒˀ ə] (WF)
(10) once you ge*t* used to it [geˀ juːst] (WF)

Since no word-final consonants were replaced by glottal stops in the Dutch conversations, the relatively frequent occurrence of glottal replacements in the DLE conversations means that the informants have learnt that voiceless stops can sometimes be replaced by glottal stops in English[9]. Whereas glottal *reinforcement* was dealt with explicitly in the pronunciation classes the informants had taken the previous year, the students had not been encouraged to produce glottal *replacements*. Because glottal replacements are abundant in, for instance, Estuary English (the variety of English spoken by an increasing number of people in the south of England, see e.g. Rosewarne, 1994), it is not unlikely that some informants produce glottal replacements because they associate these with a young and trendy variety of English. One participant (no. 13), for instance, noted in the questionnaire that a Cockney hip-hop group served as his model of English. The following example is taken from this participant's speech:

(11) because now, this year, I'm on uh, I'm on on a fla*t*, I'm in a fla*t*, living in a fla*t* [flæˀ] (WF)

The word *flat* is repeated three times with a glottal stop instead of a /t/ in the coda.

The ten tokens in which a word-final voiced /d/ or – in one case /ð/ – was replaced by a glottal stop were produced by three informants, who thus occasionally apply the rule in a context in which it does not normally apply in L1 English. Examples are the following:

(12) other dogs that are bigger than them they woul*d*… they'd…gladly attack [wʊˀ] (EF)
(13) the only problem wi*th* my place right now [wɪˀ] (WF)

It should be noted that only glottal replacement and not glottal reinforcement was coded in the conversations. Collins & Mees (1999) note that

> "[p]re-glottalised forms are *never* used with *any* lenis consonant. This is an error which is characteristic of the English of more advanced learners, who tend to produce *[gʊˀd ˈmɔːnɪŋ] and *[ˈdɒˀg kɒlə] for *good morning, dog collar*" (Collins & Mees, 1999: 153).

Although glottal replacement is a step further than glottal reinforcement (the consonant is replaced by a glottal stop, rather than that the glottal stop precedes the consonant), the three participants who occasionally produced glottal replacements of voiced stops in the English conversations (see example 12 above) presumably overgeneralized the rule of glottal replacement.

4.5. Prevoicing

Whereas in Dutch word-initial voiced stops are generally prevoiced, in English there is variation between realisations with and without prevoicing (see Section 1.5.2.). In order to investigate whether the informants produce prevoicing in English voiced stops, the English word lists which were read by ten informants contained 20 words starting with an initial voiced stop. This list was also read by the ten native speakers of English. Ten of these words started with a labial /b/; the other ten with an alveolar /d/. To allow a comparison between Dutch and English, the informants also read 20 Dutch words starting with voiced stops, with the same division according to their places of articulation. For each token the prevoicing duration was measured, starting from the first periodic wave up till the burst.

4.5.1. Prevoicing in L1 Dutch

Tables 17 and 18 show the results for, respectively, the Dutch words starting with a labial and those starting with an alveolar. (The translation of the Dutch words is given in Appendix B.) The duration of prevoicing is expressed in milliseconds. When no prevoicing was produced, a zero ('0') was written in the appropriate cell. The mean values and standard deviations in the bottom row are the mean values of the prevoiced tokens.

	bal	baan	beek	boom	bod	bind	bak	bot	bed	bol	mean
no. 1	184	148	178	177	186	207	163	149	163	178	173
no. 4	184	101	100	119	122	173	107	143	123	148	132
no. 6	137	106	111	**0**	213	134	165	108	142	112	123
no. 8	0	94	83	105	103	89	88	100	104	138	90
no. 9	151	130	163	147	141	177	149	147	142	136	148
no. 10	126	73	77	44	56	58	37	66	54	66	66
no. 12	**0**	155	122	98	77	96	88	76	100	96	91
no. 13	301	178	172	143	197	162	132	124	142	249	180
no. 15	130	143	140	194	156	137	143	140	118	152	145
no. 16	208	**0**	52	121	106	65	98	31	113	**0**	79
mean	**178**	**124**	**120**	**128**	**136**	**130**	**117**	**108**	**120**	**142**	**130**
s.d.	**58**	**34**	**43**	**45**	**52**	**51**	**41**	**40**	**31**	**52**	

Table 17. Prevoicing duration in Dutch isolated words starting with /b/ (in ms).

	dom	deel	dol	dans	dik	deuk	dal	doos	duin	denk	mean
no. 1	182	186	208	162	208	156	142	166	114	156	168
no. 4	93	**0**	99	86	92	144	100	159	122	84	98
no. 6	108	142	115	**0**	136	177	116	**0**	120	91	101
no. 8	80	92	77	68	44	95	93	72	94	93	81
no. 9	119	112	113	96	109	118	110	119	85	106	109
no. 10	80	58	73	43	53	42	43	26	106	92	62
no. 12	83	133	130	83	99	**0**	56	48	73	92	80
no. 13	166	172	265	166	168	167	145	124	133	111	162
no. 15	162	164	147	139	157	145	115	166	123	139	146
no. 16	136	124	129	**0**	90	**0**	**0**	120	**0**	**0**	60
mean	**121**	**131**	**136**	**105**	**116**	**131**	**102**	**111**	**108**	**107**	**117**
s.d.	**39**	**41**	**59**	**45**	**52**	**44**	**35**	**52**	**20**	**25**	

Table 18. Prevoicing duration in Dutch isolated words starting with /d/ (in ms).

Tables 17 and 18 show that nearly all tokens were realised with prevoicing. Only 14 out of 200 realisations lacked any prevoicing (marked bold in the tables), half of which were produced by the same informant (no. 16). Prevoicing thus occurred in 93% of the tokens and the average duration was 115 ms. As can be seen in the tables above, the mean duration of prevoicing is somewhat longer for labials (130 ms) than for alveolars (117 ms), which was expected, as the anterior place of articulation of labials means that the oral cavity can more easily be expanded for labials than for alveolars, which leads to a slower increase in intra-oral air pressure and thus to a more favourable environment for the production of prevoicing (see Section 1.5.2.).

Figure 19 shows the waveform and spectrogram of the Dutch word *dans* 'dans', once produced with prevoicing (by informant no. 1) and once produced without prevoicing (by informant no. 16). The arrow points at the period of prevoicing or the absence of it.

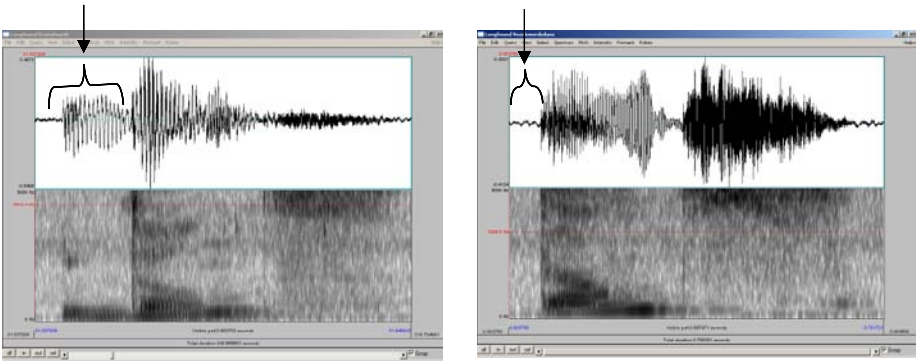


Figure 19. The Dutch word *dans* 'dance' produced (a) with prevoicing (left) and (b) without prevoicing (right) by, respectively, informant no. 1 and 16.

Van Alphen (2004), who investigated prevoicing in Dutch isolated words read by ten native speakers of Dutch, found that only 75% of the tokens were prevoiced (see Section 1.5.2.). However, in Van Alphen's test items, the initial stop could be followed by a vowel or a consonant. Of the stops followed by a vowel, 85.5% was produced with prevoicing. This is still 7.5% lower than in the present study. The average *duration* of prevoicing in Van Alphen's study (i.e. 117.5 ms), on the other hand, is very similar to the average duration in the present study (i.e. 123 ms).

An explanation for the difference in frequency of prevoicing could lie in the fact that the informants in Van Alphen's study are native speakers of Dutch in the Netherlands, whose pronunciation is undoubtedly very different from the pronunciation of the informants in this study, who speak different varieties of Belgian Dutch. It is possible that the absence of prevoicing is indeed more frequent in the Dutch variety spoken in the Netherlands than in the variety spoken in Belgium. Anecdotal evidence in support of this hypothesis comes from the way native speakers of Belgian Dutch replace voiced stops by voiceless ones when imitating the pronunciation of Dutch as it is spoken in the Netherlands. The most famous example is the realisation of the word *België* 'Belgium', *Belg* 'Belgian' and *Belgisch* 'Belgian' with a [p]. The following examples, taken from online discussion forums, illustrate that the word is sometimes even (mockingly) spelled this way.

> – (…) was hij regelmatig op de Nederlandse TV te zien als "on*s*e specialist uit *Pelgië*" (www.forum.zwartofwit.be, July 2004)
> '(…) [H]e could regularly be seen on Dutch television as 'our specialist from *P*elgium' and got space in the magazines to tell the Dutch people how bad everything is over here."
> – En dan durven die Nederlanders over '*tomme Pelgen*' spreken. (http://lvb.net/item/5974, accessed January 2009).
> 'And then the Dutch dare to speak about 'stupid *P*elgians'.

The perception of Netherlandic Dutch (as opposed to Belgian Dutch) voiced stops as voiceless by native speakers in Flanders might also be the result of the greater lip compression with which /p/ is realised in the former accent as opposed to the latter one. Further research is needed to examine whether prevoicing is indeed more frequently absent in Netherlandic Dutch than in Belgian Dutch.

Van Alphen (2004) argued that the frequent absence of prevoicing in the Dutch words read by her informants might be due to two factors: (1) the fact that the underlying [voice] specification in Dutch is not always realised phonetically and/or (2) the fact that English exerts a great influence on the Dutch language, which might lead to omission of prevoicing (see Section 1.5.2.). As there are many assimilation rules in Belgian Dutch as well, the first factor is not convincing. The second factor could play a role, as it might be argued that the influence of English, though certainly present in Flanders, is more important in the Netherlands. On the contrary, in Flanders, the influence of French, in which stops are prevoiced as well, might increase the production of prevoicing. However, an argument against this hypothesis is the fact that the single informant (no. 16) who omitted prevoicing most (in 7 out of 20 words) comes from Menen, a village very close to the French border (see Section 3.3.), where she also went to school. In the questionnaire, she states that the dialect/accent that has influenced her Dutch most is French (cf. Appendix A, question 5). Moreover, as prevoicing is non-salient and hard to suppress (see below), it is hard to believe that native speakers of Dutch would simply lose this specification because they hear and speak English. Van Alphen refers to Canadian French, in which voiced stops also frequently lack prevoicing as a result of influence from Canadian English, cf. Caramazza & Yeni-Komshian, 1974. It is clear, though, that the status of English in the Netherlands, though probably still increasing in some domains, is still very different from its status in Canada.

4.5.2. Prevoicing in L1 English and Dutch Learner English

Section 1.5.2. contained a discussion of how different studies on the presence or absence of prevoicing in English voiced stops showed different results: some studies reported that the majority of tokens were produced without prevoicing, in other studies prevoicing seemed to be the norm rather than the exception. Moreover, the production of prevoicing showed significant interspeaker-variability, prevoicing being very frequent in the speech of some native speakers but completely absent in the speech of others. The variation in L1 English was visible in the isolated word lists read by the ten native speakers of English. Tables 19 and 20 show the duration of prevoicing in initial voiced stops in the 20 /b/- or /d/-initial words in the reading task.

	boy	bite	bed	bean	bit	bide	bet	bought	bid	ball	mean
No. 1	0	0	0	0	0	0	0	0	0	0	0
No. 2	75	0	0	0	0	0	0	0	0	0	8
No. 3	84	0	0	0	0	84	0	118	0	0	29
No. 4	106	135	104	126	127	136	69	92	107	102	110
No. 5	0	0	0	60	0	63	0	0	137	40	30
No. 6	0	0	0	0	43	0	0	0	0	0	4
No. 7	0	0	0	0	0	0	0	0	148	0	15
No. 8	0	0	0	0	0	0	0	0	0	0	0
No. 9	0	0	74	0	53	66	0	0	91	0	28
No. 10	79	0	0	87	179	0	0	59	72	0	48
mean	**86**	**135**	**89**	**91**	**101**	**87**	**69**	**90**	**111**	**71**	**93**
s.d.	**14**	**n.a.**	**21**	**33**	**64**	**34**	**n.a.**	**30**	**32**	**44**	

Table 19. Prevoicing in English isolated words with /b/ in the onset, produced by ten L1 English speakers.

	date	dance	doll	died	diet	did	doom	dot	deal	dirt	mean
No. 1	0	0	0	0	0	0	0	0	0	0	0
No. 2	0	0	0	0	0	0	0	68	66	0	13
No. 3	0	0	0	0	0	0	0	0	0	0	0
No. 4	137	0	97	134	143	0	135	125	110	121	100
No. 5	0	0	0	0	0	51	76	0	40	0	17
No. 6	0	0	0	0	0	0	0	0	0	0	0
No. 7	0	0	0	0	0	0	0	0	0	0	0
No. 8	0	0	0	0	0	50	0	0	0	0	5
No. 9	0	0	87	0	74	0	65	58	0	59	34
No. 10	92	80	75	103	78	121	86	0	0	0	64
mean	**115**	**80**	**86**	**119**	**98**	**74**	**91**	**84**	**72**	**90**	**91**
s.d.	**32**	**n.a.**	**11**	**22**	**39**	**41**	**31**	**36**	**35**	**44**	

Table 20. Prevoicing in English isolated words with /d/ in the onset, produced by ten L1 English speakers.

Tables 19 and 20 show that the native speakers of English realised by far the majority of tokens (72.5%) without prevoicing. Only 29 out of 100 /b/-initial and 26 out of 100 /d/-initial words were produced with prevoicing. Two speakers, no. 4 and no. 10, especially showed a tendency to produce prevoicing. This is in line with the observation made by Docherty (1992) that speakers tend to either lack prevoicing in initial voiced stops (the majority) or show a tendency to produce prevoicing more systematically (see Section 1.5.2.).

Tables 21 and 22 present the duration of prevoicing in the isolated English words read aloud by the Dutch-speaking informants. The words in Table 21 start with bilabial /b/; the ones in Table 22 with alveolar /d/.

	boy	bite	bed	bean	bit	bide	bet	bought	bid	ball	mean
no. 1	138	145	118	168	148	115	161	157	158	157	147
no. 4	126	79	**0**	92	98	96	86	104	99	105	89
no. 6	117	66	106	118	118	103	140	121	154	94	114
no. 8	67	59	103	100	84	66	81	95	81	70	81
no. 9	78	150	126	152	100	94	102	101	79	95	108
no. 10	55	68	101	70	40	70	52	57	100	82	70
no. 12	86	69	159	**0**	**0**	85	**0**	54	71	51	58
no. 13	160	135	159	178	168	203	158	150	155	135	160
no. 15	144	140	148	184	150	175	143	154	180	173	159
no. 16	65	66	109	106	125	**0**	69	77	95	117	83
mean	**104**	**98**	**125**	**130**	**115**	**112**	**110**	**107**	**117**	**108**	**113**
s.d.	**38**	**39**	**24**	**42**	**39**	**47**	**41**	**38**	**40**	**38**	

Table 21. Prevoicing in English isolated words with /b/ in the onset (in ms), produced by L1 Dutch informants.

	date	dance	doll	died	diet	did	doom	dot	deal	dirt	mean
no. 1	153	83	130	127	108	150	138	134	154	155	133
no. 4	92	78	140	100	94	100	105	105	65	79	96
no. 6	135	98	143	121	108	146	128	133	117	118	125
no. 8	85	66	86	81	21	72	61	64	93	45	67
no. 9	99	111	117	74	103	71	93	117	106	89	98
no. 10	48	76	44	64	**0**	59	23	58	53	29	45
no. 12	57	**0**	**0**	**0**	**0**	121	92	**0**	99	**0**	37
no. 13	120	110	117	147	169	141	121	167	158	142	139
no. 15	136	119	127	126	133	146	155	159	142	148	139
no. 16	65	64	105	107	**0**	136	**0**	85	113	**0**	68
mean	**99**	**89**	**112**	**105**	**105**	**114**	**102**	**114**	**110**	**101**	**105**
s.d.	**36**	**21**	**31**	**28**	**45**	**36**	**41**	**39**	**35**	**48**	

Table 22. Prevoicing in English isolated words starting with /d/ in the onset (in ms), produced by L1 Dutch informants.

Tables 21 and 22 show that only 15 out of 200 tokens were realised without prevoicing. Nine of these were produced by informant no. 12 and four by informant no. 16, who also produced 7 out of 20 Dutch tokens without prevoicing. The percentage of prevoiced English tokens is thus 92.5%, which is about the same as the percentage of prevoiced Dutch tokens (93%) and sharply contrasts with the percentage of prevoiced L1 English tokens, which was only 27.5%. As with the Dutch tokens, the prevoicing duration varies with the place of articulation of the stop: the mean duration is 113 ms for labials and 105 ms for alveolars. The average VOT of the English tokens is 109 ms, which is somewhat lower than the 123 ms of the Dutch tokens. Although the realisation of voiced stops in English is variable, the fact that the Dutch-speaking informants produce 92.5% of the English voiced stops with prevoicing strongly indicates that they transfer the production of prevoicing from their Dutch stops onto their English stops.

Figure 20 shows the presence versus absence of prevoicing in the English word *diet* realised by informant no. 13 (left) and 16 (right).

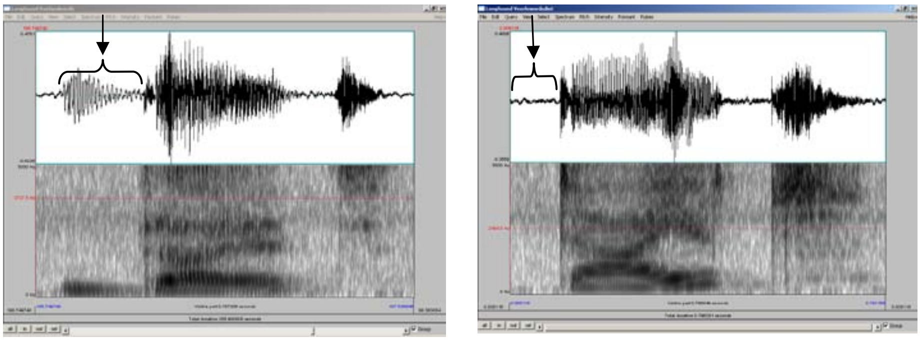


Figure 20. The English word *diet* produced (a) with prevoicing (left) and (b) without prevoicing (right) by, respectively, informant no. 13 and 16.

When we look at the individual informants, there does not seem to be a strong correlation between the duration of prevoicing in the Dutch and English tokens. The graph in Figure 21 presents the results per informant.

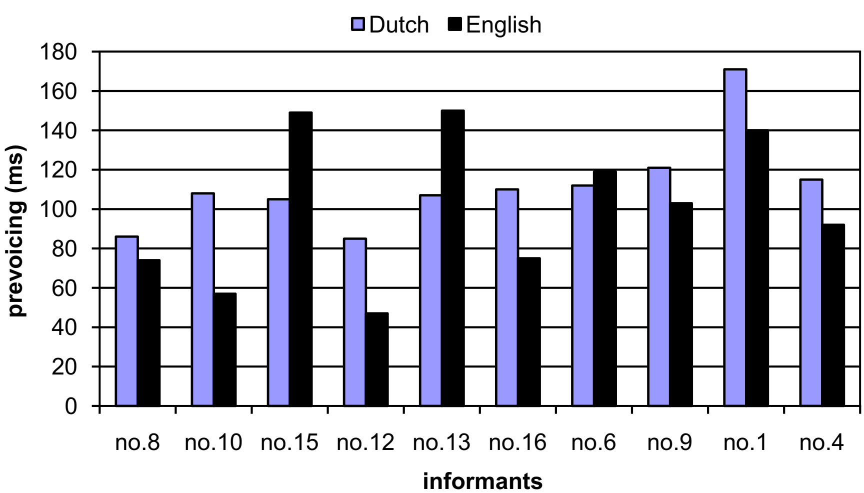


Figure 21. Prevoicing duration in Dutch and English compared per informant.

The graph shows that there are considerable inter-speaker differences. The mean prevoicing duration ranges from 85 ms (no. 12) to 171 ms (no. 1) in the Dutch tokens and from 47 (no. 12) to 150 (no. 13) in the English tokens. This means that the variation in duration is slightly larger in the Dutch than in the English tokens (i.e. 103 ms vs. 86 ms difference).

4.5.3. Conclusion on prevoicing in DLE

In the Dutch variety of the informants, voiced stops are normally produced with prevoicing: the participants produced in nearly all word-initial voiced stops in the reading task (only 14 out of 200 tokens were realised without prevoicing). In L1 English, on the other hand, both realisations with and without prevoicing are possible, though the majority of speakers do not normally produce it. The analysis of the word reading task by the ten native speakers of English confirmed this, as only 27.5% were produced with prevoicing, 30 of which were produced by two informants. Native speakers of Dutch learning English are thus faced with a situation in which there is (almost) no variation in the production of initial voiced stops in their mother tongue (i.e. prevoicing is nearly always present), but some variation in the production of prevoicing in the foreign language. The analysis showed that nearly all English words read by the Dutch-speaking informants were realised with prevoicing, which means that the variation possible in English disappeared in DLE. Consequently, the situation is such that only one form (e.g. x) occurs in the mother tongue and two forms are possible in the L2, of which one is the form that occurs in the L1 (e.g. x and y). Form x rather than y occurs in the interlanguage, even though y is more common in the target language. As L1 English speakers show a tendency for either prevoiced or unprevoiced stops (as was also confirmed in the word reading task of the ten native speakers of English in the present study), the fact that the native speakers of Dutch realised (nearly) all tokens with prevoicing does not make them sound non-native. Although prevoicing is possible in L1 English, the fact that 97% of the initial stops in the word reading task were prevoiced, points to the fact that the informants transfer the realisation of their voiced stops from Dutch into English. While extra articulatory gestures are needed to produce voicing in word-initial stops and prevoiced stops can thus be said to be more marked than unprevoiced stops, unprevoiced stops hardly occurred in the DLE words.

4.6. Summary

This chapter provided an analysis of the production of word-initial stops and word-final glottal replacement in L1 Dutch and DLE conversational speech and in word reading tasks. The results revealed that the proficient learners of English in this study had acquired the production of aspiration in single onset voiceless stops (as in *pie*), especially when paying attention to their pronunciation, as in the reading tasks. Moreover, the analysis of sonorant consonant devoicing after onset voiceless stops (as in *play*) confirmed that the participants have learnt to realise voiceless stops in English, since they produced longer VOT's in stop + sonorant consonant clusters in English than in Dutch. However, the VOT measurements on word-initial voiced stops in the reading task revealed that, unlike the L1 English controls, the Dutch-speaking informants produced prevoicing in the overwhelming majority of the English tokens. This suggests that they transfer prevoiced stops from Dutch into English. The analysis of glottal replacement of word-final stops revealed that the participants frequently replaced voiceless stops by glottal stops, as is common in many varieties of L1 English. However, some participants tended to overgeneralized the production of glottal replacements, and also replaced voiced stops by glottal stops, unlike in native English. The conclusions of these findings for the laryngeal representations of stops in Dutch, English and DLE are discussed in Chapter 11.

Notes

1. Part of the results on word-initial stops and regressive voice assimilation (see Chapter 7) have been reported in Simon (2009a).
2. While the place of articulation of the onset stop was controlled, the height of the following vowel should ideally also have been controlled, as VOT values have been reported to be slightly longer after high than after low vowels, though the effect is not robust across place of articulation of the stops (see Yavaş, 2008).
3. Lisker & Abramson (1964) found an average VOT for one native speaker of Dutch of 17 ms in words in isolation and 21 ms in words embedded in a sentence. Flege & Eeftink (1987), who analysed VOTs after /t/'s in Dutch and English words read by 50 native speakers of Dutch in the Netherlands, found that the average VOT after Dutch /t/ was 23 ms, which is the same value found after /t/ in the present study.
4. The sound files of all examples whose number is shaded are available on the CD-rom accompanying this book. All sound files on the CD-rom are equalized in Praat (Boersma & Weenink, 2009) (peak at 0.97).
5. The language which formed an exception to this general pattern was Dahalo, an endangered language in Kenya, in which alveolars were heavily affricated and therefore had longer VOTs.
6. Other, non-aerodynamic reasons for the longer VOTs in velars are reviewed in Cho & Ladefoged (1999).
7. It should be noted that a number of informants produced velarized [ɫ]'s in the word *play* in the reading task.
8. In some varieties of English (e.g. in Cockney, and more generally, in Estuary English, but not in RP), word-internal intervocalic /t/'s can be replaced by glottal stops (as in butter [bʌʔə]) (cf. Wells, 1982b: 322-327). Word-internal glottal replacements were, however, not coded in the conversations.
9. It could be assumed that speakers who frequently produce glottal replacements have acquired the laryngeal specification of voiceless stops in English and produce longer VOTs than informants who never produce glottal replacements. However, the correlation proved to be only 0.4, which means that there is no strong link between the production of glottal replacements and the production of VOT in word-initial voiceless stops.

Chapter 5

Acquiring fricatives: Duration and vocal fold vibration

5.1. Introduction

The present chapter focuses on fricatives: unlike stops (discussed in Chapter 4), fricatives in voicing languages, like Dutch, and aspirating languages, like English, do not immediately show different realisations. This chapter examines the contrast between voiced and voiceless fricatives in Dutch and English and searches for potential differences in fricative duration and vocal fold vibration between Dutch, English and DLE voiceless and voiced fricatives in utterance-initial position.

5.2. The voice contrast in fricatives

Both Dutch and English have a two-way laryngeal contrast in fricatives. However, in Dutch the phonetic voiced-voiceless distinction in fricatives is weaker than in stops and this is most apparent in utterance-initial position. Van de Velde, Gerritsen & Van Hout (1995) conducted a study on the voice contrast in Dutch fricatives. They recorded sentences read aloud by 160 Dutch language teachers from eight different regions (four regions in the Netherlands and four regions in Flanders). In these sentences the fricatives /v/, /z/ and /ɣ/ occurred in word-initial position following a schwa. The analysis showed that the fully voiced velar fricative rarely occurred in any of the regions and that the fricatives /v/ and /z/ were also frequently devoiced in the Netherlands. The devoicing hierarchy is such that velar /ɣ/ is devoiced more than labiodental /v/, which in its turn is more devoiced than alveolar /z/ (Van de Velde, Gerritsen & Van Hout, 1996). Though some devoicing could also be found in Flanders, it was considerably less frequent than in the Netherlands. The study also showed that both in the Netherlands and in Flanders, there is variation in devoicing between the different regions. (For the realisation of utterance-initial fricatives in the Dutch dialects, see Section 1.2.)

Verhoeven & Hageman (2007) investigated the devoicing of fricatives in the speech of 40 young native speakers of Dutch from different regions in Flanders. In total, 4,800 realisations of fricatives were analysed acoustically. Their analysis revealed that the majority of phonologically voiced fricatives (65%) were realised without any vocal fold vibration and that devoicing was more frequent in word-initial than in word-medial position. The analysis also showed that there was significantly less devoicing in the fricatives produced by the East-Flemish informants than in those produced by informants from West-Flanders, Antwerp or Limburg. (The differences between these last three regions were not significant.) However, the study also showed that the contrast between voiceless and devoiced fricatives was not neutralised, since the former were significantly longer and had a different spectral structure than the latter.

Ernestus (2000: 50-52) argues that the weak voice contrast in fricatives is also reflected by the very low number of minimal pairs which differ only for the voice specification of the initial fricative. Examples are *fee* 'fairy' – *vee* 'cattle' and *fier* 'proud' – *vier* 'four'. In contrast, minimal pairs in which the voice specifications of the initial stops differ are abundant. Examples are *paard* 'horse' – *baard* 'beard', *peer* 'pear' – *beer* 'bear' and *poot* 'paw' – *boot* 'boat' and so on.

Danneels (1979) found that in Dutch, initial plosives are much more frequent than initial fricatives and among the fricatives, initial voiced fricatives are much more frequent than initial voiceless ones. An explanation of the greater frequency of voiced fricatives in initial position as compared with voiceless fricatives is provided by Taeldeman (1975), who argues that voiced and voiceless fricatives used to be allophones of the same phoneme in Old-West-Germanic. The voiced allophones then got the upper hand and caused the voiceless fricatives to become exceptional in word-initial position. Word-initial fricatives occur in a relatively small number of Dutch words (e.g. *sukkel* 'duffer; wretch', *fakkel* 'torch') and in words recently borrowed from French or German. Note that in word-initial position, there is no contrast for the velar fricative: only /ɣ/ is possible; voiceless /x/ does not occur in word-initial position, except in a number of borrowed words, such as *chloor* /xloːr/ and *cholesterol* /xɔlɛstɛˈrɔl/, in some varieties of Dutch, especially in the Netherlands. (In Belgian Dutch varieties, these words tend to be produced with word-initial /k/, see Heemskerk & Zonneveld, 2000.)

As in Dutch, the voice contrast between obstruents is maintained in utterance-initial position in English. In contrast to stops, voiceless fricatives in English are not aspirated. Docherty notes that

> "[t]here are no cases of a delay in onset of voicing in the transition from a voiced or voiceless fricative to a following vowel (…). The general pattern of events is that towards the end of a fricative, the level of fricative noise gradually attenuates, and the noise stops as voicing begins" (Docherty, 1992: 118).

The noise attenuation towards the end of a fricative is probably caused by the fact that the vocal folds become adducted in order to start vibrating for the following vowel or because the oral constriction is widening for the production of the following vowel (Docherty, 1992: 119). It has also been shown that the peak glottal opening occurs earlier in voiceless fricatives than in voiceless stops (Löfqvist & Yoshioka, 1981: 23).

Docherty (1992) analysed voicing in word-initial voiced fricatives in English. He conducted an experiment in which five native speakers of British English were asked to read words with a voiced fricative in the onset. Docherty distinguished between three types of voicing patterns: (a) no medial voicing[1], (b) voicing throughout the medial phase and (c) voicing only during part of the medial phase. The duration of the medial phase was measured on the basis of speech waveforms. The beginning and end of the fricative medial phase were marked where the noise component, which indicates the close approximation typical of fricatives, begins and ends.

Table 23 shows to what extent utterance-initial voiced fricatives (/z, ð, v/) were produced with voicing during their medial phase.

	Utterance-initial fric.
No medial voicing	20/66 (= 30.3%)
Voicing throughout medial phase	36/66 (= 54.5%)
Voicing only during part of medial phase	10/66 (= 15.2%)

Table 23. Voicing timing in word-initial voiced fricatives (Docherty, 1992: 120, 124).

The frequencies in Table 23 show that there was variation in the production of vocal fold vibration in onset voiced fricatives: the majority of utterance-initial fricatives were produced with voicing throughout the medial phase, though a fair number also lacked any medial voicing or were voiced during part of the medial phase.

A study by Stevens et al. (1992) investigated the voicing duration in fricatives produced by three native speakers of American English. The authors found that

> "[f]or some phonologically voiced fricatives glottal vibration continued throughout the entire interval of the consonant, whereas others showed evidence of glottal vibration only near the boundary with the vowel but no glottal vibration internal to the fricative" (Stevens et al., 1992: 2985).

It is interesting to note that voiced fricatives are the least frequent of all obstruents in English. The voiced fricative /v/ was introduced in English in initial position through words borrowed from Old French and Latin. The voiced fricative /ð/ used to be an allophone of the phoneme /θ/ in early Middle English, which occurred at the beginning of unstressed words, such as *the, this, them, they, there, thus,* etc. (Van Herreweghe, 1987: 21). The voiced fricative /z/ was introduced in English through Greek and Arabic words borrowed in Latin and French, such as *zeal, zone, zoology,* and so on (Van Herreweghe, 1987: 21; Nielsen, 1994: 25) and /ʒ/ does not occur in initial position in the native vocabulary of English. Although 30% of the utterance-initial voiced fricatives in Docherty's (1992) study lacked any vocal fold vibration (see Table 23), there are no reports in the literature that the distinction between voiced and voiceless fricatives would be neutralized in English.

5.3. Voiceless fricatives

Whereas utterance-initial voiceless stops in Dutch and English are clearly distinct from each other (see Chapters 1 and 4), the distinction between L1 Dutch and L1 English voiceless fricatives is much less clear. Collins & Mees (1999: 140) nevertheless note that there are two differences in the phonetic realisation of fricatives in these two languages. The main difference between English and Dutch fricatives is that in English the contrast between voiced and voiceless fricatives is one of energy rather than of voice: the fricatives /f/, /s/, /ʃ/ and /θ/ are realised with more energy than their counterparts /v/, /z/, /ʒ/ and /ð/ (Collins & Mees, 1999: 140). Another difference between English and Dutch /f/ is that English /f/ has a more advanced place of articulation than Dutch /f/. Though both Dutch and English /f/ are articulated as labiodentals, the place where the lips make contact with the upper teeth is slightly more advanced for English /f/ than for Dutch /f/ (Collins & Mees, 1999: 141).

A note on /h/

The fricative /h/, which is a phoneme of both Dutch and English, is usually classified in phoneme inventories as a voiceless sound, though its realisation as voiced or voiceless is very variable (see Section 3.6.2). In this study it has been coded in the conversations as a voiced sound, for two reasons.

First, Collins & Mees (1999: 148,192) note that in Dutch, /h/ is typically realised as voiced [ɦ] in all contexts. This is different in English, where it is usually only voiced when occurring between voiced sounds. In the Dutch conversations by both East- and West-Flemish informants, elision of /h/ was very frequent, as in examples (14) and (15):

(14) dat was zo *(h)*alf elf 's avonds of zo [ɑlv] (EF)
'it was like half past ten in the evening or something'

(15) *(h)*e(b) je al…moderne poëzie? [ɛ jə] (WF)
'do you already have…modern poetry?'

When the informants did not elide onset /h/, for instance when the word was emphasised or occurred in quoted Standard Dutch speech, it was typically voiced. In example (16), informant no. 4 is retelling a speech she heard, which was apparently delivered in Standard Dutch. In the fragment, the informant elides /h/ in the word *bovenhalen* 'fetch', which is produced outside the quote, while the /h/'s occurring in the quote are not elided and are voiced:

(16) "ja, en dan schrijf je *h*ier en daar een paar kernwoordjes op in potlood"; 'k zeg: 'moet 'k ik nu al mijn potlood boven*(h)*alen ook?', "dan begin je je tekst te formuleren in je *h*oofd" (EF)

"well, and then you write down some key terms with a pencil here and there", I thought: 'do I have to fetch my pencil now as well?', "then you start formulating the text in your mind"

The second reason is that in West-Flemish Dutch and in some western varieties of East-Flemish Dutch, the fricative /ɣ/ is often realised as [ɦ], both in word-initial position preceding a vowel or a sonorant consonant, and in word-medial position. The analysis of the conversations showed that many of the West-Flemish and East-Flemish participants frequently realised /ɣ/ as [ɦ], as in examples (17) and (18):

(17) 't was 'k wee(t) nie(t) (h)oe *g*rappig [ˈɦrɑpəh] (EF)
'it was really very funny'

(18) maa(r) heel er*g* mar*g*i [ɛrɦ mɑrɦi] (WF)
'but really very marginal'

Because an underlying /ɣ/ was frequently realised as a voiced [ɦ], it was decided to code /h/ as a voiced segment (though in utterance-final position /x/ or /ɣ/ may be realised as a voiceless [h], as in the coda of the word *grappig* 'funny' in (17).

Fricative duration

One aspect of fricatives in which Dutch and English may differ is the duration. Fricative duration has been measured by Kissine, Van de Velde & Van Hout's (2005) for Dutch and by Baum & Blumstein's (1987) and Pirello et al. (1997) for English. The results of these studies are presented in Table 24:

		[f]	[s]
L1 Dutch	Kissine et al. (2005)	177	176
L1 English	Baum & Blumstein (1987)	149	174
	Pirello et al. (1997)	214	236

Table 24. Fricative durations in L1 Dutch and L1 English (in ms).

In Kissine et al.'s (2005) study on L1 Dutch, the average duration of [f] and [s] was virtually the same: 177 ms for [f] and 176 ms for [s]. In this study, the words were embedded in carrier phrases, in which the fricative was preceded by a schwa and followed by the vowel /œy/. The informants in this study were 160 teachers of Dutch from eight different regions in the Netherlands and Flanders. Although no exact durations for each region are given, it can be deduced from a graph that the mean durations of /f/ and /s/ lie close to 180 ms for the West-Flemish informants and close to 190 ms for the East-Flemish informants. The high values found in Kissine et al.'s study might be due to the fact that the (nonsense) words containing the fricatives were embedded in carrier phrases of the form *In de xuize horen we 'x'* 'In the xuize we hear 'x''in which x was either 'f', 'v', 's' or 'z', which are likely to draw the reader's attention to the fricative sound.

Baum & Blumstein (1987) measured the friction noise of fricatives in CV syllables read by three native speakers of American English. As can be seen in Table 24, the duration of /s/ was considerably longer than that of /f/. The stimuli in Baum & Blumstein's (1987) study consisted of CV clusters. In Pirello et al.'s (1997) study on L1 English, the stimuli were presented in isolation and in a context. The values presented in Table 24 are those for the isolation condition: the fricatives occurred in CV syllables and were read by four native speakers of American English. Despite the very similar set of stimuli, the values in Pirello et al.'s study are considerably longer than in Baum & Blumstein's study and than in the DLE words.

Because the studies discussed above have employed different sets of stimuli and because the mean durations are considerably different from each other, it is hard to conclude from these studies to what extent Dutch and English voiceless fricatives differ from each other in terms of duration. It was therefore decided in the present study to measure fricative durations in the Dutch and English words read by the ten native speakers of Dutch, and in the English words read by the ten native speakers of English.

The word reading task contained four words starting with a voiceless fricative. Two words had labiodental /f/ in the onset; the other two started with alveolar /s/. The Dutch words were *fout* 'mistake' and *saai* 'boring' and the English words *fire* ans *sir*[2]. Table 25 shows the mean durations (in ms) of the voiceless fricative [f] and [s] in the L1 Dutch, DLE and L1 English words (standard deviations in brackets).

	[f]	[s]
L1 Dutch (n = 10)	160 (s.d. 31)	199 (s.d. 41)
DLE (n = 10)	159 (s.d. 24)	205 (s.d. 29)
L1 English (n = 10)	151 (s.d. 30)	161 (s.d. 33)

Table 25. Mean duration of voiceless and voiced fricatives in the word reading task (in ms).

Table 25 shows that the mean durations of [f] in L1 Dutch and L1 English are very close to each other (two-tailed independent-test, $p > .05$). As a result, Dutch learners of English do not need to learn a new phonetic durational realisation when producing [f] in English. The fricative [s], however, proved to be significantly longer in L1 Dutch than in L1 English ($p = .04$). This suggests that Dutch-speaking learners of English may need to shorten word-initial [s] when speaking English. The results from DLE reveal that the participants did not produce shorter [s] in English than in Dutch and the difference between the DLE and the L1 Dutch duration of [s] proved to be non-significant ($p = 0.7$).

While the longer duration of [s] in Dutch as compared with English in the word reading task may reflect a larger difference in phonetic realisation of [s] in these two languages, more detailed phonetic studies should be carried out to confirm this.

5.4. Voiced fricatives

Both in Dutch and in English, voiced fricatives are frequently (partly) devoiced (see Section 5.2). This devoicing can phonetically be explained as resulting from the fact that voicing in fricatives requires a delicate balance between a sufficiently open glottis (necessary to produce friction) and a sufficiently closed glottis (necessary to allow vocal fold vibration). In the word reading task four words occurred with a voiced fricative in the onset. Two words started with labiodental /v/ and two with alveolar /z/: the Dutch words *veel* 'much' and *zee* 'sea' and the English words *very* and *zero*. All word-initial voiced fricatives in the reading task were coded '1' if they were fully voiced, '2' if they were partially devoiced and '3' if they were completely voiceless. The coding was based on auditory judgement and on inspection of the waveform and the spectrogram. Tables 26 and 27 present the results for all Dutch-speaking and English-speaking participants:

	[v]		[z]	
inf. no.	**veel**	**very**	**zee**	**zero**
1	1	2	2	1
4	2	2	2	2
6	2	2	2	2
8	2	2	3	2
9	1	1	3	2
10	2	1	2	2
12	1	3	2	1
13	2	2	3	3
15	2	2	1	2
16	1	2	2	2

Table 26. (De)voicing in initial voiced fricatives: L1 Dutch speakers.

	[v]	[z]
inf. no.	**very**	**zero**
1	1	2
2	3	1
3	3	2
4	2	2
5	3	3
6	1	1
7	3	1
8	2	1
9	2	3
10	2	2

Table 27. (De)voicing in initial voiced fricatives: L1 English speakers.

Tables 26 and 27 show that there is a great deal of intra- and inter-speaker variation. Table 28 summarises the results for all speakers together.

	L1 Dutch	**DLE**	**L1 English**
fully voiced	5	4	6
partly devoiced	12	14	8
fully devoiced	3	2	6

Table 28. (De)voicing in initial voiced fricatives: summary.

In the Dutch and English words produced by the native speakers of Dutch, the onset fricatives in the overall majority of the tokens were partly devoiced[3]. These fricatives started with a (shorter or longer) period of vocal fold vibration, followed by a period of voiceless friction. Figure 22 shows the production of the fricatives and part of the vowels in the Dutch word *veel* 'much' (left) and the English word *very* (right), produced by informant no. 6. A rectangle is drawn around the fricative:

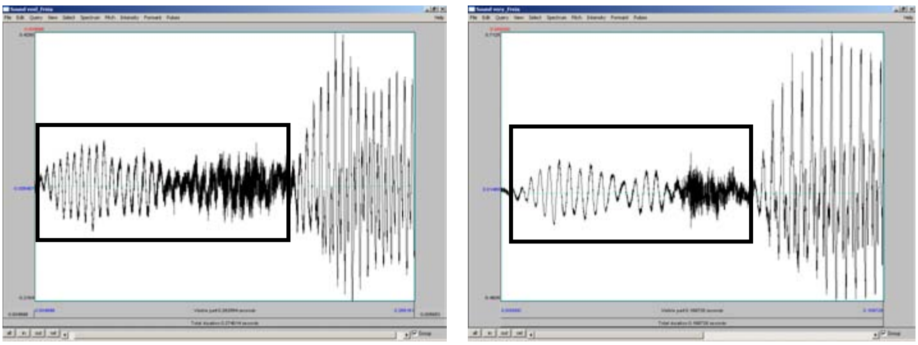


Figure 22. Realisations of the fricative and part of the vowel in the Dutch word *veel* 'much' (left) and the English word *very* by inf. no. 6.

The waveforms show that in both cases the fricative is voiced at the beginning, and then becomes voiceless before the vowel starts.

Variation was also observed in the L1 English fricatives: six were fully voiced, eight were partly devoiced and the remaining six were fully devoiced. Figures 23 and 24 show the production of the fricative and part of the vowel in the English word *zero* read by L1 English speaker no. 5 (left) and 10 (right):

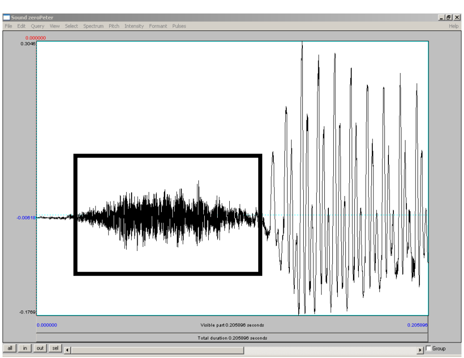


Figure 23. Fully devoiced fricative in the onset of the word *zero* (L1 Eng. inf. no. 5).

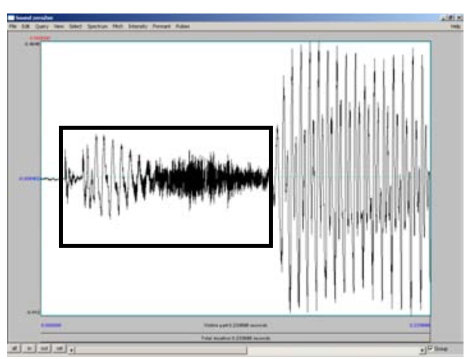


Figure 24. Partly devoiced fricative in the onset of the word *zero* (L1 Eng. inf. no. 10).

In a number of tokens, the fricative was realised as fully voiced, as is illustrated with the waveform in Figure 25.

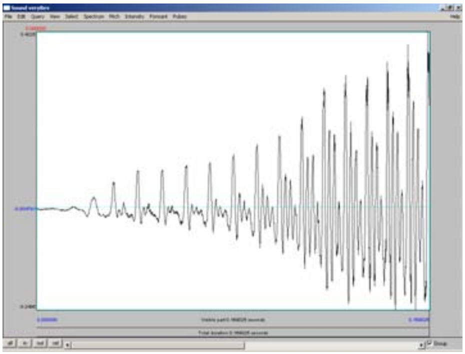


Figure 25. Fully voiced fricative in the onset of the English word *very* (L1 Eng. inf. no. 6).

Because the fricative in the word *very* produced by informant no. 6 was realised with very little lip compression, there was little obstruction to the airflow, which leads to a slower increase in intra-oral air pressure. As a result, it is easier to maintain vocal fold vibration throughout the fricative.

The differences between the L1 English informants might be due to regional differences: informant no. 5, for instance, who produced two completely voiceless fricatives, has a local accent from Dublin, while informant no. 6, who realised both fricatives with vocal fold vibration throughout the fricative, reported to speak Received Pronunciation (cf. Appendix C, question no. 5).

Whereas prevoicing in voiced stops can be measured relatively easily, because the burst is clearly visible in the waveform and on the spectrogram, it is more difficult to measure voicing in fricatives. Although in Figures 23 and 24 it would be fairly straightforward to mark the boundary between the voiced and the voiceless part, in most fricatives the transition is very gradual and if the fricative is completely voiced, it is hard to mark the point where the fricative ends and the vowel begins (as in Figure 25). What is clear, however, is that both in the Dutch and in the English words, there was a great deal of variation between fully voiced, partly devoiced and fully devoiced fricatives. Although no measurements of the period of voicing in the utterance-initial fricatives were carried out (and there may be certain phonetic differences), the fricatives produced by the informants in the English words do not seem to differ considerably from voiced fricatives produced in L1 English.

As it is – from a phonetic point of view – difficult to sustain vocal fold vibration in fricatives, the chance that the fricative becomes devoiced towards the end increases as it becomes longer. Table 29 shows the mean durations of the voiced fricatives [v] and [z] in Kissine et al.'s (2005) study on L1 Dutch and in Baum & Blumstein's (1987) and Pirello et al.'s (1997) studies on L1 English:

		[v]	[z]
L1 Dutch	Kissine et al. (2005)	140	155
L1 English	Baum & Blumstein (1987)	116	152
	Pirello et al. (1997)	128	167

Table 29. Average duration of onset voiced fricatives in L1 Dutch and L1 English.

As was the case for the voiceless fricatives, the labiodental fricative ([v]) was considerably shorter than the alveolar one ([z]). Since the values are rather far from each other (which might be due to the use of different stimuli in the experiments, see Section 4.2.2), the average durations of onset [v] and [z] in the word reading task were measured. The word reading task contained the Dutch words *veel* 'much' and *zee* 'sea' and the English words *very* and *zero.*

	[v]	[z]
L1 Dutch	159 (s.d. 39)	174 (s.d. 34)
DLE	125 (s.d. 52)	165 (s.d. 42)
L1 English	84 (s.d. 40)	114 (s.d. 32)

Table 30. Average duration of onset voiced fricatives in L1 Dutch, DLE and L1 English.

The results presented in Table 30 show that, just as initial [s] (see 4.3), both [v] and [z] are significantly longer in L1 Dutch than in L1 English ($p = 0.000$). The DLE productions of [v] and [z], however, are not significantly different from the L1 Dutch durations ([v]: $p = 0.1$, [z]: $p = 0.6$). This suggests that learners did not shorten [v] when speaking English, but transferred the fricative duration from Dutch into DLE.

5.5. Summary

This chapter examined to what extent Dutch and English have different realisations of word-initial voiceless and voiced fricatives and how potential differences are reflected in the English speech of native speakers of Dutch. While a large number of studies have focused on the opposition between stops in voicing and aspirating languages, fricatives are often left out of the discussion, because there are fewer acoustic differences and because the voice contrast in fricatives is often less strong than in stops, as is the case in Dutch. An analysis of fricative duration revealed that Dutch fricatives tend to be longer than their English counterparts, though phonetic studies based on a larger set of data would need to be carried out to examine whether this trend can be confirmed. The Dutch participants in this study did, however, not produce significantly shorter fricatives in English than in Dutch. The analysis of vocal fold vibration in utterance-initial voiced fricatives showed that both in L1 Dutch, L1 English and DLE there was a great deal of variation: fricatives were sometimes fully voiced, sometimes partly voiced, and sometimes even fully devoiced. As a result, there is no obvious way in which voiced fricatives in L1 Dutch (as it is spoken by the East- and West-Flemish informants) differs from voiced fricatives in L1 English. Though there may be subtle phonetic differences between Dutch and English fricatives (such as the degree of energy used, see Section 5.3.), the learners' DLE fricatives did not seem to differ considerably from the fricatives produced by the L1 English speakers in this study. One way in which further research could nevertheless discover potential differences between Dutch and English fricatives would be to carry out a perceptual categorization study, in which native speakers of English are asked to label the English fricatives produced by L1 Dutch speakers as instances of the voiced or voiceless category and to rate the goodness of the matches on a scale. The laryngeal representations of Dutch, English and DLE fricatives are dealt with in Chapter 11.

Notes

1. Docherty uses the traditional division of an obstruent into three phases: (1) an onset phase, during which the articulators move together to form a constriction, (2) a medial phase, during which there is a constriction in the oral cavity and (3) a release phase, during which the articulators move apart again.

2. The English word list also contained the word *think*, which is left out of the discussion because /θ/ does not occur in Dutch. The reading lists did not contain words with velar fricatives in the onset, as these occur only in Dutch and not in English and the voiceless fricative /x/ does not occur in the onset of native Dutch words (see Section 1.2.). Although /h/ is a phoneme of both Dutch and English, it differs from the other fricatives in that the friction is produced in the glottis and not by the articulators. Therefore only the labiodental fricative /f/ (and its voiced counterpart /v/), and the alveolar fricatives /s/ (and /z/) are discussed.

3. While 50% of the Dutch tokens were partly devoiced in the present study, as many as 65% of the onset voiced fricatives were fully devoiced in Verhoeven & Hageman's study (2007). This difference might be due to two factors. First, whereas in the present study only /v/ and /z/ were analysed, Verhoeven & Hageman also analysed /ɣ/, which proved to be significantly more devoiced than /v/ and /z/. Secondly, in the present study four of the ten informants came from East-Flanders, which is the region where the tendency to devoice is, according to Verhoeven & Hageman, significantly less strong than in the other regions.

Chapter 6

Final laryngeal neutralisation

6.1. Introduction

Dutch is one of the many languages (including German and many Slavic and Turkic languages, cf. Jansen, 2004: 63) in which syllable- and word-final obstruents are subject to laryngeal neutralisation. English, on the contrary, maintains the contrast between voiced and voiceless obstruents in syllable- and word-final position (as in the minimal pair *bed-bet*). This chapter discusses traditional generative approaches as well as phonetic approaches to laryngeal neutralisation and examines to what extent advanced native speakers of Dutch produce it when speaking English.

6.2. Contexts of final laryngeal neutralisation in Dutch vs. English

Utterance-final position

In Dutch, devoicing of final obstruents occurs both within words (in syllable-final position) and across word boundaries. Traditionally, the process of final laryngeal neutralisation has been referred to as 'final devoicing' (or, with the German term, as 'Auslautverhärtung' or 'Auslautverschärfung'), because it was seen as a process through which underlying voiced obstruents are devoiced when occurring in final position. This view was reflected in the way the rule was formulated in traditional generative phonology. Trommelen & Zonneveld (1979), for instance, formulate the following rule:

Rule: [–son] → [–voice] / ___#

The rule states that an obstruent receives the specification [–voice] when occurring in morpheme-final position (i.e. at the end of a word or part of a compound)[1]. Examples (19) and (20) taken from Zonneveld (1983: 298), illustrate the process:

neutralisation	**neutralisation**	**no neutralisation**
(19) *rond* [t] ('round')	*rondrit* [t] ('tour', (round) trip')	*ronde* [d] ('round' – infl. adj.)
(20) *hard* [t] ('hard')	*hardlopen* [t] ('race'– inf.)	*harde* [d] ('hard' – infl. adj.)

The examples show that the spelling does not reflect the final devoicing, which seems to indicate that speakers' intuitions about the underlying form are strong.

Stops as well as fricatives undergo final laryngeal neutralisation in final position. Examples (21) and (22) containing fricatives are provided by Trommelen & Zonneveld (1979: 100):

neutralisation	**neutralisation**	**no neutralisation**
(21) *huis* [s] ('house')	*huisarts* [s] ('family doctor, GP')	*huizen* [z] ('houses')
(22) *hoef* [f] ('hoof')	*hoefijzer* [f] ('horseshoe')	*hoeven* [v] ('hoofs')

The underlying form of fricatives is, however, not reflected in the spelling of the canonical forms in the first column. Intuitions about the underlying forms of fricatives might therefore be less strong than those about the underlying forms of stops, though the phonotactic rules of Dutch disambiguate the voice character of the fricative: if the vowel is long, it is followed by a voiced fricative; if it is short, it is followed by a voiceless fricative (Van Oostendorp, 2007). Exceptions are, for instance, *kuisen* /ˈkœʸsə/ 'to clean' (non-Standard Dutch) and *juichen* /ˈjœʸxə/ 'to cheer'.

Booij (1995a) also mentions the examples *huisarts* and *hoefijzer*, but claims that they are pronounced with a voiced fricative. He attributes this to a rule of intervocalic voicing of fricatives, which is an optional rule in many regions. (See Chapter 10 on prevocalic voice assimilation)

In autosegmental and phonetic approaches, it has been argued that final obstruents in Dutch are actually laryngeally neutral, rather than by definition voiceless. In an autosegmental framework, laryngeal devoicing is expressed as a process delinking the voice specification from a final consonant: the [voice] feature of the final /d/ of the word *rond* ('round'), for instance, is delinked. When the voice specification is delinked from the final consonant, the consonant becomes laryngeally neutral. Final consonants in a language with laryngeal neutralisation are therefore said to have no voicing target. Because the delinking process leads to a laryngeally neutral obstruent, rather than by definition to a voiceless one, the term *laryngeal neutralisation* is now considered to be more appropriate than the term *final devoicing*, which has been used in the traditional analyses of Dutch voice assimilation.

The thesis that coda obstruents are laryngeally neutral is also defended by Ernestus (2000) in her approach to Dutch voice assimilation. She claims that coda obstruents are neutral obstruents, which means that the distinction between underlyingly voiced and voiceless obstruents is erased and their realisation is not related to their underlying [voice]-specification (Ernestus, 2000: 148). This more recent approach indeed "harks back to older, 'archiphonemic', and therefore symmetric conceptions of laryngeal neutralisation" (Jansen, 2004: 66)[2]. Ernestus (2000) formulates a hypothesis which she calls the 'Complete Neutralisation Hypothesis', later referred to as the 'Permanent Neutralisation Hypothesis' (Ernestus, 2003). The hypothesis states the following:

> "Neutral obstruents do not have [voice]-specifications in the output of phonology, and their realisation is completely determined by phonetics" (Ernestus, 2000: 157).

Ernestus argues that the hypothesis implies that

> "a neutral obstruent is realised as voiced if, given its physical properties and those of its surrounding segments, a voiced realisation can be produced with less effort than a voiceless one" (Ernestus, 2003: 125)[3].

According to Ernestus, the hypothesis makes the correct prediction about the realisation of obstruents before major phonological boundaries: they are realised as voiceless in the phonetic component. Only if extra articulatory gestures are produced can they be perceived as voiced. Because no such actions are taken in Dutch, utterance-final, neutral obstruents are voiceless.

However, Ernestus & Baayen (2006) in later work claim that neutralisation is, in fact, incomplete in Dutch (see Section 1.5.3). They base this claim on the observsation that, while word-final /b, d/ are realized as voiceless stops, they retain some acoustic characteristics of voiced stops. They argue that the production and interpretation of incomplete neutralisation in Dutch is mainly a lexical effect, in that the lexical representations of words contain detailed information about the probability that word-final obstruents are realized with acoustic characteristics of voiced obstruents. In other words, when listeners hear the word *verwijd* ('(I) widen'), they make use of the information on, for instance, the expected shorter release noise duration in the lexical representation of the final stop to infer that the word is *verwijd* and not *verwijt* ('(I) reproach'). In the latter form the final /t/ has a slightly longer release noise duration in its lexical representation.

Steriade (1997) argues that laryngeal neutralisation occurs in positions where the voice contrast is difficult to perceive:

> "[L]aryngeal categories are neutralised in positions where the cues to the relevant contrast would be diminished or obtainable only at the cost of additional articulatory maneuvers. Conversely, laryngeal contrasts are permitted (or *licensed*) in positions that are high on a scale of perceptibility" (Steriade, 1997: 2).

She contrasts her hypothesis, which she calls *Licensing by Cue*, with the hypothesis that laryngeal features are licensed or neutralised depending on the *prosodic* position they occupy, a hypothesis which she refers to as *Licensing by Prosody*. Thus, instead of stating that in Dutch voice is not licensed in the coda, Licensing by Cue states that it is not licensed in positions where there are few cues to the voiced/voiceless distinction, i.e. where the perceptibility of the voice contrast is poor. This hypothesis has important consequences for the way the grammar works. Traditionally, decisions about where to have a contrast and where to have neutralisation were supposed to be taken in the phonological component, which formed the input to the phonetic component. Steriade, however, argues that speakers have knowledge about the relative perceptibility of voice contrasts in different positions and that this phonetic knowledge is part of the grammar. Although there are differences between languages concerning the sites in which voice is licensed, Steriade shows that there is no language which licences voice in contexts where fewer cues are available and neutralises voice in contexts where there are more cues to signal the contrast, which points to the existence of a scale of perceptibility. There are, for instance, more cues available to signal voicing in a consonant following a vowel and preceding a consonant (e.g. VOT values, F0 and F1 values at the onset of voicing in the following vowel) than there are cues to signal voicing in word-final position. Thus, if a language licenses voice in word-final position, it will also license it in a consonant following a vowel and preceding a sonorant. The perceptibility scale as proposed by Steriade (1997: 11) looks as follows (> means that voice is more perceptible in the context to the left of it than in the context to the right of it)[4]:

V__[+son] > V__ # > V__[–son] > {[–son] __ [–son], [–son] __ #, # __ [–son]}

Steriade proposes that every context corresponds to a constraint of the form *[α voice]/ X__Y. The constraints are ranked in the reverse order of the perceptibility scale. Thus the constraint banning voice in word-final position following a vowel, for instance, is ranked higher than the constraint banning voice in an obstruent which occurs between a vowel and a sonorant: *[α voice]/V__# >> *[α voice]/V__[+son]. The constraints banning voice in certain positions interact with a faithfulness constraint 'Preserve [voice]'. Steriade stresses the fact that the perceptibility scale can be different in different languages:

> "[T]he perceptibility of laryngeal distinctions depends on inter-gestural timing and the magnitude of glottal gestures, factors which vary from language to language" (Steriade, 1997: 12).

The constraint ranking does not exist independently of the scale: if the scale changes, the constraint ranking also changes.

Unlike Dutch, English maintains the voice contrast in utterance-final position. In other words, there is no final laryngeal neutralisation of stops or fricatives. This can be illustrated by means of minimal pairs in which the members differ only in the voice character of the final obstruent, as in *bed – bet, bid – bit, bide – bite, kid – kit, cub – cup*, *his – hiss*, *leave – leaf* and so on.

If one assumes – as Kingston & Diehl (1994) do (see Section 2.4.1.) – that [voice] is active in both Dutch and English, this means that utterance-final obstruents lose their [voice] – specification in Dutch, but not in English. In a model which assumes that the feature [spread glottis] is active in English, final voiced obstruents do not have a laryngeal specification (in a unary approach) or are marked [–spread glottis] (in a binary approach). Figure 26 shows how the English words *bed* and *bet* are distinguished from each other in the two approaches:

one feature [voice]

b e t	b e d
∅ or [-voice]	[voice]

the feature [spread glottis]

b e t	b e d
[spread gl.]	∅ or [-spread gl.]

Figure 26. Representations of the codas of *bet* and *bed.*

Iverson & Salmons (1995) and Kager et al. (2007), who argue for a feature [spread glottis] in English, use monovalent features. Figure 26 shows that in a monovalent, [spread glottis]-approach, utterance-final voiced stops are laryngeally unspecified. Laryngeally *unspecified* obstruents are not to be confused with laryngeally *neutral* obstruents. Ernestus (2000) defines neutral obstruents as obstruents whose realisation is "not related to their underlying [voice]-specifications" and argues that "[t]he distinction between voiced and voiceless obstruents is neutralised for these obstruents" (Ernestus, 2000: 148). Because it is articulatorily hard to keep the vocal folds vibrating in utterance-final position, neutral obstruents occurring in this position would then be predicted to be always fully voiceless, which is not what we find in English. In English, voiced, utterance-final obstruents always remain *phonologically* voiced and do not merge with phonologically voiceless obstruents (as in Dutch), which means that they cannot be neutral obstruents.

Because in the privative, [spread glottis]-approach voiced obstruents in English are laryngeally unmarked, some variation is expected in the way they are realised. There is free variation between prevoiced stops and stops with a short-lag VOT in utterance-initial position in English (see Section 1.5.2). Phonetic studies have shown that in aspirating languages (such as English), voiced stops often become partially devoiced in utterance-final position:

> "Auditory analysis suggests that pre-pausal voiced and voiceless stops in English cannot be reliably distinguished on the basis of the existence and/or duration of voicing during the closure phase" (Docherty, 1992: 35).

> "Speakers of this language [i.e. English] often partially devoice (utterance-final) word-final lenis stops (which suggests that they are passively voiced) (…)" (Jansen, 2004: 49).

This variability is consistent with a monovalent [spread glottis]-approach.

Preceding voiceless obstruents

While obstruents are devoiced or laryngeally neutralised in utterance-final position in Dutch, they can undergo regressive voice assimilation when followed by a following voiced stop (see Chapter 7, in which regressive voice assimilation is discussed in detail). When followed by a voiced fricative, they tend to be devoiced and may trigger progressive devoicing in the following fricative (see Chapter 9). When a final voiced obstruent is followed by a voiceless obstruent (stop or fricative), however, final laryngeal neutralisation does take place in Dutch.

In English there is normally no assimilation in voiced obstruent + voiceless obstruent clusters[5]. The following examples illustrate this:

(23) *red plate* /dp/ → [dp]
(24) *leave Canterbury* /vk/ → [vk]

If we assume that voiced obstruents in English are unspecified and voiceless ones specified for [spread glottis], the specifications in this type of obstruent cluster look as indicated in Figure 27.

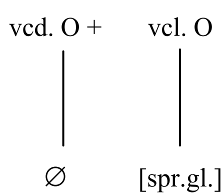


Figure 27. Laryngeal representations in voiced obstruent + voiceless obstruent clusters.

Since the [spread glottis] specification does not spread to the preceding obstruent, the word-final voiced obstruent does not become voiceless. Because voiced obstruents in English are unspecified, some variation is expected in the way they are realised. This appears to be the case in the realisation of word-final fricatives, which become voiceless when occurring in word-final position in an unstressed syllable and followed by a voiceless obstruent. Collins & Mees (1999: 210) note that this type of assimilation is most frequent with final inflectional consonants and in grammatical items such as *of* and *as.* They argue that "[t]his feature is to be heard constantly in all but the most careful styles of speech" (Collins & Mees, 1999: 283). Examples provided by Cruttenden (2001: 257) are:

(25) *he was sent* /z/ → [s]
(26) *of course* /v/ → [f]

Cruttenden (2001) notes that

> "[t]he phonemic change in such examples may be complete in that a preceding long vowel or diphthong may be realised in the reduced form appropriate to a syllable closed by a voiceless consonant" (Cruttenden, 2001: 283).

The devoicing of the final voiced fricative is obligatory in the auxiliaries *used to* and *have to* (Collins & Mees, 1999: 210), as is illustrated in the following phrases:

(27) *I used to play tennis.* /juːzd tuː/ → [ˈjuːstə]
(28) *He has to leave now.* /hæz tuː/ → [ˈhæstə]

It should be noted that voiced fricatives rather than voiced stops can become voiceless before a word-initial voiceless obstruent, though word-internally both stops and fricatives may become voiceless when preceding a voiceless obstruent (Collins & Mees, 1999: 210; Cruttenden, 2001: 283). Examples provided by Collins & Mees (1999: 210) are:

(29) *newspaper* /zp/ → [sp]
(30) *absolute* /bs/ → [ps]

The fact that there is variation in the realisation of syllable-final obstruents preceding voiceless obstruents is in line with a theory which assumes that voiced obstruents in English are laryngeally unspecified. Whereas there is no rule spreading [spread glottis] from a word-initial voiceless obstruent to a preceding one, final voiced obstruents can become (partly) devoiced before voiceless obstruents as the result of phonetic spill-over.

6.3. Final laryngeal neutralisation in Dutch Learner English

This section discusses the production of final laryngeal neutralisation of stops (Section 6.3.1.) and fricatives (Section 6.3.2.) in the database of spoken Dutch Learner English.

6.3.1. Stops

Utterance-final position

In order to investigate whether the informants transferred the process of laryngeal neutralisation from their mother tongue into English, all voiced stops which occurred in utterance-final position in the DLE conversations were coded. Since prepausal voiced stops are never realised as voiced in Dutch, they were not coded in the Dutch conversations. Because the conversations are spontaneous, turn-taking happens quickly and there are few pauses. In total, 95 tokens were coded which ended in a voiced stop and were followed by a pause. Of these 95 tokens, 39 were realised with a voiceless stop, which corresponds to 41%. All but one of these tokens ended in a voiced alveolar /d/; only one token ended in a voiced velar /g/. The East-Flemish informants devoiced prepausal stops in 42% of the tokens; the West-Flemish informants did so in 35% of the tokens. However, since 72 of the 95 possible final devoicing sites occurred in the speech of East-Flemish informants and only 23 in the speech of West-Flemish informants, it is difficult to compare the two groups. The example phrases in (31)-(34) contain a final stop which was devoiced:

(31) I was really like… oh go*d* [gɒt] (WF)
(32) I I went to Eng.Englan*d*…London. [ˈɪŋlənt] (WF)
(33) well hu.. yesterday, I got this uh.. mail from a frien*d*… [frent] (EF)
(34) sort of uh….one last thing to do before we get uh.. to uh.. well study really har*d*… [hɑːt] (EF)

The word reading task also contained five words ending in a voiced alveolar stop, namely *bid*, *did*, *bed*, *bide* and *died*. One of the ten informants who participated in the reading task (no.16) realised all five words with a voiceless stop at the end. Figure 28 shows the spectrogram of the word *did*, realised as [dɪt] by informant no. 16. Although final voiced stops become partially devoiced in English as well (see Section 6.2.), the devoiced stops in the English words read by the informants share with the voiceless stop the more explosive burst and greater energy. A stop was coded as having undergone final devoicing when there was no vocal fold vibration during closure and when the burst was produced with the greater energy typical for voiceless stops. Vowel length was measured, but not taken into account in the coding of the stop (see below). The arrow points at the burst of the plosive [t].

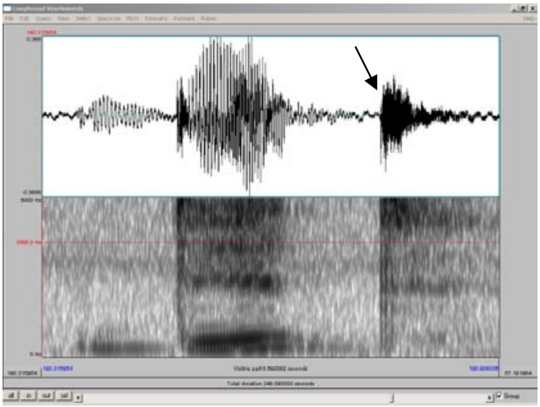


Figure 28. Spectrogram showing the word *did* realised as [dɪt] by informant no. 16.

Except for eight tokens which were realised with laryngeal neutralisation by three different participants, all tokens (42 in total) were realised without devoicing. It should be noted that the informants' attention had been drawn to the process of 'final devoicing' in pronunciation classes. In the questionnaire the informants were asked to define 'final devoicing' and give an example. Eight of the 16 students were able to come up with a definition and six could also give an example. Their explicit knowledge about this process could explain why by far the majority of tokens were realised with a final voiced stop in the reading-task, whereas 39% of the word-final /d/'s was devoiced in the spontaneous conversations.

Two informants (no. 1 and no. 12) sometimes released the final alveolar stops very audibly, so that (a hint of) a final schwa could be perceived, as in *bid* [bɪdᵊ], *did* [dɪdᵊ] and *died* [daɪdᵊ]. Figure 29 presents the spectrogram of the word *bid* produced by informant no. 1. The arrow points at the final vocalic element:

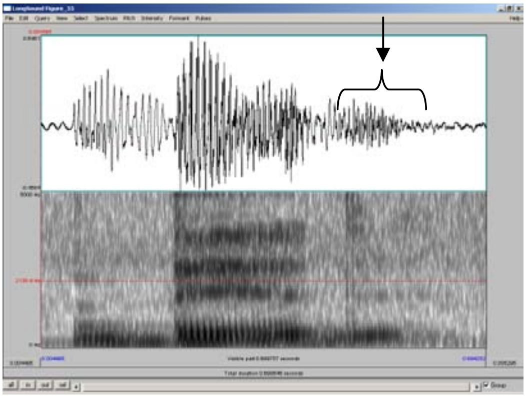


Figure 29. Spectrogram showing the word *bid* realised as [bɪdᵊ] by informant no. 1.

Informant no. 1 realised the word *bed* with a final voiced fricative, as [beð]. The realisation of /d/ (and /t/) as [θ] occurred a few times in the DLE conversations as well, as is illustrated in the following phrase:

(35) that were my my **ba*d* uh** [bæθ] (WF)

Since the fricatives /ð/ and /θ/ are frequently realised as [d] and [t] by the informants, realisations of final /d/'s as fricatives are instances of hypercorrection. The following fragment (taken from the DLE conversation between informant no. 13 and 14) shows that the informant who produced Example 35 (speaker A in the fragment below) is aware of the fact she has difficulty producing the fricative /θ/, which she usually realises as [t].

A: it's very difficult to speak with a 'th', don't you think?
B: no, no, not for me
(…)

B: he couldn't, he always said '*f*ink', with an '*f*'; 'no, no', I said, 'it's *th*ink..*th*ink'
A: but it is it is very difficult to say *th*ink…*th*ink…

As the informants have been 'drilled' in their pronunciation classes to avoid 'final devoicing', realisations of final voiced stops with epenthetic schwas or as fricatives are probably the result of an attempt to avoid final voiceless stops.

As the voiced/voiceless distinction in English word-final stops is mainly signalled through the length of the preceding vowel (see Section 1.5.3.) the vowel lengths in six words in the reading task were measured. The six words formed three minimal pairs, which differed only in the voice character of the coda consonant (and in the length of the preceding vowel): *bet – bed*, *bit – bid* and *bite – bide*. The results for the ten native speakers of Dutch are presented in Table 31.

ms	bet	bed	bit	bid	bite	bide
No.8	144.4	137.7	86.8	109.8	221.2	273.8
No.6	128.7	167.1	126.1	175.4	208.7	302.8
No.9	73.5	212.2	87.4	217.3	180.6	468
No.10	101.5	139.4	128.5	141.7	195.2	255.8
No.12	145.7	239.9	103.4	211.0	205.5	367.8
No.15	144.6	259.3	150	163.8	183.2	298.2
No.1	126.5	243.1	105.8	207	226.9	357.4
No.13	153.1	148.6	141.6	163.9	211.8	331
No.16	85.7	129.2	84.8	83	236.1	266.4
No.4	119.5	155.2	91.7	125.3	189.2	312.3
mean	122.3	183.2	110.6	159.8	205.8	323.4
difference	50%		44%		57%	

Table 31. Vowel length in minimal pairs (in ms): L1 Dutch speakers.

In all but three minimal pairs the length of the vowel was longer when followed by a voiced stop than when followed by a voiceless one. In the three cases in which the opposite was true (which are underlined in the table), the difference between the two was minimal. In those tokens, in which the final voiced stop was devoiced, the vowel length of the preceding vowel is each time shorter than the average vowel length for that word. The vowel lengths of tokens with final devoicing are shaded in Table 31. The last row in the table shows that the mean difference in vowel length is about 50% for *bet-bed*, 44% for *bit-bid* and 57% for *bite-bide*. The average difference in vowel length produced by the participants thus lies around 50%. English has been reported to have vowels before voiced stops which are 50% or more longer than vowels before voiceless stops (cf. Kingston, in preparation). The informants have thus acquired the competence to vary vowel length in function of the voice character of the following stop in English.

In order to test whether the difference in vowel length before /t/ and /d/ was statistically significant in the readings of the L1 Dutch informants, a t-test was carried out for each pair (*bet-bed*, *bit-bid* and *bite-bide*), as shown in Table 32.

	bet-bed	bit-bid	bite-bide
Mean difference in V length	60.9	49.2	118
Standard deviation	51.6	46.5	72.0
$t = \dfrac{\mu}{SD/\sqrt{n}}$	3.73	3.35	5.16
p	0.002356	0.004268	0.000298

Table 32. t-test for significance of pre-stop vowel length.

As all three p-values are much smaller than 0.01, the difference in vowel length is highly significant for all three pairs.

The Dutch word list was not originally designed to test vowel length and contained only one pair of words in which only the underlying voice specification of the final stop differed, namely the pair *bot-bod* ('bone'-'offer'), both realised as [bɔt]. In order to examine whether the native speakers of Dutch produced longer vowels before underlying voiced stops than before underlying voiceless stops in this pair, the vowels were measured in these two words as well. The duration values (in ms) are presented in Table 33.

ms	bot	bod
No. 8	79.2	97.9
No. 6	105.9	122.6
No. 9	109.1	86.6
No. 10	85.1	93.2
No. 12	94.7	110.2
No. 15	191.2	220.1
No. 1	122	119.8
No. 13	95.1	175.1
No. 16	130.1	118.2
No. 4	95.7	83.5
mean	110.8	122.7

Table 33. Vowel length in *bot – bod* in Dutch.

A t-test showed that the difference in vowel length was not statistically significant ($p = 0.112934 > 0.05$). However, it is possible that more data from a larger number of participants would reveal a slight durational difference, as found by Warner et al. (2004) (see Section 1.5.3). In any case, the results confirm that in Dutch, vowel length does not vary with the voice character of the following stop as it does in English.

Table 34 presents the vowel lengths (in ms) in the three pairs produced by the ten native speakers of English:

	bet	bed	bit	bid	bite	bide
no.1	140.6	151.7	111.3	118.6	157.1	202.6
no.2	199	218.2	130.7	153.7	203.8	317.9
no.3	61.7	100.7	60.8	92.1	147.7	391.4
no.4	130.6	161.2	67.2	113.2	240.5	289.1
no.5	137.3	202.6	87	172.4	177.8	326.4
no.6	169.8	217.4	126.4	204.5	192.8	440.2
no.7	155	182.3	120.3	148.1	217.4	360.5
no.8	102.1	133.7	68.6	125.9	113.4	242.2
no.9	139.9	165.7	120.4	138.8	206.1	310.3
no.10	129	175.6	109.9	142	196.7	313.8
mean	136.5	170.9	100.3	140.9	185.3	319.4
	25%		41%		72%	

Table 34. Vowel length in minimal pairs (in ms): L1 English speakers.

The average difference in the length of a vowel preceding a voiceless and a voiced stop was 46%. Table 34 shows that the difference in vowel length is much smaller in the *bet-bed* pair (difference of 25%) than in the *bit-bid* pair (41%) and the *bite-bide* pair (72%). The overall difference in vowel length, 46%, is also slightly lower than the overall difference produced by the L1 Dutch speakers. However, even though the difference in vowel length was slightly lower in the L1 English tokens (especially for the *bet-bed* pair), in none of the tokens produced by the L1 English speakers was the vowel preceding /t/ longer than the one preceding /d/. Vowel length is thus very systematically used as a cue for the voice character of the following final stop.

Preceding voiceless obstruents

Word-final voiced stops preceding voiceless stops are always devoiced in Dutch, and this type of cluster was therefore not coded in the Dutch conversations. In the English conversations, 53 tokens were coded which contained a voiced stop + voiceless stop cluster. Only nine of these were realised with a final voiced stop; the remaining 44 tokens (i.e. 83%) were realised with a voiceless one. Here are some examples in which a final voiced stop is devoiced even though it is not part of an unstressed syllable:

(36) to know the bi*g* periods uh that are presented [bɪk ˈpiːrɪədz] (EF)
(37) it was l.. a.. ba*d* teacher [bæt ˈtiːtʃə] (WF)

Most of the tokens, however, contained devoicings that are obligatory or common in native English (see Section 6.2). The auxiliary *had to,* for instance, occurred as [hæt_tu] (or [hæt_tə]) 11 times and 12 instances of *need to* occurred, all of which were realised as [niːt_tu] (or [niːt_tə]).

6.3.2. Fricatives

Utterance-final fricatives

Fricatives – just like stops – become voiceless in prepausal position in Dutch, but not in English. Because in Dutch there are no exceptions to this rule (word-final fricatives which are voiced in the underlying form are even spelled like voiceless ones in word-final position, see Section 6.2.), utterance-final voiced fricatives were not coded in the Dutch conversations. In the DLE conversations, 200 tokens containing a final voiced fricative followed by a pause were coded. As many as 150 of these 200 final fricatives were devoiced. Moreover, 22 out of the 50 tokens in which the prepausal fricative was *not* devoiced were produced by the same informant (no. 4). Examples of devoiced prepausal fricatives are provided in (38) – (40).

(38) I saw the twin*s* [twɪns] (EF)
(39) four day*s*…[deɪs][6] (EF)
(40) becau*se*…I wasn't.. good [bɪˈkɒs] (WF)

Table 35 shows the number of tokens in which the final fricative was devoiced in relation to the preceding segment. With the preceding segment is meant the preceding segment that was actually realised, rather than the preceding underlying segment. The word *depends*, for instance, was once realised as [diˈpens], in which the segment preceding the fricative was taken to be the sonorant [n] rather than the deleted obstruent /d/.

FIN	DLE
obstruent + voiced fric. + ##	13/20 (65%)
sonorant C. + voiced fric. + ##	30/38 (79%)
long vowel + voiced fric. + ##	24/37 (65%)
short vowel + voiced fric. + ##	83/105 (79%)
Total	150/200 (75%)

Table 35. Devoicing of utterance-final prevocalic fricatives in function of the preceding segment.

When the word-final fricative was preceded by an obstruent and devoicing took place, both the obstruent and the fricative were devoiced. Examples are *kids* and *dogs,* which were pronounced as [kɪts] and [dɒks], respectively. In an Optimality Theory account, the devoicing of the fricative could be considered to be the result of a constraint which says that coda obstruent clusters should agree in voicing (e.g. AGREE, see Section 2.5.2.). Whereas clusters like [tz] and [ds] violate this constraint, clusters like [ts] and [dz] satisfy it.

As can be seen in Table 35, more than half of the prepausal voiced fricatives (i.e. 105 out of 200 tokens) were preceded by a short vowel. Proportionately, the number of devoiced fricatives is slightly lower when the fricative is preceded by an obstruent or a long vowel than when it is preceded by a sonorant consonant or a short vowel. However, because of the great differences in possible assimilation sites, it is hard to compare the percentages.

Table 36 shows that the possible final laryngeal neutralisation sites greatly differ for the different fricatives, final /z/ being much more frequent than final /ð/ or /v/. The fricative /ð/ actually only occurred in the word *with*, which was realised as [wɪθ] three times and as [wɪt] two times. Whereas *with* is usually realised as [wɪð] in British English, the realisation [wɪθ] is preferred in Scottish and American English (cf. Wells, 2000; Jones, 2003). All three fricatives were often devoiced in relation to their occurrence:

FIN	DLE
/ð/	5/5
/v/	24/27
/z/	121/168

Table 36. Final devoicings in the DLE conversations per fricative.

The results for the East- and West-Flemish informants were very similar: the East-Flemish informants devoiced 72% of the tokens (87/120); the West-Flemish informants 79% (63/80).

When we compare utterance-final voiced fricatives with utterance-final voiced stops, it appears that the former were much more often subject to devoicing than the latter: whereas 75% of all final fricatives were devoiced, only 41% of the stops were devoiced. The results per phoneme are presented in Table 37.

FIN	stops		fricatives	
	/b/	0/0	/v/	24/27 (89%)
	/d/	38/95 (40%)	/z/	121/168 (72%)
	/g/	1/1	/ð/	5/5

Table 37. Devoicing of utterance-final obstruents per phoneme.

No instances of utterance-final /b/ were coded in the DLE conversations and utterance-final /g/ and /ð/ only occurred once and five times respectively, in which cases they were always devoiced. Utterance-final fricative /v/ was devoiced most frequently (in 89% of the tokens), followed by final /z/, which was devoiced in 72% of the tokens. The stop /d/ was less frequently devoiced: in 40% of the tokens. The greater difficulty involved in producing vocal fold vibration during fricatives in comparison to stops is probably responsible for this difference.

Word-final voiced fricatives preceding voiceless fricatives

Because word-final voiced fricatives are always voiceless in Dutch before a voiceless fricative, this type of cluster was not coded in the Dutch conversations. In the DLE conversations, 78 tokens of this type were coded. In 66 of these (i.e. 84%) the final fricative was devoiced. The East-and West-Flemish speakers produced final laryngeal neutralisation in about the same proportion of tokens: it occurred in 87% of the tokens produced by the East-Flemish informants and in 81% of the tokens produced by West-Flemish informants. Table 38 presents the results per word-final fricative:

FIN	DLE
/ð/	1/2
/v/	18/22
/z/	47/54

Table 38. Final laryngeal neutralisation in voiced fricative + voiceless fricative clusters.

The table shows that the fricative /ð/ occurred only twice in word-final position preceding an onset voiced fricative, but that both /v/ and /z/ were very frequently devoiced in this context. Two examples of coda fricatives which were devoiced preceding a voiceless onset fricative are given in (41) and (42):

(41) it's a nice…uh chan*ge f*rom the ordinary sit-write-and-listen classes, so… [tʃeɪnʃ frəm] (WF)
(42) I wa*s s*itting there like [wəs ˈsɪtɪŋ] (EF)

The high percentage of devoicing of coda fricatives before onset voiceless fricatives is not surprising, since (1) fricatives are always voiceless preceding voiceless fricatives in Dutch, (2) it is aerodynamically difficult to produce voicing in fricatives, and (3) coda voiced fricatives are frequently phonetically voiceless in English when occurring in a final unstressed syllable and followed by a voiceless obstruent (see Section 6.2). In fact, closer inspection of the data revealed that 43 of the 66 tokens which underwent devoicing were function words which are often unstressed and reduced (excluding the demonstrative pronoun *those,* which occurred four times). This means that only 23/66 (35%) of the devoicings could be considered deviations from the target language.

6.4. Summary

This chapter has discussed the process of final laryngeal neutralisation, which is obligatory in Dutch, but does not occur in English, in which the phonological contrast between voiced and voiceless obstruents is maintained in word-final position. In an autosegmental approach assuming one feature [voice] in Dutch and English, laryngeal neutralisation in Dutch is explained as the delinking of the [voice] feature of coda obstruents in word-final position. In English, no such delinking rule occurs. In a Multiple Feature approach, on the other hand, there is a delinking rule in Dutch, but voiced obstruents in English are laryngeally unspecified, resulting in variation in the phonetic realisation.

The analysis of final laryngeal neutralisation in the DLE database revealed that native speakers of Dutch devoiced 41% of utterance-final stops, and as much as 75% of utterance-final fricatives. A one-tailed paired t-test confirmed that this difference was significant ($t = 2.52$, $df = 14$, $p = 0.012 < 0.05$).The difference in the extent to which stops and fricatives are devoiced was linked to the relative markedness of the segments: since for voiced fricatives the glottis needs to be sufficiently open to allow friction to be produced, but also sufficiently closed in order to keep the supraglottal pressure lower than the subglottal pressure, it is aerodynamically more difficult to produce voiced fricatives than voiced stops. It is suggested that this difference in markedness, which is not apparent in L1 Dutch (in which both stops and fricatives are devoiced in final position), nor in English (in which the contrast is maintained in both cases) emerges in the interlanguage of the learners. The analysis further showed that more than 80% of both voiced stops and fricatives were devoiced preceding onset voiceless obstruents in DLE, a result which is not surprising given that obstruents are voiceless in this position in Dutch and that (partial) phonetic devoicing is expected even in L1 English.

Notes

1. The process is also mentioned by, among others, Blanquaert (1964: 156), van den Berg (1964: 61), Zonneveld (1983: 298), Booij (1995a: 32) and Collins & Mees (1999: 51).

2. cf. Trubetzkoy's Archiphonemes (see Section 2.2.).

3. According to Ernestus (2000), the Permanent Neutralisation Hypothesis is not compatible with the privative feature hypothesis, since there are consonants which are always realised as voiceless, regardless of the phonetic context. Under the Permanent Neutralisation Hypothesis, however, it would be expected that all neutral consonants are sometimes realised as voiced and sometimes as voiceless, depending on which realisation requires the least articulatory effort given a certain phonetic context. According to Ernestus, this means that obstruents which are always realised as voiceless need to be specified [-voice]. Ernestus thus employs [+voice] stops, [-voice] stops and neutral stops ([0voice]).

4. Steriade (1995) uses the symbol 'R' to represent the meaning 'is more perceptible than'. This symbol is replaced by '>' in the present work, because the symbol R stands for 'sonorant' elsewhere in the book.

5. The dialect of Yorkshire forms a notable exception, in that in this dialect there is regressive voice assimilation in voiced obstruent + voiceless stop clusters (Wells, 1982b, see 2.3.2.).

6. As an anonymous reviewer pointed out, the role of orthography cannot be excluded here. In total, 45 out of the 150 tokens in which a final fricative was devoiced, were plural forms ending in –s. It is possible that some participants – on the basis of the spelling – had an underlying representation with /s/ and were thus not actually devoicing an underlying /z/, but producing a faithful [s]. However, since all participants were second year university students of English who had received explicit instruction on the plural formation and its pronunciation in English and since they were not reading, but engaged in natural conversations, the role of orthography is likely not to have had an important impact.

Chapter7

Regressive voice assimilation

7.1. Introduction

Regressive voice assimilation (henceforth RVA) is the process through which the laryngeal realisation of syllable- or word-final obstruents is changed under the influence of the following syllable- or word-initial segment. This chapter discusses the contexts in which regressive voice assimilation occurs in Dutch and English and to what extent it is produced in the English interlanguage of native speakers of Dutch. The chapter discusses both rule-based and phonetic approaches to RVA. The implications of the learner results for the laryngeal representations in Dutch, English and DLE will be dealt with in Chapter 11.

7.2. Contexts of regressive voice assimilation in Dutch vs. English

In Dutch, word-final obstruents are voiced when preceding word-initial voiced stops. Booij (1995a: 59) gives the following examples[1]:

(43) *kookboek* [g] ('cooking book') /kokbuk/ → [ˈkogbuk]
(44) *misdaad* [z] ('crime') /mɪsdad/ → [ˈmɪzdat]

The process also applies across word boundaries, as is illustrated in the following phrases:

(45) *laat boeken* [db] ('(to) book late') /lat bukən/ → [lad ˈbukə]
(46) *twaalf dozen* [vd] ('twelve boxes') /twalf dozən/ → [twalv ˈdozə]

Trommelen & Zonneveld (1979: 134) formulate a rule of regressive voice assimilation in traditional generative phonology, which makes use of the alpha-notation:

Rule 1: $[-\text{son}] \rightarrow [\alpha \text{ voice}] / \_\_ \ (\#) \begin{bmatrix} -\text{son} \\ \alpha \text{ voice} \end{bmatrix}$

Because the alpha stands for either the positive (+) or the negative (–) value, the rule has two expansions: one in which obstruents become voiced before voiced obstruents and one in which they become voiceless before voiceless obstruents. The symbol # stands for a boundary between two members of a compound word. Trommelen & Zonneveld (1979) only discuss assimilations within (compound) words, but the rule also applies across word boundaries, so that the boundary symbol in Rule 2 should actually be #(#), in which # # stands for a word boundary:

Rule 2: $[-\text{son}] \rightarrow [\alpha\ \text{voice}] / \_\_\ \#(\#)\begin{bmatrix}-\text{son}\\ \alpha\ \text{voice}\end{bmatrix}$

The following phrases illustrate the application of the rule across word boundaries:

(47) *gaat binnen* ('goes in'): /tb/ → [db] /ɣat bɪnən/ → [ɣad ˈbɪnə]
(48) *kies kaarten* ('choose cards'): /zk/ → [sk] (< *kiezen* [z]) /kiz kartən/ → [kis ˈkartən]

In example (48) *kies kaarten,* the devoicing of the fricative can also be explained as the result of the rule of final devoicing, in which case the alpha-notation is superfluous. Because a final obstruent also becomes voiceless before a voiceless obstruent within one word, the alpha notation is only superfluous if the final devoicing rule is formulated so as to include word-internal boundaries. Trommelen & Zonneveld provide the following examples containing word-internal devoicings (1979: 130):

(49) *raadsel* ('riddle'): /d/ → [t], /ˈraːdsəl/ → [ˈraːtsəl] (~ *raden* [d] 'to guess')
(50) *liefste* ('dearest, sweetest'): /v/ → [f], /ˈliːvstə/ → [ˈliːfstə] (~ *lieve* [v] 'dear, sweet', adj.)

In order to account for these cases of word-internal devoicings, the final devoicing rule thus has to include the syllable-boundary (in which case the alpha-notation in Rule 2 is superfluous and the alpha should be replaced by a plus) *or* the voice assimilation rule has to include the alpha-notation (and the final devoicing rule does not need to include word-internal boundaries).

It should be noted that regressive voice assimilation can also apply if two final voiceless obstruents are followed by an initial voiced plosive: both the first and the second obstruent then become voiced. However, the middle consonant would typically be deleted in such contexts. Examples are provided in (51)-(52):

(51) *zet de ka<u>st b</u>innen* ('put the cupboard inside') /kɑst bɪnən/ → [kɑzd ˈbɪnə] or [kɑz ˈbɪnə]
(52) *in de li<u>ft b</u>lijven* ('stay in the lift') /lɪft blɛivən/ → [lɪvd ˈblɛivə] or [lɪv ˈblɛivə]

Jansen (2004) conducted an experiment, in which four native speakers of Dutch (living in Groningen, a town in the north of the Netherlands) were asked to read a number of sentences which contained clusters of word-final /ps/ followed by a voiced stop, a voiceless stop or a sonorant in onset position. He found that the voiced interval of the /ps/ clusters was much longer when the following word-initial consonant was a voiced stop (as in *Jaaps benen* 'Jaap's legs') than when it was a voiceless stop (as in *Jaaps peren* 'Jaap's pears'). Regressive voice assimilation is thus an iterative process in Dutch: the word-initial stop makes the preceding obstruent voiced, which in its turn spreads its voice leftward to the preceding obstruent. Jansen (2004: 168) argues that many traditional generative analyses (such as Trommelen & Zonneveld, 1979 and Berendsen, 1983) were not able to account for regressive voice in three-term clusters with a medial fricative, since the regressive voice assimilation rule specified that the initial obstruent had to be [-cont] (i.e. fricatives were excluded)[2]:

Rule 3: $$\begin{bmatrix} -\text{son} \\ +\text{tense} \end{bmatrix} \rightarrow [-\text{tense}] / \_\_\_ \#(\#) \begin{bmatrix} -\text{son} \\ -\text{cont} \\ -\text{tense} \end{bmatrix}$$

Note that, although Trommelen & Zonneveld indeed mention this rule with the [–cont] specification (1979: 63, 102), later on in the book they replace it by a rule containing the alpha-notation, in which the manner restriction is left out (1979: 134, 137; here translated from Dutch):

Rule 4: $$[-\text{son}] \rightarrow [\alpha\ \text{voice}] / \_\_\_ \#(\#) \begin{bmatrix} -\text{son} \\ \alpha\ \text{voice} \end{bmatrix}$$

However, the manner restriction is left out only because the rule is preceded by a fricative rule, which devoices fricatives after voiceless obstruents. Trommelen & Zonneveld's (1979: 131) brief rule ordering in Dutch is consequently not able to account for regressive assimilation in three-term clusters with a medial fricative.

In Autosegmental Phonology, the regressive assimilation pattern in Dutch is regarded as a spreading process (see Section 2.5.2.). In the privative theories proposed by Iverson & Salmons (1995; 2003) and Kager et al. (2007) Dutch voiced obstruents are argued to be laryngeally marked. Because they are specified for [voice] (in Kager et al.'s analysis) or for Glottal Tension (in Iverson & Salmons' model, see Section 2.4.2.), they are able to spread this specification to a preceding obstruent. Figure 30 illustrates the regressive spread of [voice] in the Dutch phrase *boek dicht* ('book closed'), which is realised with a word-final voiced stop [g].

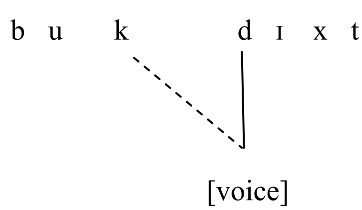


Figure 30. Regressive spread in the Dutch phrase *boek dicht.*

Jansen (2004) advocates a phonetic approach to Dutch regressive voice assimilation. He argues against the common view in traditional approaches that only word-initial voiced stops trigger regressive voice assimilation. This traditional view implies that whether the second, word-initial consonant is a voiceless obstruent or a sonorant does not affect the voicing of the preceding obstruent, which in this context is always voiceless as the result of final devoicing. However, Jansen's experiment showed that the first obstruent cluster (the /ps/ cluster) was significantly more voiced when followed by a voiced obstruent than when followed by a voiceless one. According to Jansen, the experiment thus provides evidence for a phonetic, coarticulation-based approach to Dutch regressive assimilation.

Jansen's argument is compatible with the Permanent Neutralisation Hypothesis proposed by Ernestus (2000). According to Ernestus' Permanent Neutralisation Hypothesis, neutral obstruents (i.e. word-final obstruents and coda obstruents) are realised according to the principle of least articulatory effort. In clusters of a neutral obstruent followed by a voiced stop, the realisation of the word-final stop which requires the least effort is a voiced realisation. Before voiceless obstruents, it requires less effort to produce a voiceless than a voiced obstruent and the analysis thus correctly predicts regressive voice assimilation before voiced stops and the absence of regressive voice assimilation before voiceless stops (cf. Ernestus, 2000: 159).

Whereas in Dutch, voiceless obstruents become voiced when followed by a voiced stop, this is not the case in English. Examples are the following:

(53) *get better*: /get ˈbetə/ → [get ˈbetə] (and not [ged ˈbetə])
(54) *if Davy*: /ɪf ˈdeɪvi/ → [ɪf ˈdeɪvi] (and not [ɪv ˈdeɪvi])

Because regressive voice assimilation in the direction of voicedness occurs in Dutch, but not in English, native speakers of Dutch learning English are advised to avoid regressive voice assimilations, as in the following quote from Collins & Mees (1999)[3]:

> "Assimilations involving lenis to fortis are only acceptable in *unstressed* syllables. *Note that in stressed syllables such assimilations should be avoided by the learner, as should all fortis to lenis assimilations*" (Collins & Mees, 1999: 220; original italics).

In word-internal position, regressive voice assimilation to voicedness is occasionally possible in English, though it is restricted to a number of lexical items. Jansen (2004: 124), for instance, notes that the fricative in the suffix *mis–* does not become voiced preceding a voiced obstruent, in contrast with the fricative in *dis–* (e.g. *misguided* [sg] vs. *disguised* [zg]). This type of coarticulation is lexically restricted and is thus different from regressive voice assimilation in Dutch, which is not restricted in the same way.

Jansen also mentions examples like *Osborne* [zb], *Osgood* [zg], *Marsden* [zd] and *Neasden* [zd], which are all normally realised with a voiced fricative, in contrast with, for instance, *Oscar* [sk] and *osprey* [sp], in which the syllable-final fricative is voiceless. According to Jansen's phonetic approach, coda obstruents are laryngeally neutralised in English and are therefore voiced before passively voiced stops, but become voiceless when they are followed by actively devoiced stops, such as the /k/ in *Oscar*.

If it is assumed that voiced obstruents in English are not specified for [voice] (or Glottal Tension), there cannot be a rule which spreads [voice] to the preceding segment and regressive assimilation in English obstruent + voiced obstruent clusters is hence impossible.

$$\begin{array}{ccc} \text{vcl. O} & + & \text{vcd. O} \\ | & & | \\ \text{[spr.gl]} & & \varnothing \end{array}$$

Figure 31. Laryngeal representations in voiceless obstruent + voiced obstruent clusters.

The hypothesis that voiceless obstruents in English are marked for [spread glottis] and voiced obstruents are unmarked is confirmed by Kager et al.'s (2007) analysis of consonant harmony in the speech of one child from the CHILDES-database, who was acquiring American English. It appeared that, whereas in this child's speech voiceless coda obstruents triggered devoicing of the onset consonant, voiced coda stops and sonorants were inactive (Kager et al, 2007).

Whereas there is no phonological regressive assimilation in either voiceless obstruent + voiced stop clusters or voiceless obstruent + voiced fricative clusters, Jansen (2004) claims that there is still a difference between the two types of clusters. He argues that, although there is no phonological assimilation across word boundaries in English, phonetic assimilation takes place in obstruent + voiced fricative clusters, but not in obstruent + voiced stop clusters. Jansen conducted an experiment with four native speakers of British English (all living in the London area), who were asked to read sentences containing clusters in which the first consonant was /k, ɡ, ŋ/ and the second /t, d, s, z, r/[4], occurring across word boundaries (e.g. *How does patchwork duvet translate?* (/k + d/)). Jansen (2004) argues that voiced fricatives in English are actively voiced sounds, in contrast with voiced stops, which are passively voiced (see Section 1.4.). A phonetic approach to voicing assimilation predicts that only actively voiced sounds are able to trigger voice assimilation in a preceding obstruent. Jansen's measurements indeed revealed that

> "[a]ctively voiced /z/ and to a lesser extent, actively devoiced /t,s/ all cause deviations in the phonetic voicing of a preceding obstruent relative to a baseline sonorant context. Crucially, English /d/, which was argued (…) to be passively voiced, did not trigger any form of voicing assimilation (…)" (Jansen, 2004: 141).

A similar result was obtained in an earlier study by Thorsen (1971), who investigated the voicing duration in consonant clusters of which the first consonant was /t/ or /d/ and found that there was considerably more voicing in /t/ and /d/ when these were followed by /z/ than when followed by /g/ (Jansen, 2004: 126). According to Jansen, these findings strongly point to the fact that English voiced fricatives are actively voiced sounds, in contrast with voiced stops, which are passively voiced and thus – according to a phonetic approach to voice assimilation – unable to spread voice to a preceding consonant. This raises the question what laryngeal specification English fricatives have, which will be discussed in Chapter 11.

7.3. Regressive voice assimilation in DLE

7.3.1. Voiceless obstruents as targets

Since RVA before voiced stops occurs in Dutch, but not in English, native speakers of Dutch have to learn not to apply this process when speaking English. In the Dutch and English conversations together, 338 tokens containing a word-final (underlyingly) voiceless stop (/p, t, k/) followed by a voiced stop (/b, d/ for Dutch and /b, d, g/ for English) were coded. In total, 34% of these were coded PVA (progressive voice assimilation), nearly all of which occurred in the Dutch conversations and contained an underlying /td/ cluster. Because /td/ clusters form an exception to the general rule of regressive voice assimilation in some varieties of Dutch (including the varieties spoken by the informants), they are left out of the analysis below (but see Section 9.3 for a discussion of this type of cluster). The tokens which are coded PVA are hence not included in Table 39. Table 39 presents the percentages of regressive voice assimilations per language and per regiolect. The total number of assimilation sites are the tokens that underwent RVA and those that remained unmodified.

RVA	Dutch	DLE
East-Flemish	79/85 (93%)	41/60 (68%)
West-Flemish	40/49 (82%)	19/34 (56%)
total	119/134 (89%)	60/94 (64%)

Table 39. Regressive voice assimilation in voiceless stop + voiced stop clusters.

The production of regressive voice assimilation was extremely frequent in the Dutch conversations, where 89% of the voiceless stops became voiced when preceding a voiced stop. In the English conversations 64% of the tokens were produced with regressive assimilation.

In Dutch, not only stops but also fricatives are realised as voiced preceding onset voiced stops. Table 40 presents the production of regressive voice assimilation in all obstruent + voiced stop clusters (except /td/ clusters):

RVA	Dutch	DLE
East-Flemish	192/206 (93%)	53/86 (62%)
West-Flemish	114/128 (89%)	29/53 (55%)
total	306/334 (92%)	82/139 (59%)

Table 40. Regressive voice assimilation in voiceless obstruent + voiced stop clusters.

As regressive assimilation to voicedness does not normally occur in English, the high percentage of RVAs in the DLE conversations indicates that both the East- and the West-Flemish informants transferred this type of assimilation from Dutch into English.

Some examples of assimilations in Dutch are given in (55)-(57) and assimilations in DLE are illustrated in (58)-(60).

Dutch:

(55) ee(n) volledige rode **stree*p* door** [streːb doːr] (EF)[5]
'a full red line through'

(56) 'k zeg "'k moet 'k ik hier toch niet toekomen en den **afwa*s* *d*oen** zeker" [ˈɑfwɑz dun] (EF)
'I said: "I don't have to come home and start doing the dishes, right"

(57) *ton* moe(t) je nog je **ticke*t* betalen** [tiˈkɛd bəˈtaːl̩n] (WF)
'you still have to pay your ticket then' (*ton:* West-Flemish variant of *dan* 'then')

DLE:

(58) and and also uh on the uhm.. **differen*ce* *b*etween**…uhm [ˈdɪfrənz bəˈtwiːn] (EF)
(59) they don't **figh*t* back**, you know [faɪd bæk] (EF)
(60) and you know these people of course a **lo*t* better** [lɒd ˈbedər] (EF)

The tendency of native speakers of Dutch to devoice word-final stops in English is thus overruled by the process of regressive voice assimilation, which proves to be very strong.

Van Rooy & Wissing (2001) argue that languages whose stops are specified for [voice] – in the narrow sense of being realised with vocal fold vibration – will always exhibit regressive voice assimilation. They argue that regressive voice assimilation does not have to be formulated as a rule, but is an automatic consequence of the [voice] specification of stops. They formulate the following implicational universal: "[I]f [voice] is selected as distinctive feature, then regressive voicing assimilation automatically applies in that language" (Van Rooy & Wissing, 2001: 305). Van Rooy & Wissing (2001) base this claim on the results of an experiment they conducted in which four native speakers of Tswana, who were proficient in English, read

English sentences which contained possible assimilation sites. Tswana is a Southern Bantu language, which has distinctive [voice], but does not allow coda obstruents (only syllabic nasals are allowed in the coda), and regressive voice assimilation across word-boundaries is thus inherently impossible. The reading test revealed that 55% of all obstruent clusters with a voiced obstruent in the onset were realised with regressive voice assimilation by the Tswana speakers. In two thirds of the tokens in which no regressive voice assimilation was produced, a pause of more than 200 ms was inserted between the two words (each time a name and a surname, e.g. *Jeff Brown*, *Dick Dean*, etc.) and the obstruents were realised according to their underlying voice specification (i.e., no regressive or progressive assimilation took place). The frequent production of RVA in the English phrases by native speakers of Tswana led Van Rooy & Wissing (2001) to conclude that a distinctive feature [voice] implies regressive assimilation. It can be argued, however, that the Tswana English data do not provide evidence for this claim. The regressive voice assimilations produced by the native speakers of Tswana do not need to be an automatic result of the fact that their stops are specified for [voice]; it can equally well be the result of a general (high-ranked) constraint against obstruent clusters in which the obstruents do not agree in voicing (e.g. AGREE, see Section 2.5.2.). Moreover, Ringen & Helgason (2004) argue that Swedish provides direct counterevidence to Van Rooy & Wissing's claim. In their experiment, in which six native speakers of Swedish read Swedish word lists, 93% of word-initial voiced stops were produced with prevoicing, which points to the fact that they are specified for [voice]. However, Ringen & Helgason (2004: 60) argue that Swedish does not have regressive voice assimilation to voicedness (only regressive or progressive assimilation to voicelessness). They argue that Swedish thus provides evidence against Van Rooy & Wissing's (2001) claim that distinctive [voice] implies regressive assimilation to voicedness. The opposite claim, however, seems to be true: in all languages in which regressive assimilation to voicedness occurs, stops are marked for [voice]. Jansen (2004: 117), for instance, notes:

> "All and only the varieties of this group that are described as employing a prevoiced vs. short lag realisation of fortis and lenis plosives are also reported as exhibiting RVA to lenis plosives (…)".

Because in the present study all ten informants who participated in the word reading task produced prevoicing and most did so in *all* Dutch and English word-initial voiced stops (see Section 4.5), the data did not lend themselves to investigating whether the production of prevoicing is a necessary condition for the production of regressive voice assimilation[6].

7.3.2. Voiced obstruents as targets

In the Dutch conversations only 17 tokens containing a voiced stop followed by a voiced stop were coded. In all of the tokens, the voiced stop surfaced as voiced. Here are some examples:

(61) allez, ik **(h)e*b* da(t)** g(eh)oord (*heb* < *hebben*) [ɛb dɑ] (EF)
'well, I've heard that'

(62) ik **(h)e*b* daar** toch wel iets juist geschreven ook [ɛb daːr] (EF)
'I've surely written something right there as well'

(63) 'k ze(g), moet 'k ik nu al mij(n) **potloo*d* bovenhalen** ook [ˈpɔtloːd ˈboːvənaːlən] (*potlood* < *potloden*) (EF)
'I thought, do I have to fetch my pencil now as well'

In English, there is no process of final laryngeal neutralisation and sequences of two voiced stops across word boundaries thus remain unmodified. In the DLE conversations, 50 tokens of this type were coded. All but one were realised without final laryngeal neutralisation. (In one phrase, *stayed down,* the coda /d/ was replaced by a glottal stop). Examples are the following:

(64) he **ha*d* been** in Dublin for one year [hæd bin] (WF)
(65) it **coul*d* be** an hour [kʊd biː] (EF)

The observation that 39% of the prepausal stops were devoiced but none of the stops preceding another voiced stop underwent laryngeal neutralisation indicates that the informants transferred the process of regressive voice assimilation from Dutch into English. If voiced stops occurring before other voiced stops always surfaced as voiced in both the Dutch (17/17) and DLE (49/49) conversations only as the result of the phonetic context, they would then also be expected to be always voiced before vowels, as the intervocalic position is the most voice-friendly of all. The tendency of the informants to devoice final voiced stops is thus overruled by the process of regressive voice assimilation. The production of prevocalic assimilation is discussed in Chapter 10.

In Dutch, utterance-final voiced fricatives are always voiceless. When they are followed by an onset voiced stop, however, a process of regressive voice assimilation applies and the fricative is usually voiced. In English, there is no process of regressive voice assimilation in the direction of voicedness, but final fricatives remain voiced in word-final position (except when occurring in an unstressed syllable preceding a voiceless segment). Because both in Dutch and English word-final voiced fricatives are realised as voiced when preceding a voiced stop, final fricatives were expected to remain voiced in this context in the DLE conversations.

Table 41 shows to what extent the informants devoiced word-final fricatives preceding voiced stops in the Dutch and DLE conversations:

FIN	L1 Dutch	DLE
East-Flemish	1/15 (7%)	5/42 (12%)
West-Flemish	1/10 (10%)	4/40 (10%)
total	2/25 (8%)	9/82 (11%)

Table 41. Final devoicing in voiced fricative + voiced stop clusters.

Although the number of coded tokens is small (especially in the Dutch conversations), it is clear that the participants devoiced hardly any final fricatives preceding voiced stops, which is in accordance with the expectations. In the overall majority of tokens, the fricative remained voiced, as is illustrated in the following examples:

Dutch:

(66) mij **creatie*f* *b*ezig** houden (*creatief ~ creatieve*) [ˈkreːɑtiv ˈbeːzəx] (WF)
‘keeping myself busy in a creative way’

(67) **‘k geloo*f* *d*at** ‘t tachtig frank is (*geloof ~ geloven*) [kxəˈloːv dɑt] (EF)
‘I think it’s eighty francs’

DLE:

(68) don’t they ha*ve* *b*eer over there? [hæv bɪər] (EF)
(69) I **wa*s* *d*isappointed** [wəz dɪsəˈpɔɪntɪd] (EF)

The fact that the informants hardly ever devoiced final fricatives preceding voiced stops in the DLE conversations could mean two things: either the informants have learnt to maintain a contrast between voiced and voiceless fricatives in word-final position in English or the voiced fricatives are the result of the process of regressive voice assimilation transferred from Dutch. Since firstly, it was shown that the informants very frequently produced RVA in voiceless obstruent + voiced stop clusters in the DLE conversations and secondly, the informants very frequently devoiced fricatives in utterance-final and word-final position preceding a voiceless fricative (see Section 6.3.2.), the absence of final devoicing in voiced fricative + voiced stop clusters in the DLE conversations is most likely to be the result of transfer of RVA from the informants’ mother tongue into English.

7.4. Summary

This chapter contained a discussion on the process of regressive voice assimilation in word-final obstruents followed by word-initial voiced stops in Dutch and DLE. The analysis of the Dutch and DLE conversational speech revealed that this process was highly frequent in Dutch as well as in DLE, although the process does not normally occur in L1 English (though some phonetic spill-over has been reported in obstruent + voiced fricative clusters across word-boundaries by Jansen, 2004). Even though voiced obstruents were frequently devoiced when occurring before a pause or an onset voiceless obstruent (see Chapter 6), they were realised as voiced preceding voiced stops, suggesting that the process of regressive voice assimilation overruled the process of final laryngeal neutralisation in the learners' interlanguage. It was further argued that regressive voice assimilation in Dutch is a phonological rule, which involves the spreading of the feature [voice] of the onset consonant to the preceding coda consonant(s), and not an automatic consequence of the [voice] specification of voiced stops, as argued by Van Rooy & Wissing (2001). Since all participants in the present study produced prevoiced stops in the overall majority of tokens in Dutch and DLE (see Chapter 4), the data could not provide evidence for Jansen's (2004) hypothesis that the production of prevoicing is a necessary condition for the occurrence of regressive voice assimilation in a language.

Notes

1. The process is also mentioned by, among others, Trommelen & Zonneveld (1979: 106), Collier & Droste (1983: 35) and Slis (1985: 122).
2. Note that the boundary symbol # is again replaced by # (#), because the process also occurs across word boundaries.
3. Similar advice is given by Gussenhoven & Broeders (1976:101) and Cruttenden (2001:284).
4. Jansen notes that stimuli containing /ŋ/ and /r/ were included "to create baseline conditions for the comparison of the relative effects of fortis vs. lenis C_2 on the properties of the preceding segment" (Jansen, 2004: 128).
5. Here and elsewhere the round brackets around letters in examples indicate that these were not pronounced in the colloquial speech of the participants.
6. The two informants who omitted prevoicing most (each in 11 tokens) are informants no. 12 and 16. Informant no. 12 produced RVA in 5 out of 6 tokens in the Dutch conversations and in 4 out of 8 tokens in the DLE conversations. Informant no. 16 produced assimilation in 6 out of 8 tokens in the Dutch conversations and in the only token of this type in the DLE conversations. It is hence not the case that informants who frequently omitted prevoicing in the reading task did not produce RVA in the spontaneous conversations.

Chapter 8
Sonorant consonants as triggers of voice assimilation

8.1. Introduction

Many models assume that, since all sonorants are voiced, they are laryngeally unspecified. As such, they are expected to be unable to trigger voice assimilation (see Section 2.3. on underspecification). However, voice assimilation patterns involving sonorant consonants have been reported for a number of language varieties, such as Catalan, Kraków Polish, and West-Flemish. This chapter deals with the intriguing question how sonorants can act as triggers of voice assimilation. Rule-based, phonetic and constraint-based approaches are discussed and evaluated. The production of regressive voice assimilation in Dutch and DLE conversational speech by West-Flemish speakers are compared to that of East-Flemish speakers.

8.2. The situation in Dutch and English and a comparison with other languages

In Standard Dutch, obstruents do not normally become voiced before sonorant consonants. The sonorant consonants in Dutch comprise the liquids /l,r/, the glides /w,j/ and the nasals /m,n,ŋ/. The lack of assimilation is illustrated in examples (70)-(71):

(70) *vat wijn*	[tw]	'barrel of wine'
(71) *glas limonade*	[sl]	'glass of lemonade'

However, the situation in Dutch is not completely unambiguous. Various authors note that in certain circumstances fricatives become voiced before sonorant consonants in Dutch. Scharpe (1912: 8) already stated in 1912 that voiceless fricatives become voiced before /j/, as in *half jaar* [vj] 'half a year'. Linthorst, Leerkamp & Galle (1979) argue that there is an optional assimilation process in Dutch, through which all word-final voiceless fricatives become voiced before sonorant consonants. They give the following examples (1979: 108):

(72) *waar was je* [zj]	'where were you'
(73) *leef lang* [vl]	'live long'

Gussenhoven & Broeders (1976: 139) note that this assimilation process is optional in varieties spoken in "many areas north of the rivers [i.e. the rivers Maas, Waal and Rhine, which flow from east to west through the southern part of the Netherlands]".

Booij (1995a) argues that there is a rule in Dutch which voices fricatives preceded by a sonorant and followed by a vowel, a liquid, a glide or a nasal. It should be noted that the two examples provided by Booij are phrases in which the second word is the second person singular pronoun *je* 'you' (weak form): *was je* 'were you' and *kies je* 'choose you'. Voicing of fricatives does not occur within prosodic words. The diminutive form of *was* 'wash', *wasje,* is always realised with a voiceless fricative, as [ˈwɑsjə] (Booij, 1995a: 147) or even as [ˈwɑʃjə].

The rules mentioned by Scharpe (1912), Gussenhoven & Broeders (1976), Linthorst, Leerkamp & Galle (1979) and Booij (1995a) are restricted to specific areas and certainly not all speakers of Dutch apply them. Most descriptions of Dutch do not mention a rule through which word-final fricatives become voiced before sonorant consonants. It is, however, reported to occur systematically in West-Flemish final fricative + sonorant consonant clusters (De Schutter & Taeldeman, 1986; Weijnen, 1991). The following examples are taken from De Schutter & Taeldeman (1986: 112):

(74) ze[z.j]aar 'six years'
(75) a[v.l]open 'to finish'

In the Dutch-speaking area, regressive voice assimilation in fricatives preceding sonorant consonants is only frequent in West-Flanders (except in the extreme southeast) and in Zeeland (a province of the Netherlands) (De Schutter & Taeldeman, 1986: 111-112). Assimilation is also reported to occur in the dialect of Amsterdam (Gussenhoven & Broeders, 1976). Between the East- and West-Flemish regions, there is a mixed area ('menggebied') where both the voiced and the voiceless realisations of the fricative are possible.

De Schutter & Taeldeman (1986: 113) note that in West-Flemish, only fricatives and not stops become voiced before sonorant consonants, except in the western part of West-Flanders, where an underlying /d/ can become voiced in this context (e.g. *avond wordt* [dw] lit. 'evening becomes'). In the south-eastern part of West-Flanders, this exception does not apply and sonorant consonants do not trigger voice assimilation in the preceding /d/.

The same difference between East- and West-Flemish that exists across word boundaries also exists across the members of a compound. Examples are the words *visnet* 'fishing net' and *waslapje* 'washing cloth', in which the fricative is voiceless in East-Flemish, but voiced in West-Flemish.

Word-initial voiceless fricatives which are followed by a sonorant consonant remain voiceless in East- as well as in West-Flemish. Examples are the words *smal* 'narrow' and *fruit* 'fruit' which are always realised with voiceless fricatives. Fricative + sonorant consonant clusters cannot occur word-finally in Dutch.

When a fricative + sonorant consonant cluster occurs across a syllable boundary within a prosodic word, variation is possible. Examples are the words *moslim, islam, Israël, cosmetica, kosmos, kosmonaut, kosmopoliet,* which all have a foreign origin[1].

The regressive voice assimilation in fricative + sonorant consonant clusters in West-Flemish may only differ from other varieties of Dutch (including the Standard variety and East-Flemish) with respect to the domain in which the assimilation process applies. Whereas in West-Flemish the process applies across word boundaries, in other varieties it only occurs across syllable-boundaries (as the syllable boundary in words like *islam, moslim* and *Oslo* lies between the fricative and the sonorant, cf. Trommelen, 1984). For instance, in the FONILEX database, which contains more than 200 000 Dutch word forms and transcriptions of the way these are pronounced in the Dutch-speaking part of Belgium, words like *moslim, islam, Israël, cosmetica, kosmos, kosmonaut,* and *kosmopoliet* are all transcribed with [z]. In yet other varieties, fricatives are always voiceless preceding sonorant consonants, no matter what the boundary between the two consonants is (see, for instance, the pronunciation in the dictionary by Heemskerk & Zonneveld, 2000).[2] There thus seems to be a certain amount of variation in the way fricative + sonorant consonant clusters are realised in Dutch[3].

It should be noted that voice assimilation before sonorant consonants has also been reported to occur in a number of other language varieties. For example, both Catalan and Kraków Polish have a process of voicing before sonorant consonants (cf. Wheeler, 1986 and Cuartero Torres, 2001 on Catalan and Bethin, 1984 and Lew, 2002 on Kraków Polish). Here are some examples:

Catalan (Wheeler, 1986, 2005)

(76) po[g.l]ògic 'not very logical'
(77) matei[ʒ.n]om 'same name'

Kraków Polish (Bethin, 1984)

(78) bra[d.r]odzony 'own brother'
(79) ja[g.n]igdy 'as never'

English has no regressive assimilation in clusters containing a voiceless obstruent (stop or fricative) followed by a sonorant consonant. On the contrary, there is normally a delay in onset of voicing of the sonorant consonant. The devoicing of sonorant consonants following a voiceless stop in word-initial clusters was discussed in Section 1.5.1. Whereas Brown (1977) and Jones (1931) argue that this type of devoicing does not normally occur across word boundaries[4], Docherty (1992) shows that some devoicing is possible. He conducted an experiment with seven male native speakers of (Standard) British English, aged between 18 and 30. The informants were asked to read a number of sentences in which a stop and the following sonorant consonant were separated by different types of boundaries. The analysis showed that, although there is more devoicing when the boundary between the obstruent and the sonorant is less strong, some devoicing still occurs even across word boundaries, as in the following example sentences (Docherty, 1992: 181):

(a)	*We all know it's a steep road, don't we?*	(adjective/noun word boundary)
	We all know Philip ran, don't we?	(subject/verb word boundary)
	We all saw the cap Ron bought, didn't we?	(word and clause boundary)

Across these three types of word boundaries, delay in VOT of the sonorant was most frequent in type (a) sentences and least frequent in type (c) sentences.

Docherty also analysed sentences containing /s/ + nasal clusters across different types of boundaries. It appeared from the analysis that in this type of cluster there was a delayed VOT in nearly all cases, which was independent of the type of intervening boundary. Docherty argues that this finding

> "supports the interpretation (…) that the timing of voicing in /s/-nasal sequences is governed by a tight temporal constraint which allows for very little variability, even, it would appear, across different boundary conditions" (Docherty, 1992: 188).

Jansen's experiment (described in Section 7.2.) showed that a word-initial /z/ caused the preceding obstruent to become more voiced than a word-initial sonorant consonant (/r, ŋ/) did. He argues that this points to the actively voiced nature of voiced fricatives in English, in contrast with passively voiced sonorants.

In word-internal voiceless fricative + sonorant consonant clusters, voicing of the fricative seems possible in at least some lexical items in English. Examples are *Muslim, Islam, Israel, cosmetics, cosmos, cosmonaut, cosmopolitan, Oslo*. All these are loanwords or foreign place-names and are transcribed in the pronunciation dictionaries by Wells (2000) and Jones (2003) with [z] only, except for *Islam* and *Oslo*, for which transcriptions with [s] and [z] are given. The variation in the realisation of fricative + sonorant consonant clusters within prosodic words observed for Dutch (see above) is thus also partly present in English. These words are realised with voiceless fricatives in their original languages, but with a voiced fricative when adapted to English.

One explanation could be that sonorants in English are able to spread voice to a preceding fricative when the fricative and sonorant are separated by a syllable boundary, but not when they are separated by a word boundary[5]. Another explanation is that a final voiceless /s/ in English is signalled in the spelling by a double 'ss', as in *hiss* [s] (vs. *his* [z]), *kiss* [s] and *loss* [s]. The single syllable-final 's' in words like *Islam, Israel, cosmos* and *cosmetics* thus leads native speakers of English to assume that there is a voiced fricative in the underlying form[6]. This voiced fricative then remains voiced preceding a sonorant consonant.

8.3. Proposals on how sonorants can trigger voice assimilation

A number of proposals have been put forward in the literature to account for the absence of assimilation in fricative + sonorant clusters in some languages or language varieties and its presence in others. These proposals are discussed below.

8.3.1. Temporary underspecification of [voice] in sonorants

Mascaró (1995) and Cho (1999) both assume temporary underspecification of voice in sonorants. The idea that sonorants are unspecified for voice in the underlying form goes back to Kiparsky (1985). Kiparsky argued that, since voice is not contrastive for sonorants, they should not be specified for [voice] in the underlying forms (see Section 2.3.). This means that they cannot act as triggers of voicing assimilation, which is in line with the fact that in many languages, including Standard Dutch, Hungarian (cf. Gnanadesikan, 1997; Nagy, 2000; Jansen, 2004) and the Polish spoken in Mazowse and Pomerania (Lew, 2002), obstruents but not sonorants trigger voice assimilation. Other evidence for the underspecification of [voice] in sonorants comes from the facts of Russian voicing assimilation (cf. Ewen & Van der Hulst, 2001: 72-73). In Russian obstruent clusters, the [voice] specification of the last obstruent in the cluster determines the [voice] values of all the preceding consonants (both within words and across word boundaries). Some examples are:

(80) zub-ki /zubki/ → [zupki] 'little teeth'
(81) Mcensk # # byl /mtsɛnskbɨl/ → [mtsɛnzgbɨl] 'it was Mcensk'

If the consonant cluster is broken up by a sonorant, the [voice] specification of the obstruent following the sonorant stills spreads to the preceding obstruents, as is illustrated by the following phrases:

(82) iz Mcenska /iz mtsɛnska/ → [is mtsɛnska] 'from Mcensk'
(83) ot mzdy /ɑt mzdɨ/ → [ɑd mzdɨ] 'from the bribe'

In examples (82) and (83), the [voice] specification of the final obstruent in the cluster (voiceless /ts/ in (82) and voiced /d/ in (83)) determines the [voice] value of the preceding obstruents in the cluster, even when a sonorant intervenes. Sonorants thus seem to be transparent to the spreading process, which may point to the underspecification of [voice] in sonorants.

The facts of Japanese voicing assimilation, discussed by Itô & Mester (1986), seem to provide additional evidence for the hypothesis that sonorants are unspecified for [voice]. In Japanese, there is a rule which states that the initial segment of the second member of a compound becomes voiced. This process is called Rendaku, meaning 'sequential voicing' (Itô & Mester, 1986: 819; see also Kubozono, 2005). Here is an example:

(84) yu 'hot water' + tofu 'tofu' → yudoofu 'boiled tofu'

However, if the second member of a compound contains a voiced segment, the onset of the second member is blocked from becoming voiced, as a result of the Obligatory Contour Principle (OCP)[7]. The Japanese process which blocks the voicing of the onset of the second member of a compound when there is a voiced segment somewhere in the remainder of the word is referred to as Lyman's Law (1894). What is interesting is that Rendaku is not blocked when the second member starts with a sonorant. The following two examples by Itô & Mester illustrate this process:

(85) kami + kaze → kamikaze 'divine wind'
(86) ori + kami → origami 'paper folding'

Because the second member in (85) contains the voiced segment /z/, the OCP blocks the onset /k/ from becoming voiced /g/, leading to the form *kamikaze*. In the second example (86), the sonorant /m/ does not prevent /k/ from becoming /g/ and the result is thus *origami*. Because sonorants, in contrast with voiced obstruents, do not block the process, the Japanese data seem to offer strong evidence for the hypothesis that sonorants are phonologically unspecified for [voice]. (For counterarguments, see Section 8.3.2.).

If sonorants are unspecified for [voice] in the underlying form, the absence of assimilation before sonorant consonants in Standard Dutch (and East-Flemish) is accounted for. The fact that sonorant consonants can be triggers of voice assimilation in West-Flemish could be explained if it is assumed that they receive a specification for [voice] at a later stage in the phonological component. Booij (1995a) assumes that sonorants are unspecified for [voice], but that the feature [voice]

> "must be available before the end of the phonological derivation, for instance because there is a postlexical rule in Dutch that voices word-final fricatives before vocoids" (Booij, 1995a: 12).

This hypothesis is called the Redundancy rule hypothesis by Rice (1993). She summarises the hypothesis as follows:

> "a. Redundant features are absent from underlying representation.
> b. The feature [voice] is redundant for sonorants.
> c. The feature [voice] can be filled in on sonorants in the postlexical phonology." (Rice, 1993: 311).

Rice's arguments against the Redundancy rule hypothesis are discussed in Section 8.3.2.

Mascaró (1995) formulates a Reduction/Spreading theory of voicing. He views assimilation as a process involving two different operations: Reduction, which he defines as "the loss of some phonological property" and Spreading, involving "the association of some phonological property to adjacent skeletal units" (Mascaró, 1995). Mascaró distinguishes three different phonological stages. Figure 32, slightly adapted from Mascaró (1995: 283), illustrates the three stages (O_m stands for marked obstruents; O_u for unmarked obstruents and S for sonorants).

	Stage 1	**Stage 2:** after application of Complement rules	**Stage 3:** after application of Default rules
	[+]vc	[+]vc [-]vc	[+]vc [-]vc [+]vc
	O_m O_u S	O_m O_u S	O_m O_u S
TRIGGERS	Voiced obstruents	Obstruents	All consonants

Figure 32. Reduction/Spreading theory of voicing, assuming three stages (slightly adapted from Mascaró, 1995: 283).

Figure 32 shows that in the first stage all segments have their lexical specifications, which means that only marked obstruents are marked for [voice]. Unmarked obstruents and sonorants are unspecified for voice and hence cannot trigger voice assimilation, as only specified segments are licit spreaders. In this stage, all segments can be targets of reduction and spreading. Between the first and the second stage Complement rules apply. Mascaró defines Complement rules in the following way:

> "Complement rules are of the form [e]N → [– α]N/P, where N is some phonological node (such as Voice, Place, etc.), e an empty element, P some phonological context, and α is the marked, lexically specified value of N" (Mascaró, 1995: 275).

This means that in Stage 2, unmarked obstruents become specified for [–voice], the unmarked value of [voice] for obstruents and only sonorants remain unspecified. Finally, in Stage 3, Default rules have applied. Default rules are defined as follows:

> "Default rules are of the form $[X]_N \rightarrow [\alpha]_N$ / P, where X is fixed and stands for any specification (+,–,e), and α is the predictable value of N in P" (Mascaró, 1995: 275).

As the result of the application of Default, sonorants, which up to this point had been unspecified, become specified for [+ voice] in this third stage, which means that they can now act as triggers of voice assimilation.

Mascaró argues that the difference between a language with and one without assimilation in obstruent + sonorant sequences lies in the point at which Reduction and Spreading apply. If Reduction and Spreading occur after Complement but before Default, as in Standard Dutch, assimilation occurs in obstruent-obstruent, but not in obstruent-sonorant sequences. If, on the other hand, Reduction and Spreading occur at a point at which Default has already applied, sonorants trigger voice assimilation in preceding obstruents, as is the case in, for instance, Catalan, Kraków Polish and West-Flemish.

Cho (1999) follows Mascaró (1995) in claiming that a different rule order explains the difference between a language without regressive voice assimilation before sonorant consonants (such as Dutch) and one with this process (such as Catalan):

> "(…) [I]f spreading of [voice] precedes a redundancy rule inserting [voice] for sonorant consonants, then sonorants which are not marked for [voice] cannot act as triggers in Dutch. If, on the other hand, spreading follows a redundancy rule of specifying voicing for sonorant consonants, then sonorants are triggers as in Catalan" (Cho, 1999: 113).

The rule ordering is hence determined on a language-specific basis.

8.3.2. The feature [Sonorant Voice]

Although the analysis by Mascaró (1995) is able to deal with the difference between languages with and without regressive voice assimilation in obstruent-sonorant sequences, other data are still problematic. Rice (1993) discusses data from Kikuyu, a language spoken in Kenya, which present problems for the analyses proposed in the previous section. In Kikuyu, there is a process through which two adjacent syllables cannot begin with voiced segments, whether these are sonorants or voiced obstruents (a result of the OCP). If the stem begins with a voiceless segment, as in example (87) below, the prefix starts with [ɣ]. If, on the other hand, the onset segment of the stem is a voiced obstruent (example(88)) or a sonorant (example (89)), the prefix starts with a voiceless [k]. The examples are taken from Rice (1993: 310):

(87)	ɣo-tɛm-ɑ	'to cut'
(88)	ko-ɣɑt-ɑ	'cutting'
(89)	ko-niin-ɑ	'to finish'

The Kikuyu data are problematic for theories assuming laryngeal underspecification of sonorants, since voiced obstruents and sonorants clearly pattern together, implying that they should both be specified for [voice][8]. Rice (1993) claims, however, that these data can easily be understood when not one but two features referring to voice are assumed. She argues for the existence of a feature [sonorant voice] (SV), next to the traditional feature [voice], which characterises the type of voicing found in sonorants. Whereas voiced obstruents are marked for [voice], sonorants and in some languages voiced obstruents, called 'sonorant obstruents', are marked for [sonorant voice]. Sonorant obstruents are defined by Rice as

> "obstruents that receive voicing from sonorants, and obstruents that alternate with sonorants – in short, obstruents that pattern together with sonorants or function as sonorants in a language" (Rice, 1993: 308).

Rice argues that the facts from Japanese and Kikuyu can be accounted for by means of the feature [sonorant voice]. Whereas in Japanese voiced obstruents are marked for [voice] (and sonorants are marked for [sonorant voice]), in Kikuyu voiced obstruents as well as sonorants are marked for [sonorant voice], thus accounting for the fact that in Kikuyu voiced obstruents and sonorants pattern together. The idea is that in Kikuyu

> "SV can delink from a syllable-initial consonant when the following syllable in the appropriate domain begins with a segment marked by SV" (Rice, 1993: 314).

According to Rice, a hypothesis assuming the feature [sonorant voice] is able to account for some data which cannot be accounted for in a theory assuming that sonorants are unspecified for the feature [voice] in the lexical phonology, and can only become specified for [voice] in the post-lexical component. In Japanese, for instance, the process of Rendaku implies that sonorants are unspecified in the lexical phonology, since they – in contrast with voiced obstruents – do not prevent the onset of the second member of a compound from becoming voiced. However, there is another process in Japanese through which the obstruent of a suffix marking the gerundive becomes voiced after nasals. Examples from Itô & Mester (1986: 69) are the following:

(90) sin + te → [šinde] 'die' (gerundive)
(91) kam + te → [kande] 'chew' (gerundive)

This process seems to imply that sonorants are marked for [voice] in the lexical phonology, which is problematic, given the Rendaku data. Itô & Mester (1986) propose that Rendaku applies in the lexical phonology before [voice] is inserted on nasals. However, Rice (1993, 2005) argues that the feature [sonorant voice] allows for a much simpler solution: whereas in Rendaku, the feature [voice] is active, for which nasals are not specified, the post-nasal voicing in Japanese is the result of the spreading of [sonorant voice]. As nasals are specified for [sonorant voice], they are able to spread this [sonorant voice] to the following obstruent.

It is questionable, however, whether the feature [sonorant voice], which represents the spontaneous voicing of sonorants, is able to cause obstruents to become voiced. Since the production of voicing in obstruents requires extra articulatory gestures, it is not evident that the voice feature of sonorants is sufficient to make the preceding obstruent voiced. Rice indeed notes that "[t]he exact phonetic definitions of voice and SV require study" (1993: 341).

8.3.3. The feature [Pharyngeal Expansion]

Like Rice (1993), Steriade (1995) also argues for the existence of two different features to characterise the distinction between voice in obstruents and voice in sonorants. In contrast with sonorants, which are spontaneously voiced, obstruents require extra articulatory gestures, such as pharyngeal expansion, in order to be produced with vocal fold vibration. She argues:

> "We may conjecture, then, that voiced obstruents share in permanent exclusivity some active process of pharyngeal expansion, which (…) would have to correspond to a phonological feature" (Steriade, 1995: 155).

Steriade proposes that voiced obstruents are always specified for [pharyngeal expansion] as well as for [vibrating vocal cords]. Sonorants, on the other hand, are specified for [vibrating vocal cords], but are permanently unspecified for [pharyngeal expansion]. Steriade's (1995) approach differs from Rice's (1993) in that both voiced obstruents and sonorants are specified for [vibrating vocal cords], whereas in Rice's account only voiced obstruents are specified for voice.

If we assume that voiced obstruents are marked for [pharyngeal expansion] and for [vibrating vocal cords] and sonorants only for [vibrating vocal cords], the difference between East- and West-Flemish can be explained by assuming that in West-Flemish there is a rule which spreads [vibrating vocal cords] from onset sonorants to preceding fricatives, which is absent in East-Flemish. Regressive voice assimilation in obstruent-obstruent clusters is then explained by means of a rule which spreads the [pharyngeal expansion] specification of onset voiced obstruents to preceding obstruents. This rule applies in both East- and West-Flemish. As sonorants are spontaneously voiced and thus permanently unspecified for [pharyngeal expansion], the rule does not take effect in obstruent-sonorant sequences.

In this approach it is the feature [voice] of sonorants which makes preceding obstruents voiced. This is more acceptable than that a feature [sonorant voice] should be able to voice obstruents, as is the case in Rice's (1993) proposal. However, if all obstruents necessarily need to be marked for [pharyngeal expansion] in order to be voiced, it still needs to be explained why the spreading of [voice] alone should be sufficient to cause obstruents to become voiced before sonorants. It should also be kept in mind that in West-Flemish, only fricatives and not stops undergo assimilation when followed by a sonorant consonant (except again in the western part of West-Flanders, in which /d/ remains voiced before a sonorant consonant). Why this is the case still remains to be explained. It should also be noted that the difference between East- and West-Flemish is not necessarily the result of different representations. It can also be the result of different rules or constraint rankings. These options will be discussed in Chapter 11.

8.3.4. *Summary of rule-based proposals*

Table 42 (p. 144) summarises the approaches which deal with the processes in Kikuyu, Japanese and East- and West-Flemish discussed in Sections 8.3.1. to 8.3.3. above. Three different approaches are distinguished: (1) the approach by Mascaró (1995), which makes use of only one laryngeal feature, [voice], and assumes temporary underspecification of sonorants, (2) the model proposed by Rice (1993), which introduces the feature [sonorant voice], typical of sonorants and some types of obstruents (which she calls sonorant obstruents) and which also makes use of the temporary underspecification of sonorants, and (3) the approach adopted by Steriade (1995) that voiced obstruents are specified for [pharyngeal expansion], which reflects the extra articulatory gestures needed for the production of [voice] in obstruents. Steriade's model does not make use of temporary underspecification. As is common in the literature, O refers to obstruent(s) and R to sonorant(s).

	(1) [voice] Underspecification (e.g. Mascaró, 1995)	(2) [voice] and SV – Underspecification (Rice, 1993)	(3) [voice] and [Pharyngeal Expansion] – No Underspecification (Steriade, 1995)
Kikuyu	*Vcd. O and R pattern together: if the stem starts with a vcd. O or R, the prefix starts with a vcl. O (OCP). If the stem starts with a vcl. O, the prefix starts with a vcd. O.*		
	Examples: ɣo-tɛm-ɑ *vs.* ko-ɣɑt-ɑ and ko-niin-ɑ		
	Default rule specifying Rs for [voice] has applied. Because Rs are specified for [voice], the prefix cannot start with a vcd. O, since the OCP would then be violated.	Os in Kikuyu are 'sonorant obstruents': both vcd. O and R are specified for SV, which explains why they pattern together.	Both vcd. Os and Rs are specified for [voice] throughout the phonology (no underspecifica-tion). A vcd. O in the prefix would therefore incur a violation to the OCP.
Japanese (Rendaku)	*Vcd. O and R. do not pattern together: Rendaku is blocked if there is a vcd. O in the second member of the compound (OCP), but not if there is a sonorant (or vcl. O) in the second member.*		
	Examples: yu+tofu → yudoofu (Rendaku); kami + kaze → kamikaze (Rendaku blocked); ori+kami → origami (Rendaku not blocked)		
	The Default rule specifying sonorants for [voice] has not yet applied; sonorants are unmarked for [voice] at the time Rendaku applies.	Vcd. Os are marked for [voice]; Rs are marked for SV. If the onset of the second member is marked [voice] and a following R is marked SV, the OCP is not violated.	Vcd. Os, in contrast to Rs, are marked for [pharyngeal exp.]. If the onset of the second member is marked for [pharyngeal exp.] and the sonorant is marked for [voice], the OCP is not violated.
Japanese (gerund)	*The obstruent of the suffix marking the gerund becomes voiced after nasals, i.e. nasals function as triggers of voice assimilation.*		
	Examples: sin +te → sinde; kam+te → kande		
	The Default rule has applied: nasals are speci-fied for [voice] when the gerund is formed. Default thus applies after the gerund formation and before Rendaku.	Nasals are specified for SV. They can spread this SV specification to the preceding O.	Nasals are specified for [voice]. They can spread this [voice] specification to the preceding O.

Table 42. Voice assimilations involving sonorants: different proposals.

	(1) [voice] **Underspecification (e.g. Mascaró, 1995)**	(2) [voice] and SV – **Underspecification (Rice, 1993)**	(3) [voice] and [Pharyngeal Expansion] – No **Underspecification (Steriade, 1995)**
East-Flemish (and Standard Dutch)	*Voice assimilation in O-stop-clusters, but not in OR-clusters.*		
	Examples: boe/k/ dicht → boe[g] dicht *vs.* gla/s/ limonade → gla[s] limonade		
	Vcd. O are marked for [voice] and spread this specification to preceding O. R are unspecified for [voice] at the time spreading takes place, because Default applies only later.	Vcd. Os are marked for [voice], which spreads to preceding O. R are unspecified for [voice]. They are specified for SV, but they are not specified for [voice], as the Default rule has not (yet) applied.	Vcd. O are marked for [Pharyngeal Exp.], which spreads to preceding O. R are specified for [voice], but there is no rule spreading [voice] to preceding O.
West-Flemish	*Voice assimilation in O-stop clusters and in OR-clusters if the O is a fricative (or /d/), i.e. sonorant consonants trigger assimilation in preceding fricatives.*		
	Examples: boe/k/ dicht → boe[g] dicht *and* gla/s/ limonade → gla[z] limonade		
	Os are marked for [voice]; sonorants are at first unspecified, but become specified for [voice] due to the application of Default. Spreading takes place only after Default has applied.	Vcd. Os are marked for [voice], which can spread to a preceding O. Rs become specified for [voice] by the application of a Default rule.	Vcd. O are marked for [Pharyngeal Exp.], which spreads to preceding O. R are specified for [voice] and there is a rule spreading [voice] from R to preceding fricatives (and /d/).

Table 42. Voice assimilations involving sonorants: different proposals *(Continued).*

Model (1), which uses only [voice] and argues that sonorants are underspecified for [voice] is essentially derivational, in that it needs different rule orders: Default applies before Spreading in some cases and after Spreading in other cases. The point at which Default applies seems to be determined on a language-specific basis. In model (2), in which Sonorant Voice represents the spontaneous voicing in sonorants, it is not clear how the SV specification of R can cause a preceding O to be voiced, since extra articulatory gestures are needed to produce voicing in O. Despite the introduction of the feature SV, the model still needs to make use of underspecification in order to explain the voice assimilation before sonorant consonants in, for instance, West-Flemish. Model (3), in which voiced obstruents are marked for [pharyngeal expansion] and sonorants for [vocal fold vibration] seems to be the best approach: it reflects the fact that voicing in O and R is fundamentally different in that extra gestures are needed to produce voicing in O. However, if these extra gestures are always needed, it still needs to be explained why obstruents in West-Flemish do not need [pharyngeal expansion] in order to become voiced before R. It also remains to be explained why in West-Flemish only fricatives and not stops become voiced before R. These questions are taken up in Chapter 11.

8.3.5. A phonetic approach: Positional neutralisation

Another way of dealing with the problem of sonorants triggering voice assimilation in preceding obstruents is to assume a form of permanent *positional* underspecification. Ernestus (2000) states that Dutch obstruents are not specified for [voice] when they occur in the coda or at the end of a word. Ernestus writes:

> "These obstruents are called neutral since the realisation of these obstruents is not related to their underlying [voice]-specification. The distinction between underlying voiced and voiceless obstruents is neutralised for these obstruents" (Ernestus, 2000: 148).

She further notes:

> "For analyses adopting the CNH [i.e. the Complete Neutralisation Hypothesis, also referred to as the Permanent Neutralisation Hypothesis, cf. 6.2.] to be valid, they should predict that the phonetic component realises unspecified obstruents as voiceless before sonorants, since neutral obstruents tend to be voiceless before this type of consonant" (Ernestus, 2000: 160).

However, the CNH states that whether a neutral obstruent is realised as voiced or voiceless depends on which realisation requires the least articulatory effort. The CNH would therefore seem to predict that obstruents are realised as voiced when occurring between vowels and sonorant consonants, a fact not borne out by the data from Standard Dutch. Ernestus does not investigate the realisation of obstruent +

sonorant consonant clusters in her corpus of casual Dutch, as she argues that not enough is known about the acoustic correlates of obstruents preceding sonorants.

Jansen (2004) conducted acoustic measurements on Dutch three-term clusters consisting of a word-final /ps/ cluster followed by a voiced or voiceless obstruent or a sonorant. He found that the /ps/ cluster was significantly more voiced before a sonorant consonant (as in *Kaaps meisje* 'little girl from Capetown') than before a voiceless stop (as in *Jaaps tunnel* 'Jaap's tunnel'). As sonorants are passively voiced sounds, this means that voice can spill over from the sonorant to the preceding neutralised consonant, since neutralised obstruents do not have voicing targets. According to Jansen, voicing assimilation before sonorant consonants only occurs in languages or language varieties in which word-final obstruents are subject to laryngeal neutralisation. He mentions Krakow Polish, Catalan and Frisian as examples and argues that

> "[i]t could well be this increased amount of voicing (relative to utterance-final and _[+tense] contexts) that is interpreted by linguists as voicing assimilation. It could also become a source of confusion to listeners, who might reanalyse all presonorant obstruents (along with obstruents preceding a lax obstruent) as [-tense] on the surface, at least in theory (which would in turn lead to pronunciations that are likely to be interpreted as assimilation by linguists)" (Jansen, 2004: 119).

However, if the increased amount of voicing before sonorant consonants in West-Flemish is assumed to be purely phonetic, there is no clear reason why there should not be increased voicing in East-Flemish or why the increased voicing should be interpreted as voicing assimilation in West-Flemish but not in East-Flemish.

8.3.6. A constraint-based approach

Nagy (2000) proposes a constraint-based approach to voice assimilation in obstruent-obstruent and obstruent-sonorant sequences. Nagy's approach is couched in Optimality Theory and is different from the rule-based approaches discussed so far (see Table 42 for a summary). However, because it specifically deals with the question of how voice assimilation before sonorants can be accounted for, it is important to take it into consideration. In this section, Nagy's OT analysis is discussed and applied to the East- versus West-Flemish case.

Like Rice (1993) and Steriade (1995), Nagy argues that two distinct features are needed in order to capture the difference in voice between obstruents and sonorants. She assumes that the Laryngeal node dominates a node called S-voice, representing the type of voicing found in voiced obstruents and sonorants, which in its turn dominates O-voice, a feature typically present in voiced obstruents only.

Figure 33, showing the representation of obstruents and sonorants, is taken from Nagy (2000: 101):

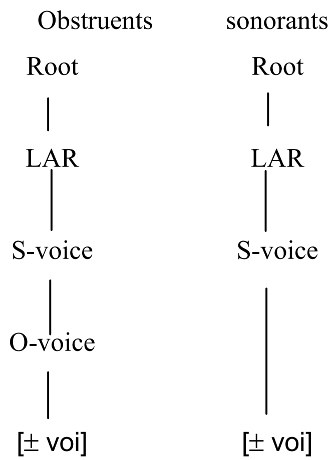


Figure 33. Laryngeal nodes of obstruents and sonorants (Nagy, 2000: 101).

Obstruents and sonorants differ in markedness, in that, whereas voiced obstruents are universally more marked than voiceless obstruents (and this is especially true for fricatives), the reverse is true for sonorants: voiceless sonorants are cross-linguistically much more marked than voiced ones. Nagy argues that in a constraint-based model this difference can be expressed as a different interaction between markedness constraints for obstruents and sonorants. She proposes the following ranking:

– for obstruents: *[+ O-voice] dominates *[– O-voice]
– for sonorants: *[– S–voice] dominates *[+ S–voice]

The constraint banning voiced obstruents from the output is thus universally ranked higher than the constraint banning voiceless obstruents. The constraint banning voiceless sonorants, on the other hand, is ranked higher than the constraint banning voiced sonorants. Nagy argues that these markedness differences explain why sonorants, in contrast with obstruents, often fail to trigger or undergo voice assimilation and are only rarely subject to final devoicing, as has been discussed by Hayes (1984).

Like Lombardi (1995a, 1999), Nagy makes use of Agree constraints to explain voice assimilations. She proposes the following two constraints:

– Agree [O-voice]
  Adjacent segments should agree in their [O-voice] features

– Agree [VOICE]
  Adjacent segments should have the same value for their salient [VOICE] feature.

The Agree [O-voice] constraint is responsible for voicing assimilation in obstruent-obstruent sequences. In the second constraint, Agree [VOICE], [VOICE] encompasses both voicing in obstruents and voicing in sonorants. This constraint triggers voice assimilation involving obstruents as well as sonorants (Nagy, 2000: 103).

Nagy discusses two languages to test her OT analysis: Hungarian and Kraków Polish. The assimilation patterns in Hungarian are similar to the ones in East-Flemish (and Standard Dutch), in that (regressive) voice assimilation occurs in OO-clusters, but not in OR-clusters. Kraków Polish is similar to West-Flemish, in that regressive assimilation takes place in obstruent-obstruent sequences, as well as in obstruent-sonorant sequences. The constraint rankings discussed in this section are taken from Nagy (2000), but the examples from Hungarian and Kraków Polish are replaced by examples from East-Flemish (or Standard Dutch) and West-Flemish.

In order to account for the absence of voice assimilation in OR-sequences, Nagy makes use of two constraints: Agree [O-voice] and Ident [O-voice]. The Ident [O-voice] constraint requires that an output segment has the same specification for [O-voice] as the corresponding input segment. The following tableau shows that no voicing assimilation occurs in voiceless obstruent + voiced sonorant sequences in the phrase *zes jaar* 'six years', which in East-Flemish is realised as [zɛs jar]. The following tableau is adapted from Nagy's (2000) tableau on Hungarian. It should be noted, however, that both candidates satisfy Agree[O-voice] and there is hence no conflict between the two constraints and no valid ranking argument (McCarthy, 2002:5). The full line between the constraints in Nagy's tableau is therefore replaced by a dashed line, suggesting that in this tableau the constraints remain unranked with respect to each other.

/zɛ[s+j]ar/	Agree [O-voice]	Ident [O-voice]
☞ a. ze[s+j]aar	*	
b. ze[z+j]aar	*	*

Both candidates incur a violation of the Agree [O-voice] constraint, because the sonorant [j] is not marked for [O-voice]. In the second candidate, the coda obstruent is marked [+ O-voice], in contrast to the coda obstruent in the input, which is marked [– O-voice]. The second candidate thus violates the faithfulness constraint Ident [O-voice], which requires the value for [O-voice] to be identical in the input and the output.

In Kraków Polish and in West-Flemish, there is RVA in OO-clusters and in OR-clusters. To account for the assimilation in OR-clusters, Nagy (2000: 109) proposes the following constraint ranking:

Agree [VOICE] >> * [–S –voice] >> Ident [O-voice]

This ranking is illustrated by the same Dutch phrase *zes jaar,* which in West-Flemish is pronounced as [zɛz jar]:

/zɛ[s+j]ar/	Agree [VOICE]	*[–S-voice]	Ident [O-voice]
a. ze[s+j]aar	*!		
☞ b. ze[z+j]aar			*
c. ze[s+j̥]aar		*!	

The high-ranked Agree [VOICE] constraint rules out only the first candidate, in which the voiceless obstruent is marked [– O-voice] and the sonorant is unmarked for [O-voice]. The third candidate, 'ze[s+j̥]aar', contains a voiceless sonorant and thus violates *[–S-voice]. Although the second candidate violates the Identity constraint Ident[O-voice] because the coda obstruent is marked [–O-voice] in the input, but [+O-voice] in the output, it is the winning candidate. This constraint-ranking thus ensures that the candidate which has undergone regressive voice assimilation in its obstruent + sonorant sequence is the winning output.

Why fricatives but not stops (except /d/) are subject to regressive voice assimilation before sonorant consonants in West-Flemish still needs to be explained. This issue is taken up in Chapter 11.

8.4. Assimilation before sonorant consonants in L1 Dutch and DLE: East- vs. West-Flemish speakers

8.4.1. Voiceless fricatives preceding sonorant consonants

Both in East-Flemish Dutch and in English voiceless fricatives remain voiceless before onset sonorant consonants, and the East-Flemish informants were therefore expected not to produce assimilation in voiceless fricative + sonorant consonant clusters in the DLE conversations. Because the realisation of this type of cluster can be different in West-Flemish and English, two different patterns could be expected in the DLE conversations by the West-Flemish informants.

First, the West-Flemish informants could transfer the process of regressive voice assimilation in fricative + sonorant consonant clusters from their variety of Dutch into English. The result would then deviate from the L1 English norm.

A second possibility is that the West-Flemish informants have learnt to suppress RVA before sonorant consonants, because it does not occur in L1 English.

In total, 481 tokens were coded which contained a cluster of a word-final voiceless fricative followed by a word-initial sonorant consonant. However, when the word-final fricative was preceded by a stop and followed by an onset sonorant consonant, assimilation was not normally produced. Examples from the Dutch conversations are

Duits woord 'German word' and *iets nieuws* 'something new', which were realised with a voiceless stop and fricative in the coda. One token was coded in which the final fricative was preceded by another fricative (which was preceded by a sonorant consonant), namely *zelfs les* 'even class'. This token was realised with two voiced fricatives, as [zɛlvz lɛs]. In the DLE conversations, only one out of 89 tokens in which the fricative was preceded by an obstruent underwent assimilation. Most tokens of this type in the DLE conversations were combinations with *it's,* such as *it's more, it's really, it's long*, which were all realised with voiceless obstruents in the coda. Because assimilation did not normally occur when the fricative was preceded by a stop and only two tokens were coded in which the fricative was preceded by another fricative, all tokens in which the fricative was preceded by an obstruent will be left out of the discussion. Table 43 presents the production of RVA in those tokens in which the fricative was preceded by a sonorant (consonant or vowel) and followed by a sonorant consonant:

RVA	L1 Dutch	DLE
East-Flemish	19/136 (14%)	1/38 (3%)
West-Flemish	128/160 (80%)	12/45 (27%)
total	147/196 (75%)	13/83 (16%)

Table 43. RVA in sonorant + vcl. fric. + sonorant consonant clusters.

The analysis shows that – as the literature predicts – there is a difference between the East- and West-Flemish informants in the realisation of coda voiceless fricative + onset sonorant consonant cluster: whereas the East-Flemish informants voiced the underlyingly voiceless fricatives in only 14% of the tokens in the Dutch conversations, the West-Flemish informants voiced them in as many as 80% of the coded tokens. Here are some examples:

Dutch:

(92) voo(r) **ze*s* maanden** [zɛz mãːndn̩] (WF)
'for six months'

(93) en 'k (h)e(b) ([ɛn]) ik eigenlijk heel tijd **Fran*s* moe(te)n** klapp(e)n [frãnz muːᵊn] (WF)
'and in fact I had to talk French all the time'

(94) **da'*s* waa(r)** [dɑz waː] (WF)
'that's true'

The high percentage of RVA in the Dutch conversations of the West-Flemish informants contrasts with the lower frequency of RVAs in their DLE conversations, in which only 27% of the tokens realised by West-Flemish informants were produced with assimilation. The following phrases illustrate the process of RVA in fricative + sonorant consonant clusters in the DLE conversations:

DLE:

(95) ***if* you** really live...few months in England [ɪv juː] (WF)
(96) **ye*s*, we're** gonna have these arguments [jez wir] (WF)

In the majority of tokens, the fricative remained voiceless preceding an onset sonorant consonant, as in the following examples:

DLE:

(97) and **stu*ff* *l*ike** that [stʌf laɪk] (EF)
(98) i.***if y*ou i*f y*ou** got used to it [ɪf juː] (2 times) (WF)

A division according to whether the triggering sonorant consonant was a glide, liquid, or nasal revealed that there are no important differences in assimilation sites between different consonants, though the number of possible assimilation sites differed greatly (e.g. initial /w/ was much more frequent than initial /l/ in Dutch), so that no statistical comparison was possible. Similarly, an analysis of the interspeaker variation in the production of RVA before sonorant consonants revealed that the number of possible assimilation sites differed between informants. It was, however, clear that in the Dutch conversations, nearly all West-Flemish informants (no. 9-16) frequently produced regressive voice assimilation before sonorant consonants. In the DLE conversations between the East-Flemish informants, regressive voice assimilation before sonorant consonants was almost completely absent. Only one informant produced one token with RVA; the other seven informants did not produce any assimilations in this type of cluster. The West-Flemish informants produced considerably fewer assimilations in the DLE conversations than in the Dutch conversations. Informant no. 12, for instance, produced 36 out of 42 tokens with RVA in the Dutch conversations, but produced only one out of eight English tokens with RVA. Similarly, informant no. 13 produced assimilation in 29 out of 31 clusters in the Dutch conversations, but in only two of the nine clusters in the DLE conversations. The reason why the West-Flemish participants produced regressive voice assimilation more frequently in Dutch than in DLE remains unclear and a subject for further investigation.

The following two sections shed light on different aspects of the process: the phonetic realisation of assimilation before sonorant consonants and the L1 acquisition of the process.

Phonetic realisation

A closer look at the phonetic realisation of fricative + sonorant consonant clusters reveals that the assimilations produced by the West-Flemish informants in many Dutch clusters of this type are clearly visible on a spectrogram and in the waveform. The two waveforms/spectrograms in Figure 34 show the production of part of the phrase *geef Lien* ‘give (to) Lien’[9]. Only the fricative itself, part of the preceding vowel and the following lateral and vowel are shown. The arrows point at the fricatives. The figure on the left is produced without RVA by an East-Flemish informant (no. 5). In the figure on the right, produced by a West-Flemish informant (no. 12), the fricative preceding the sonorant consonant has become voiced.

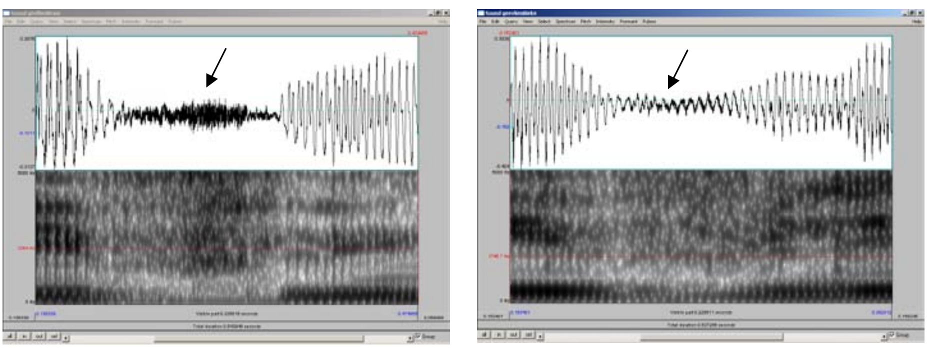


Figure 34. Part of the phrase *geef Lien* produced without RVA by inf. no. 5 (left) and with RVA by inf. no. 12 (right).

A comparison of the two waveforms shows that the phonetic realisations of the fricatives are indeed very different. In the phrase produced by the East-Flemish informant (shown in the figure on the left), the fricative is completely voiceless and shows the friction noise typical of a voiceless fricative. In the phrase produced by the West-Flemish informant (shown in the figure on the right), on the other hand, voicing continues all through the fricative and the noise intensity is much lower, as is typical of voiced fricatives.

First language acquisition

Vercruysse (2004) collected spontaneous conversations between five- to six-year old West-Flemish children. The children were left per two in a room and were asked to do a jigsaw puzzle. The conversations between the children were recorded on minidisk. Although no systematic analysis of the assimilations produced by the children was carried out, it appeared that RVA before sonorant consonants was produced by the children at that age. The sentences in (99)-(100) illustrate the production of RVA in fricative + sonorant consonant clusters:

Examples:

(99) 'k (H)e(b) gaan kijken in de klas en **'t wa*s* *n*iemand**, alleen maar juffrouw*s* [twɑz ˈniːmɑnt]
'I went into the classroom to see, and there was no-one, only teachers'

(100) ee(n) kop **i*s* *w*e(l)** voo(r) dieren, (h)e [ɪz wɛ]
'a head is for animals, right'[10]

There is evidence that children already produce assimilated forms at a very early age. Schaerlaekens & Gillis (1977: 56), for instance, relate an anecdote in which a child aged 1;2 repeatedly produced the phrase *'t is dat* ('it's that') as [tɪzdɑ]. The phrase *wat is dat?* 'what's that?' is also frequently realised as [wɑzdɑ] in child language. However, in these cases the children have not yet learnt to distinguish the words from each other and forms like [tɪzdɑ] and [wɑzdɑ] are stored in their lexicon as single units. (Note that some multiword expressions, such as Dutch *op 'n gegeven moment* 'at a certain moment' and English *by the way* may also be stored as pre-fabricated lexical chunks by adults and typically undergo considerable pronunciation reduction, .) In the examples (99) and (100) above, however, the children have learnt to actively produce the process of RVA, as the assimilated forms do not occur in fixed phrases. The examples thus indicate that RVA is a productive process, which is produced by five- to six-year old West-Flemish children not only in fixed phrases, but also in new contexts[11].

8.4.2. Voiced fricatives preceding sonorant consonants

In Standard Dutch as well as in the East-Flemish regiolect, voiced fricatives are devoiced when occurring in word-final position before a sonorant consonant. In West-Flemish, however, they can be realised as voiced. In English, there is no process of final laryngeal neutralisation and voiced fricatives thus remain voiced in this type of cluster. The database contains 302 tokens in which a word-final voiced fricative is followed by a sonorant consonant. Table 44 shows the extent to which final voiced fricatives were devoiced by the East- and West-Flemish informants in the Dutch and DLE conversations:

FIN	L1 Dutch	DLE
East-Flemish	25/28 (89%)	53/109 (49%)
West-Flemish	11/38 (29%)	23/147 (18%)
total	35/66 (53%)	76/236 (32%)

Table 44. Final devoicing in voiced fricative + sonorant consonant clusters.

The results of the Dutch conversations are in line with what could be expected from the literature: whereas the East-Flemish informants produced 89% of the fricatives without voice, the West-Flemish informants devoiced 29% of the tokens. The analysis of *voiceless* fricative + sonorant consonant clusters showed that the West-Flemish informants transferred RVA in this context to a limited extent only. It was therefore expected that East- and West-Flemish informants would realise *voiced* fricative + sonorant consonant clusters in English relatively similarly. The results in Table 44 show that this is not the case: whereas the East-Flemish informants devoiced 49% of all fricatives preceding sonorant consonants, the West-Flemish informants did so in only 18% of the tokens. These different percentages of devoicing for East- and West-Flemish informants are clearly the result of transfer from the informants' Dutch regiolects.

Examples of tokens in which the fricative remained voiced are provided in (101)-(104):

Dutch:

(101) 'k pei(n)sde ik dat dat jongens van acht tot…**twaal*f j*aar** gingen zijn [twaːlv jaːr] (WF) (twaalf ~ plural: twaalven)
'I thought they would be boys from eight to…twelve years old'

(102) massa's **gro*f, j*ongen** [ɦrɒv ˈjɒŋn̩] (WF) ('*massa's*': colloquial West-Flemish meaning 'very') (*grof ~ grove*)
'really rude, man'

DLE:

(103) **he*'s n*ice** [hiːz naɪs] (WF)
(104) I **wa*s l*ooking** at those kettles [wəz ˈlʊkɪŋ] (EF)

In examples (105) to (108), the fricative was devoiced preceding an onset sonorant consonant:

Dutch:

(105) 'k he(b) om **(h)al*f n*egen** les morgen [ɑlf ˈneːɦə] (*half ~ halve*) (EF)
'I've got a class at half past eight tomorrow'

(106) en die dacht dat dat zo **serieu*s w*as** [sərˈjøs wɑs] (*serieus ~ serieuze*)(EF)
'and he thought it was really serious'

DLE:

(107) **becau*se y*ou're** thinking and talking [bɪˈkɒs jɔːr] (EF)
(108) I **wa*s n*ot** the only candidate [wɒs nɒt] (EF)

A comparison between clusters in which an onset sonorant consonant is preceded by a voiceless fricative (discussed in Section 8.4.1) and a voiced fricative reveals that there are important differences in the way they are realised by the informants, at least in the DLE conversations. In order to illustrate this, two graphs are given below: the graph in Figure 35 (left) shows the production of RVA in voiceless fricative + sonorant consonant clusters; Figure 36 (right) presents the extent to which voiced fricatives remained voiced when preceding a sonorant consonant. In both graphs the surface structure that is presented is thus a voiced fricative followed by a sonorant consonant. The light bars represent the East-Flemish informants' realisations; the dark bars those of the West-Flemish informants.

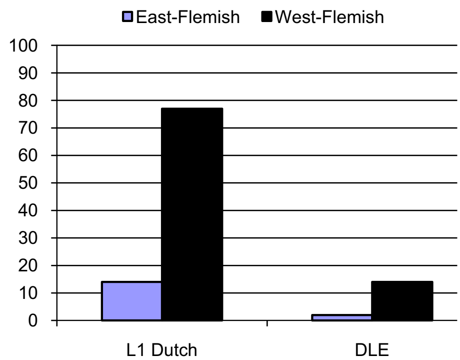


Figure 35. RVA in voiceless fric. + son. consonant clusters (e.g. /fj/ → [vj]).

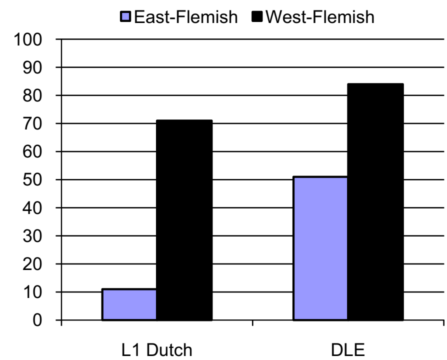


Figure 36. Unmodified voiced fricatives + sonorant consonant clusters (e.g. /vj/ → [vj]).

When we look at the Dutch conversations, it is clear that the results are very similar, whether the word-final fricative was voiceless or voiced in the underlying form. The East-Flemish informants voiced a final fricative in only 14% of the tokens if it was voiceless in the underlying form and in only 11% of the tokens if it was voiced in the underlying form. The West-Flemish informants, on the other hand, produced a voiced fricative in the majority of tokens in the Dutch conversations: in 77% of the voiceless fricative + sonorant consonant clusters and in 71% of the voiced fricative + sonorant consonant clusters. The analysis of this type of cluster in the Dutch conversations hence reveals two things:

First, East- and West-Flemish informants indeed realise fricative + sonorant consonant clusters very differently, in that the former usually produce a voiceless fricative in this position and the latter a voiced fricative.

Secondly, the analysis of the fricative + sonorant consonant clusters in the Dutch conversations shows that the underlying voice specification of the fricative does not have an effect on its surface realisation.

The analysis of fricative + sonorant consonant clusters in the DLE conversations shows a completely different picture. When the fricative was voiceless in the underlying form (Figure 35), both the East- and the West-Flemish informants very rarely voiced it, though the West-Flemish informants did so more frequently than the East-Flemish informants. When the fricative was voiced in the underlying form (Figure 36), the East-Flemish informants realised it as voiced in 51% of the tokens, while the

West-Flemish informants did so in 84% of the tokens. Again, two conclusions can be drawn from this.

A first conclusion is that the difference between the East- and West-Flemish informants is greater in the Dutch than in the DLE conversations. This seems to indicate that both East- and West-Flemish speakers adjusted their realisations in the direction of L1 English: the East-Flemish informants suppressed their tendency to devoice final voiced fricatives; the West-Flemish informants did not suppress their tendency to voice fricatives before onset sonorant consonants.

A second conclusion that can be drawn from the comparison of voiceless and voiced fricative + sonorant consonant clusters is that in the DLE conversations – in contrast with the Dutch conversations – the underlying voice specification of the fricative played an important role in its surface realisation. When the fricative was voiceless in the underlying form, it was also realised as voiceless in the majority of tokens produced by East- and West-Flemish informants. When the fricative was voiced in the underlying form, the East-Flemish informants devoiced it in 49% of the tokens, while the West-Flemish informants did so in only 18% of the tokens. It thus seems that the informants have learnt that in English the contrast between voiced and voiceless fricatives is maintained in word-final position before a sonorant consonant. That almost half of the final voiced fricatives were devoiced by the East-Flemish informants is probably due to the fact that the informants have difficulties with the phonetic implementation of voicing in final fricatives (see also Section 6.3.2. on final laryngeal neutralisation in fricatives.)

8.5. Summary

This chapter has provided a critical overview of various explanations for the occurrence of sonorant consonants as triggers of voice assimilation in different language varieties. Theories assuming temporary underspecification of sonorants, or assuming different laryngeal features for sonorants and obstruents, as well as phonetic explanations proved to be problematic. The constraint-based account provided by Nagy (2000), on the other hand, seemed to be able to account for the occurrence of voice assimilation before sonorants in the West-Flemish data. This proposal is further discussed in Chapter 11. The comparison between the productions of the East- and West-Flemish participants in Dutch and DLE conversational speech revealed that the West-Flemish, but not East-Flemish, participants produced assimilation before sonorant consonants with a high frequency in L1 Dutch, but not in DLE. The process is thus different from regressive voice assimilation before voiced stops, which was frequently transferred into English by all participants. This finding suggests that West-Flemish participants to some extent suppress the process of voice assimilation in English. When a word-final voiced fricative was followed by a word-initial sonorant consonant, and the target English realisation of the word-final fricative was therefore voiced, the West-Flemish participants produced considerably more target realisations than the East-Flemish participants, who tended to devoice the final fricative. This suggest that the West-Flemish informants did not suppress their tendency to produce word-final fricatives as voiced before sonorant consonants when this is indeed the target realisation. In other words, the low application rate of regressive voice assimilation in voiceless fricative + sonorant consonant clusters across word-boundaries is not simply the result of final laryngeal neutralisations, as we would in that case expect devoicing in voiced fricative + sonorant consonant clusters across word-boundaries. It must be the result of the participants' suppression of the application of their L1 phonological assimilation process before sonorant consonants.

Notes

1. Compare for instance the pronunciations mentioned in Heemskerk & Zonneveld (2000) and in Mertens & Vercammen (1998).
2. The pronunciation with /s/ is also recommended by the *Nederlandse Taalunie* ('Dutch Language Union'), an organization which gives advice about the Dutch language (personal email correspondence, November 2004).
3. Beckman & Ringen (2005) remark that in German there is also variation in the realisation of this type of cluster in words like *gruslig* ('spooky') and *fasrig* ('fibrous; stringy'), which are sometimes transcribed with [s] and sometimes with [z] in pronunciation dictionaries. (Note that alternative spellings of these words are *gruselig* and *faserig*).
4. Jones (1931) claimed that pairs such as *my train – might rain* and *grey trout – great rout* are distinguishable due to the delay in VOT in the sonorant consonants in the first phrase of each pair and the absence of it in the second one.
5. Bob Ladd (p.c.) pointed out to me that in some lexical items ending in a voiceless fricative, voicing is possible before a sonorant consonant in some varieties of English. He referred to one native speaker's realisation of *if you* as [ɪv juː], but believed that this phenomenon is lexically restricted and maybe even restricted to the word *if.* A discussion on the Linguist List (June, 2002) also showed that there is variation in the realisation of word-internal fricative + sonorant consonant clusters in words like *Kashmir* and *cashmere* ([ʃm] or [ʒm]).
6. Anecdotal evidence comes from the pronunciation of the name of the Greek island *Kos* as [kɒz] by English-speaking tourists.
7. The Obligatory Contour Principle (OCP) is an important principle in Autosegmental Phonology, which states that adjacent identical elements are prohibited. The term was coined by Goldsmith (1976) (and based on a proposal by Leben, 1973) in the context of tone languages, where it disallowed two adjacent identical tones. McCarthy (1988) gives the example of a geminate consonant like /pp/. The Obligatory Contour Principle ensures that this geminate is represented "as a single segment from a featural standpoint that branches to two syllabic positions, occupying the space of a cluster" (McCarthy, 1988: 88)
8. Alternatively, the Kikuyu data could be explained as dissimilation of [-voice] (though Rice 1993 works with privative features).
9. The phrase *geef Lien* occurred in a sentence reading task performed by the participants. Participants were asked to read a number of Dutch and English sentences containing possible assimila-

tion sites. The sentence from which the phrase was taken was *Geef Lien dat boek nu terug* ('Give the book back to Lien now').

10. In (Standard) Dutch, the word *kop* is used to refer to the head of animals, while the word *hoofd* is used to refer to the head of people. In many dialects, however, the word *kop* is used for both. The child is here correcting the other child's use of the word *kop*.

11. More data are needed in order to find out whether West-Flemish children automatically produce RVA before sonorants from the very beginning or whether they have to acquire this process (and go through a stage in which they do not produce RVA before sonorant consonants in new contexts).

Chapter 9
Progressive devoicing

9.1. Introduction

In some languages obstruent clusters across word-boundaries can be subject not only to regressive voice assimilation (Chapter 7), but also to progressive voice assimilation. This is the case in Dutch, in which word-final obstruents trigger progressive devoicing in following word-initial fricatives. This chapter discusses the extent to which native speakers of Dutch produce progressive devoicing in casual Dutch and English conversations, in which progressive devoicing across word-boundaries does not normally occur.

9.2. Progressive devoicing in Dutch vs. English

9.2.1. Progressive devoicing in Dutch

When a word-final obstruent is followed by a word-initial voiced fricative, the cluster undergoes progressive rather than regressive voice assimilation. The process applies both within words and across word boundaries. Booij (1995a: 58) gives the following examples[1]:

(109) *opvallend* [pf] (‘striking’)
(110) *pechvogel* [xf] (‘unlucky person’)

Examples of progressive voice assimilation across word boundaries are the following:

(111) *laat vallen* [tf] (lit.: let drop, ‘drop it’)
(112) *vals zingen* [ss] (‘sing false’)

Trommelen & Zonneveld (1979: 104) proposed the following rule to account for this process:

$$\begin{bmatrix}-\text{son}\\+\text{cont}\end{bmatrix} \rightarrow ([-\text{voice}]\,/\,[-\text{son}])\ \#\ (\#)\ \_\_\_$$

The rule says that a word-initial continuant becomes voiceless when following an obstruent. The voice character of the preceding obstruent does not need to be specified in the rule, since it is assumed that the final devoicing rule applies before the progressive assimilation rule, so that the preceding obstruent, even if it is voiced in the underlying form, has become voiceless before the progressive devoicing rule applies.

In many southern Dutch dialects, word-final /t/ can be elided in particular words or contexts. Elision of /t/ is extremely frequent in the words *niet* ('not'), *wat* ('what'), *dat* ('that') and *met* ('with') and in the suffix-/t/ of the second and third person singular of verbs with a stem ending in a vowel, as in *zie(t)* 'sees' and *doe(t)* 'does'. It is interesting to note that, if the following word starts with a voiced fricative, the fricative becomes voiceless under the influence of the /t/, even if the coda /t/ is never realised[2]. De Schutter & Taeldeman (1986: 113-117) argue that this happens in most southern Dutch dialects, which means that in these dialects the devoicing of the fricative precedes the elision of the /t/. The phenomenon is also mentioned by Eijkman (1937). Two examples are provided in (113)-(114):

(113) *niet veel* [ni feːl] 'not much'
(114) *gaat vallen* [ɣa ˈfɑlə] lit. goes+fall-inf. 'is going to fall'

Progressive devoicing after deletion of word-final /t/ is especially frequent in the central and western regions of the southern part of the Dutch-speaking area. De Schutter & Taeldeman (1986: 115) note that if progressive devoicing is absent in these dialects, it is always in phrases in which the /t/ of an adjective is followed by a fricative-initial substantive. An example is the phrase *goed zaad* 'good seed', which can be realised as [ɣu zat] or as [ɣu sat]. In East-Brabant and (West-)Limburg, progressive devoicing also occurs with elision of /t/, but not as frequently. According to De Schutter & Taeldeman (1986: 116), the form with progressive voice assimilation is expanding in proportion to the form without progressive voice assimilation. Taeldeman (1982) argues that this evolution can be explained in the light of Kiparsky's (1968) universal rule ordering, which says that rules in counterbleeding order are more natural than rules in bleeding order, since the former order minimises the application area of the first rule. If fricative devoicing applies before deletion of /t/, both rules can apply ('counterbleeding order'); if, on the other hand, deletion of /t/ applies before fricative devoicing, the latter rule cannot apply ('bleeding order').

In some varieties of Dutch, notably those spoken in the East-Flemish and West-Flemish dialect areas and in the Brabantine region, progressive devoicing occurs not only in obstruent + voiced fricative clusters, but also when a word-final /t/ is followed by a word-initial /d/. An example is the phrase *rood drankje* ('red drink') which is realised with progressive devoicing, as [roːt ˈtrɑŋkjə], rather than with regressive voice assimilation, as [roːd ˈdrɑŋkjə].

9.2.2. Progressive devoicing in English?

Obstruent + voiced fricative clusters do not undergo progressive or regressive assimilation in English, as is illustrated in the phrases in (115)-(116):

(115) *walked very (quickly)* /wɔːkt ˈveri/ → [wɔːkt ˈveri]
(116) *not zero* /nɒt ˈzɪərəʊ/ → [nɒt ˈzɪərəʊ]

An important exception to the absence of progressive devoicing in English is the plural formation suffix /z/, which becomes voiceless when preceded by a voiceless obstruent (cf. example (117)). When the suffix is preceded by a voiced obstruent (118), a sonorant consonant (119), or a vowel (120), no devoicing occurs:

(117) *cat* + /z/ → [kæts]
(118) *dog* + /z/ → [dɒgz]
(119) *whim* + /z/ → [wɪmz]
(120) *bee* + /z/ → [biːz]

Kingston & Diehl (1994; see Section 2.4.1.) refer to the fact that voicing coarticulation occurs both in Dutch and English as evidence for the existence of one feature [voice] in the two languages. Iverson & Ahn (2007), on the other hand, regard progressive assimilation of this type as evidence for the existence of the feature [spread glottis] in English. They argue that in a model which assumes that voiceless obstruents in English are marked for [spread glottis]

> "assimilatory progressive devoicing in clusters is directly describable in terms of rightward extension of the feature [spread] into a laryngeally unmarked obstruent in cases like the /t + z/ of *cats*" (Iverson & Ahn, 2007: 254).

Iverson & Ahn argue that a privative [voice]-approach can only explain this type of devoicing as the result of a "universal devoicing" constraint, which is "a constraint on phonetic implementation to the effect that voicing cannot be maintained within the syllable once it has been turned off" (Iverson & Ahn, 2004: 254). They argue that such an explanation is not satisfactory, as it does not explain why voiceless obstruents become voiced rather than, for instance, being deleted altogether, which would also be viable repair strategies. Figure 37, taken from Iverson & Ahn, shows the difference between the two approaches:

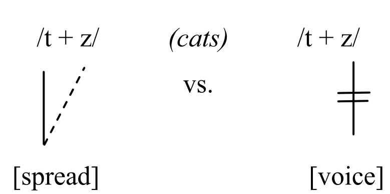


Figure 37. Laryngeal assimilation in English: privative [spread] vs. privative [voice] (Iverson & Ahn, 2004: 254).

The devoicing of the past-tense suffix *–d* after a voiceless obstruent (/p/ or /k/) can be explained in the same way, as a rightward spreading of [spread glottis] to a laryngeally unspecified /d/ (cf. examples (121) and (122)). If the suffix is preceded by a voiced segment, no devoicing occurs (cf. (123) and (124)).

(121) *liked* /kd/ → [kt]
(122) *stopped* /pd/ → [pt]

vs.

(123) *combed* /md/ → [md]
(124) *loved* /vd/ → [vd]

9.3. Progressive devoicing in Dutch Learner English

Whereas in Dutch, word-initial fricatives are devoiced when preceded by a word-final obstruent, they remain voiced in English. In Dutch, both word-final stops and fricatives trigger this type of devoicing, independently of whether they are voiced or voiceless in the underlying form. In the conversations, 1426 tokens were coded in which a coda obstruent was followed by an onset voiced fricative: 1056 of these contained an underlying voiceless coda obstruent; the other 370 tokens consisted of an underlying voiced obstruent followed by a voiced fricative. Tables 45 and 46 show the results for the Dutch and DLE conversations:

Code	Example	Dutch	DLE
UNMOD	/dv/ → [dv]	1/131 (1%)	169/239 (71%)
FIN	/dv/ → [tv]	8/131 (6%)	41/239 (17%)
PVA	/dv/ → [tf]	122/131 (93%)	29/239 (12%)

Table 45. Voiced obstruent + voiced fricative.

Code	Example	Dutch	DLE
RVA	/tv/ → [dv]	4/819 (1%)	79/237 (33%)
UNMOD	/tv/ → [tv]	52/819 (6%)	109/237 (46%)
PVA	/tv/ → [tf]	763/819 (93%)	49/237 (21%)

Table 46. Voiceless obstruent + voiced fricative.

Tables 45 and 46 show that the results for Dutch are almost exactly the same whether the word-final obstruent is voiced or voiceless in the underlying form: in the overall majority of tokens, i.e. in 93% of the clusters, the voiced fricative was devoiced following the coda obstruent; in 6% of the tokens, the word-final obstruent was voiceless (either underlyingly or as the result of final laryngeal neutralisation) and the onset fricative remained voiced; in 1% of the tokens the obstruent was voiced (either underlyingly or as the result of regressive voice assimilation) and the onset fricative remained voiced. The following two examples illustrate progressive devoicing in the Dutch conversations:

Underlying voiceless obstruent + voiced fricative:

(125) maa(r) da(t) i(s) no(g) nen ouwe **cafémaa*t* *v*an** mijn broer [kɑˈfemat_fɑm] /tv/ → [tf] (EF)
'but he's an old pub mate of my brother's' (*cafémaat* [t] 'pub mate' ~ plural: *cafématen* [t])

Underlying voiced obstruent + voiced fricative:

(126) is er al een **vraa*g* *g*esteld** geweest? [vrax_xəˈstɛlt] /ɣɣ/ → [xx] (EF)
'has a question been asked yet?' (*vraag* [x] 'question' ~ plural: *vragen* [ɣ])

In the English conversations, the results are more diverse. Underlying voiced obstruent + voiced fricative clusters remain unmodified in 71% of the tokens, which is what would be expected in L1 English. Here is an example:

Underlying voiced obstruent + voiced fricative: unmodified:

(127) **he'*s* *v*ery** conservative [hiːz ˈveri] (WF)

Final laryngeal neutralisation occurred in 17% of the tokens and final laryngeal neutralisation followed by progressive devoicing was produced in 12% of all tokens.

In underlying voiceless obstruent + voiced fricative clusters (see Table 46), the percentage of unmodified tokens was lower than if the final obstruent was voiced in the underlying form: the obstruents were realised according to their underlying voice specifications in 46% of the tokens. Whereas in Dutch, only 1% of this type of cluster underwent regressive voice assimilation, in English 33% did so. Progressive devoicing occurred in 21% of the coded tokens. The following three examples illustrate the different realisations:

Underlying voiceless obstruent + voiced fricative: RVA:

(128) he knows a lot **abou*t* *h*im** [əˈbaʊd ɦɪm] (EF)

Underlying voiceless obstruent + voiced fricative: UNMOD:

(129) **i*f* th*at** wasn't a good one [ɪf ðæt] (WF)

Underlying voiceless obstruent + voiced fricative: PVA:

(130) he spoke **Engli*sh* *v*ery** well [ˈɪŋlɪʃ ˈferi] (EF)

This finding confirms Gussenhoven & Broeders' (1976) statement that some native speakers of Dutch tend to produce regressive voice assimilation in English in clusters in which they would produce progressive devoicing in Dutch:

> "In an attempt to avoid this undesirable assimilation [i.e. progressive voice assimilation in obstruent + voiced fricative clusters] in English, students may be tempted to voice both consonants in sequences of RP fortis plosive or fricative plus lenis fricative like *this village, great zeal.* This is equally unacceptable in RP" (Gussenhoven & Broeders, 1976: 110).

Because the Dutch-speaking informants very frequently realised the English fricative /ð/ as a stop [d], the graphs in Figures 38 and 39 present the realisations of all obstruent + voiced fricative clusters, except those in which /ð/ occurred in the coda or the onset. Figure 37 shows the realisations of voiced obstruent + voiced fricative clusters; Figure 38 presents the results for voiceless obstruent + voiced fricative clusters. The clusters [tf], [tv] and [dv] are merely used as examples of each process.

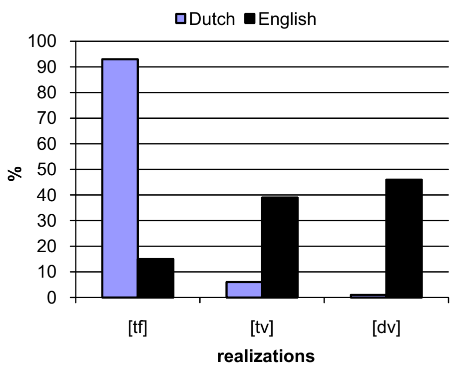


Figure 38. Voiced O + voiced fric. clusters (e.g. /dv/).

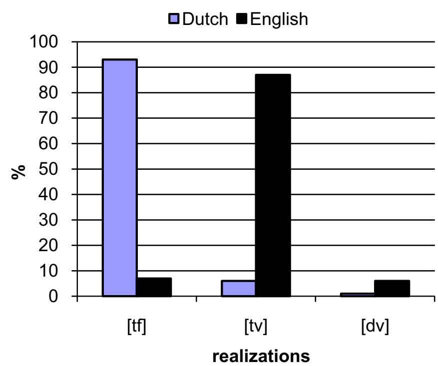


Figure 39. Voiceless O + voiced fric. clusters (e.g. /tv/).

The graphs in Figures 38 and 39 clearly show that the informants only rarely transferred the progressive devoicings they produced in Dutch (93%) into English (in only 15% of the tokens in which a voiced obstruent preceded the fricative and in 7% of the tokens in which a voiceless obstruent occurred in the coda). In the DLE conversations, voiced obstruent + voiced fricative clusters (Figure 38) were either realised with devoicing of the coda obstruent (39%) or according to their underlying voice specifications (46%). If the coda obstruent was voiceless in the underlying form (Figure 39), the overall majority of tokens (87%) were realised according the underlying voice specifications of the coda and onset obstruents. In only a small minority of tokens (6%) did the coda obstruent become voiced under the influence of the following onset voiced fricative.

Coda deletion

In most Belgian Dutch dialects devoicing of a word-initial fricative also occurs when the final /t/ of the preceding word is elided (see Section 9.2.1.). In the Dutch conversations, 102 tokens were coded in which a word-final /t/ which was followed by a word-initial voiced fricative was deleted. Of these 102 tokens, 70 were subject to progressive devoicing; in the remaining 32 tokens, the fricative was realised as voiced. Examples are provided in (131)-(134):

Deletion of coda /t/ and devoicing of the fricative:

(131) **me(t) zo'n** bootje [mɛ soː əm] (WF)
'with a small boat like that'

(132) wij moest(e)n **nie*(t) v*eel** kennen, *ze* [niː feːl] (EF)
'we didn't have to know a lot, you know'

Deletion of coda /t/ but no devoicing of the fricative:

(133) maa(r) 't (i)s **nie*(t) z*o**… [niː zoː] (WF)
'but it's not like…'

(134) (ge) zit dan allemaal **nie*(t) v*er** van elkaar op kot of zo? [niː vɛr] (EF)
'you're all living not far from one another or what?'

In two tokens the coda stop and the preceding fricative in the word *heeft* ('has') were deleted when this word was followed by a voiced fricative in the next word. In both tokens the fricative was devoiced. An example is the following:

(135) en (h)ij **(h)ee*(ft) z*e** nie(t) gegeven? [ˈeːsə] (EF)
'and he hasn't given it?'

It should be noted that, since PVA can also occur when the coda /t/ is deleted, it cannot be a purely phonetic process.

If a coda /b/ instead of a /t/ or /d/ was deleted before a voiced fricative, no devoicing occurred, as is illustrated in (136):

(136) 'k **(h)e*(b) z*e** wel wree(d) graag [kɛ zə] (WF)
'I really like her, though'

In conclusion, while all obstruents can trigger PVA in a following fricative, only coronal /t/ can also trigger the process when being elided.

/td/-clusters

Clusters of a word-final /t/ followed by a word-initial /d/ form a special case in many varieties of Dutch in Flanders and the southern part of the Netherlands, in that they undergo progressive rather than regressive assimilation, i.e. they are often realised as [tt] (and then usually reduced to [t]) rather than as [dd] (or [d]). Whereas in the

Dutch conversations, 108 /td/ clusters were coded, in the English conversations only 26 clusters of this type occurred. This difference in possible assimilation sites is due to the fact that many frequent words in Dutch have /d/ in the onset, especially the function words *de* 'the', *die* 'that', *dat* 'that', *dan* 'then' en *daar* 'there', which all occurred with a very high frequency in the Dutch conversations. The English equivalents of these words all start with the fricative /ð/ (cf. translations above). Because the informants almost invariably realise the English voiced fricative /ð/ as [d] (cf. also Collins & Mees, 1999: 142, who state that this is a typical error of native speakers of Dutch speaking English), the /tð/ clusters should also be considered in relation to the process of progressive devoicing. Table 47 presents the results for the Dutch and DLE conversations:

			Dutch	**DLE**
/td/	RVA	/td/ → [dd] → [d]	0	13/26 (50%)
	PVA	/td/ → [tt] → [t]	146/153 (95%)	3/26 (12%)
	UNMOD	/td/ → [td]	7/153 (5%)	10/26 (39%)
/tð/	RVA	/tð/ → [td] → [dd] → [d]	–	20/82 (24%)
	PVA	/tð/ → [td] → [tt] → [t]	–	41/82 (50%)
	UNMOD	/tð/ → [td]	–	21/82 (26%)

Table 47. /td/ clusters in the L1 Dutch and DLE conversations (see Simon, 2009b).

The results of the Dutch conversations revealed that the Dutch-speaking informants produced progressive devoicing in 95% of all /td/ clusters in the Dutch conversations. Progressive devoicing in this type of cluster occurred both with function and content words, as is illustrated in (137) (function word) and (138) (content word):

(137) dan (h)oorde eigenlijk nie(t) echt **wa(*t*) *d*a(t)** 't is [wɑt_tɑ] (EF)
'then you actually don't really hear what it is'

(138) 'k (h)ad **ee(r)s*t* *d*rie** op vijf [eːst_triː] (EF)
'at first I had three out of five'

In the DLE conversations, PVA was less frequent: it was produced in 12% of the /td/ clusters and in 50% of the /tð/ clusters. Examples are provided in (139) and (140):

(139) you don't need to know it..uh..for uh for the **nex*t* *d*ay** [nekst_teɪ] (EF)
(140) oh, we **wen*t* *th*ere** with school [went_tɛə] (EF)

One factor which could be responsible for the less frequent production of PVA in the DLE than in the Dutch conversations is the weakness of word-final /t/ in English. Word-final /t/ can be replaced by a glottal stop, when it is followed by a homorganic consonant, such as /d/, or it can be deleted altogether when preceded and followed by a consonant (Collins & Mees, 1999: 210; Cruttenden, 2001: 169). The weak character of word-final /t/ in English could explain why it does not easily trigger devoicing in a following consonant, but rather underwent RVA under influence of this following /d/. However, coronal stops are also weak in Dutch, where they are often deleted or realized differently from their underlying voice specification. For a more detailed discussion of /td/ clusters in Dutch and DLE, see Simon (2009b).

9.4. Summary

This chapter has discussed the process of progressive voice assimilation across word-boundaries, which occurs in Dutch, but not in English. In Dutch, word-initial voiced fricatives become voiceless when following word-final obstruents. In a rule-based approach, this is explained by assuming that the rule of progressive devoicing applies before the elision rule. The analysis of conversational data revealed that progressive devoicing was produced with a high frequency in L1 Dutch, both when the final obstruent was voiced and when it was voiceless. It was, however, not transferred into English nearly as much as regressive voice assimilation (see Chapter 7). This suggests that the learners have to some extent learnt to suppress the rule of progressive devoicing when speaking English. While voiced obstruents preceding voiced fricatives were still frequently subject to final laryngeal neutralisation, more than 40% of the final voiced obstruents and as many as 87% of the final voiceless fricatives followed by voiced fricatives were realised according to the underlying voice specification, in line with the L2 target. The reason why progressive devoicing of fricatives is not transferred to a great extent into the L1 Dutch speakers' English speech might be the universal preference of regressive over progressive devoicing in the languages of the world (Lombardi, 1999). This universal principle may emerge in the learners' interlanguage, leading to a greater production of regressive than of progressive voice assimilation. This claim and an OT analysis of the assimilation patterns in Dutch, English and DLE will be dealt with in Section 11.4.

Notes

1. The process is also mentioned by, among others, Trommelen & Zonneveld (1979: 130), Collier & Droste (1985: 35) and Collins & Mees (1999: 212).

2. The final /d/ or /t/ of this group of words is thus extremely variable: (1) it is deleted before an obstruent (and, if this obstruent is a fricative or /t/, it usually becomes voiceless), (2) it becomes voiced [d] before a vowel (though it is always deleted in the word *niet* 'not' and can also be deleted before a vowel, as in *dat is* realised as [dɑ ɪs]),and (3) it is realised as [t] before a vowel-initial clitic, such as *–ie* 'he' [iː], *(h)em* 'him' [əm] and *er* 'there' and *haar* 'her', both realised as [ər].

Chapter 10
Prevocalic voice assimilation

10.1. Introduction

In Dutch, word-final obstruents preceding word-initial vowels do not always undergo final laryngeal neutralisation, but are frequently realised as voiced. In English, voiceless obstruents do not normally become voiced in prevocalic position, though in American English there is a process of flapping or coronal lenition of word-final, prevocalic /t/. This chapter discusses the contexts in which prevocalic assimilation occurs in Dutch and English and to what extent native speakers of Dutch produce intervocalic voicing in Dutch and English conversational speech. The chapter ends with a comparison of the transferability of different regressive voice assimilation processes: regressive assimilation before voiced stops, before sonorant consonants and before vowels.

10.2. Prevocalic obstruents in Dutch vs. English

10.2.1. Prevocalic obstruents in Dutch

Stops

In Standard Dutch, word-final stops do not normally become voiced before vowels, whether they are voiceless or voiced in the underlying form[1]. Here are some examples:

(141) *de kat is* [t] ‘the cat is’ (< *katten* – underlying /t/)
(142) *de hond is* [t] ‘the dog is’ (< *honden* – underlying /d/)

However, when a word-final stop is followed by a vowel-initial clitic, voicing is possible in Standard Dutch. Berendsen (1983) argues that if the obstruent preceding the clitics *er* ([ər], ‘there’ – weak form), *ie* ([iː],’he’ – weak form), *ik* (pronounced as [ək]; weak form of ‘I’,) and *het* (pronounced as [ət]; weak form of ‘it’) is an underlyingly voiced obstruent, it may surface as voiced, but if it is underlyingly voiceless, it does not become voiced. The following example is taken from Berendsen (1983: 22):

(143) *heb ik* [b] (‘have I) versus *loop ik* [p] (lit. ‘run I’)

De Schutter & Taeldeman (1986: 98) argue that there is usually no voicing of the stop before the clitics *–ie* [iː], *er* [ər], *haar* [ər] and *hem* [əm] (e.g. *Ik **heb er** twee* [(h)ep ər]).

Because there is a universal principle which says that intervocalic consonants are assigned to the onsets of syllables rather than to the codas (dubbed the Maximal Onset Principle, cf. Selkirk, 1980: 9), resyllabification takes place in these host + clitic combinations and the stem-final obstruent becomes the onset of the next syllable. As a result, it is not subject to final laryngeal neutralisation. The phrase *heb ik,* for instance, has the syllable structure (hɛ) (bək). Booij (1995b) argues that the voiced realisation of the stop only occurs in frequent verb + clitic combinations, such as *heb ik,* since these are lexically stored. Booij (1995b) even argues that in these frequent phrases the clitic actually functions as a suffix. By contrast, combinations with less frequent verbs, such as *verbind ik* (lit. 'connect I'), surface with a voiceless obstruent, because the phrase *verbind ik* is not stored as a single lexical unit and the personal pronoun *ik* 'I' does not function as an affix. Ernestus (1997) investigated the production of word-final stops before clitics in a corpus of spoken Dutch. She looked at the following structures: verb form + *ik* ('I), verb form + *het* ('it'), *dat ik* ('that I'), *met een* ('with a'), verb form + *er* (1997; 2000). Voiced realisations of the stop occurred in all of these structures, here listed in order of decreasing frequency of voicing. Examples (144) – (146) are taken from Ernestus (1997):

(144) *heb ik* [b] ('have I')
(145) *weet ik* [d] ('know I')
(146) *heb het* [b] ('have it')

It should be noted that example (145) *wee[d] ik*, goes radically against the rule formulated by Berendsen (1983), which says that word-final stops can only become voiced before a vowel-initial clitic if they are voiced in the underlying form. The example provided by Berendsen to show that a stop does not become voiced if it is voiceless in the underlying form is *loop ik* (lit. 'run I', which is not normally realised as **loo[b] ik*). Ernestus shows that in her corpus (the data of which are provided by native speakers of Dutch living in North-Holland, South-Holland and Utrecht), the underlying voice specification of a word-final stop of a verb form followed by *ik* ('I'), *het* ('it') or *er* ('there') does not have a statistically significant effect on its output realisation. In the varieties of Dutch spoken in Belgium, however, stops which are voiceless in the underlying form do not normally become voiced (except in the dialects of Limburg, in which voicing is possible).

The fact that voiced realisations of word-final stops are possible before vowel-initial clitics is in accordance with Ernestus' claim that the voice specification of word-final obstruents is delinked and that they have no voicing targets. Under the Permanent Neutralisation Hypothesis, proposed by Ernestus, word-final obstruents are realised as voiced or voiceless depending on which realisation requires the least articulatory effort. This hypothesis thus accounts for the fact that word-final obstruents can be realised as voiced when surrounded by voiced sounds. However, since in Ernestus' corpus word-final stops can only become voiced if the following word is a vowel-initial clitic, this means that there must be a morphophonological rule which is part of the grammar and which applies only to word-final stops followed by vowel-initial clitics.

It should be noted that in some varieties of Dutch, word-final stops become voiced in intervocalic position, even when they are not followed by a clitic. Eijkman (1937), for instance, gives the example of the phrase *Wat is dat?* ('What is that?'), in which the word-final /t/ can be realised as [d], resulting in the pronunciation [wɑdɪzdɑ]. The rule is also mentioned by Stroop (1986: 151), who considers this process to be part of a dialectal Brabantine rule. De Schutter & Taeldeman (1986: 104-106) report that in some dialects in Limburg and the northwest of East-Flanders, stops can become voiced before vowels. Examples are provided in (147)-(149):

(147) *poot is*	[d]	'leg is'
(148) *bok is*	[g]	'buck is'
(149) *post is*	[zd]	'post is'

In the northwest of East-Flanders intervocalic stops also become voiced within words. The word *potten* ('pots'), for instance, can be realised as [ˈpɒdən] or [ˈpɒtən] (De Schutter & Taeldeman, 1986: 105). De Schutter & Taeldeman (1986) note that in most Flemish dialects a word-final stop can be realised as voiced before a vowel only when it is voiced in the underlying form. They provide the examples in (146) and (147) to illustrate the difference (De Schutter & Taeldeman, 1986: 106):

(150) *die poot is*	[t]	'that leg is'	< poten
(151) *dat brood is*	[d]	'that bread is'	< broden

In Iverson & Salmons' (1995) model, voiced stops in Dutch are marked for Glottal Tension and voiceless stops are unmarked. If sonorants are assumed to be unspecified for voice, the realisation of a word-final, underlyingly voiceless stop as voiced when occurring between vowels can again only be explained as phonetic spill-over of voice. Since Iverson & Salmons assume a rule through which the laryngeal specification is delinked from the obstruent in coda position, the voiced realisation of underlyingly voiced stops can only be explained as either a phonological reassociation process or as a phonetic spill-over effect.[2]

Fricatives

The fricatives in such words as *huisarts* ('family doctor, GP') and *hoefijzer* ('horseshoe') are often realised with a voiced rather than a voiceless fricative (see Section 6.2.). Such words illustrate a more general process in Dutch, through which fricatives can be voiced in Dutch when preceded by a sonorant (a sonorant consonant or a vowel) and followed by a vowel. Collins & Mees (1999: 214) give the following examples:

(152) *af en toe* [v] ('from time to time, off and on')	/ɑf ɛn tu/ → [ɑv ɛn tu]
(153) *rasecht* [z] ('pure-bred')	/rɑsɛxt/ → [ˈrɑzɛxt]

Most generative studies of Dutch voice assimilation (such as Hubers & Kooij, 1973 and Trommelen & Zonneveld, 1979) do not formulate a rule of intervocalic voice assimilation. De Schutter & Taeldeman (1986), however, state that in the southern Dutch dialects (except perhaps in East-North-Brabant) the voiced realisation of the fricative is the normal realisation if it is preceded by a voiced segment and followed by a vowel. They note that it is does not matter whether the fricative is an underlying voiced or voiceless one and illustrate this with the phrases in (154) to (157):

– with underlying voiced fricative:

(154) *on*[z] *oud huis* (< onze) 'our old house'
(155) *dat hij braa*[v] *is* (< brave) 'that he's sweet'

– with underlying voiceless fricative:

(156) *da(t) men*[z] *is* (< mensen) 'that person is'
(157) *o*[v] *in* (< of) 'or in'

De Schutter & Taeldeman (1986) formulate the following rule:

Rule 5: $\begin{bmatrix} -\text{son} \\ +\text{cont} \end{bmatrix} \rightarrow [+\text{voice}] /$ ___ # V…

The rule says that continuant obstruents become voiced when preceding a vowel. However, this rule does not hold when the fricative is preceded by a voiceless segment. An example is the phrase *de fiets is* ('the bicycle is'), which is realised as [də fiːts ɪs] in most dialects and in Standard Dutch. De Schutter & Taeldeman (1986) found, however, that in some areas in South-East-Flanders and Limburg, a realization with voiced obstruents is also possible (e.g. *de fiets is* realized as [də fiːdz ɪs]).

In order to account for voicing of fricatives before vowels, Booij (1995a: 147) posits a rule of intervocalic voice assimilation, through which the laryngeal node of the fricative (a continuant obstruent) is delinked and the laryngeal specification of the following vowel spreads leftward to the fricative, as is illustrated in the Figure 40.

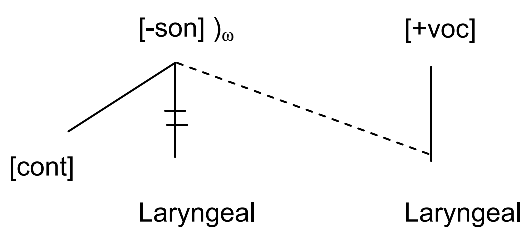


Figure 40. Intervocalic voice assimilation (Booij, 1995a: 147).

Since no intervocalic voice assimilation occurs at the lexical level (e.g. the plural of *klif* 'cliff' is [ˈklɪfən], not *[ˈklɪvən] in Standard Dutch), this rule must be postlexical.

In Iverson & Salmons' (1995) model intervocalic voicing of fricatives cannot be accounted for in the same way, because this model assumes laryngeal underspecification of vowels and sonorant consonants. Since sonorants are not specified for GT, intervocalic voicing of fricatives cannot be a spreading process, as is illustrated in Figure 41:

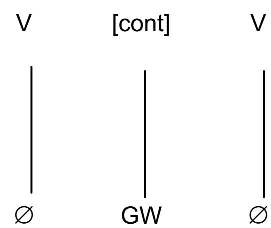


Figure 41. No phonological spreading is possible in vowel – fricative – vowel clusters.

In frameworks which assume underspecification, intervocalic voicing can only be explained as a case of phonetic assimilation, i.e. as voice spill-over from the vowels to the fricative[3] or as a constraint against voiceless fricatives in this position. Kager (1999: 325), in the framework of OT, proposes the markedness constraint INTER-V-VOICE:

INTER-V-VOICE: Intervocalic consonants are voiced.

This constraint fulfils the two criteria for markedness constraints formulated in Section 2.5.2.: (1) intervocalic voicing is a frequent cross-linguistically attested phenomenon and (2) it is phonetically grounded, as it is – from an articulatory point of view – easier to voice intervocalic consonants than not to voice them (Kager, 1999: 325). It should be noted that the constraint INTER-V-VOICE does not suffice to explain the voicing pattern in (Standard) Dutch, as coda fricatives are also frequently realised as voiced after a sonorant consonant and before a vowel. In those cases the fricative does not strictly speaking occur in intervocalic position. Since the informants voiced 41% of the prevocalic voiceless fricatives in the DLE conversations, they transferred the constraint 'voiceless fricatives after a sonorant and before a vowel should be voiced' from Dutch into English.

The reason why fricatives and not stops become voiced between vowels can be linked to the fact that the voiced/voiceless distinction in Dutch fricatives is much weaker than in Dutch stops (see Section 1.2.). It could be argued that because the voiced/voiceless distinction in fricatives is weaker than in stops, the former are more susceptible to phonetic spill-over of voice than the latter.

10.2.2. Prevocalic obstruents in English

Whereas voiceless fricatives become voiced in intervocalic position in some varieties of Dutch, English voiceless obstruents remain voiceless in this position. Examples of intervocalic stops and fricatives are provided in (158)-(159) and (160)-(161), respectively.

Intervocalic stops:

(158) *not everything* [nɒt ˈevriθɪŋ]
(159) *black eye* [blæk aɪ]

Intervocalic fricatives:

(160) *nice evening* [naɪs ˈiːvnɪŋ]
(161) *if I* [ɪf aɪ]

Note that in some varieties of English a word-final stop (especially /t/) can be replaced by a glottal stop, when preceded and followed by a vowel (see Section 1.5.4., e.g. [nɒˀ ˈevriθɪŋ]). In American English word-final /t/ can be subject to flapping or coronal lenition (see below).

Whereas there is no phonemic assimilation in word-final, prevocalic obstruents, Docherty (1992) shows that some phonetic coarticulation takes place. Table 48 shows the extent to which voiceless stops and fricatives received voicing in prevocalic context in Docherty's (1992) recording of British English speakers:

	word-final stops	**word-final fric.**
No medial voicing	12/111 (10.8%)	48/139 (34.5%)
Voicing throughout medial phase	0/111	1/139 (0.7%)
Voicing only during part of medial phase	99/111 (89.2%)	90/139 (64.7%)

Table 48. Voicing timing in word-final voiceless obstruents preceding a vowel (based on tables 3.10 and 3.14, Docherty, 1992: 122, 126).

Table 47 shows that the majority of tokens were produced with some voicing during part of the medial phase and that there is more voicing in stops than in fricatives: whereas stops are realised without any medial voicing in only 10.8% of the cases, the percentage of fricatives realised without medial voicing is as high as 34.5%. Docherty argues that his results suggest that "on the whole, there is somewhat greater resistance to medial voicing in voiceless fricatives than in voiceless stops" (Docherty, 1992: 158). This is surprising since, from an aerodynamic viewpoint, the opposite effect would be predicted: because there is complete closure during the production of stops, the intra-oral air pressure rises more quickly than during the production of fricatives, when the air can escape through a narrow constriction. As a result of the quick rise in supraglottal air pressure, vocal fold vibration is predicted to be more difficult for stops than for fricatives. The reason why intervocalic fricatives in English are less likely to become voiced than voiceless stops might, according to Docherty, again be that there is a conflict between the production of voicing and the production of friction (see 4.6.):

> "In voiceless fricatives, in the interest of achieving the goal of noise in the signal, it is necessary for the glottal abduction gesture to begin as soon as possible, thus precluding the possibility of significant intervals of voicing incursion. A certain amount of voicing incursion into voiceless stops does not threaten their principal auditory goal of a noisy release burst followed by a period of aspiration" (Docherty, 1992: 162).

Table 47 also shows that in Docherty's (1992) corpus only one voiceless fricative and no voiceless stops were voiced throughout.

American English flapping and coronal lenition

In some varieties of English, most notably in American English, but also in, for instance, Hiberno English and South African English, the medial coronal stops /t/ and /d/ are realised with an extremely short closure duration when occurring in intervocalic position (Cruttenden, 2001: 164; Iverson & Ahn, 2007: 259 ff; Jansen, 2004: 46). This decreased closure duration is referred to by Iverson & Ahn (2007: 259) as flapping. Flapping is distinguished from Coronal Lenition, which is an extension of flapping in which the shortened closure duration has a neutralising effect:

> "[W]e reserve the term 'flapping' for the exaggerated shortening of medial closure durations which affects (but does itself not neutralise) coronal stops during phonetic implementation. Coronal Lenition, on the other hand, is a phonological neutralisation merging /t/ and /d/ under conditions that are sensitive, as is widely appreciated, to stylistic as well as prosodic properties" (Iverson & Ahn, 2007: 261).

Decreased closure duration of medial coronals also occurs in colloquial RP, where the medial coronal is realised as a short tap[4] in such cases as *better, sort of, fanatic, bit of,* but is not neutralised (Collins & Mees, 1999: 162). Collins & Mees note that

> "Dutch learners (particularly the less proficient) often realise intervocalic English /t/, and English /t/ before syllabic /l̩/ and /n̩/, as /d/, e.g. *[ˈbedə, ˈsɔːdəv, ˈprɪdɪ, ˈlɪdəl, ˈkɒdən] for *better, sort of, pretty, little, cotton*" (Collins & Mees, 1999: 165).

The authors argue that native speakers of Dutch probably interpret the English tap as /d/ or produce these realisations as the result of influence from American English.

Word-internal Coronal Lenition only occurs in foot-internal contexts, as in *pretty* [ˈprɪɾi] and *matter* [ˈmæɾəʳ], but not in, for instance, *pretend*, where the foot boundary lies before the second, stressed syllable (Iverson & Ahn, 2007: 262). The phonological merger which results from Coronal Lenition is typically illustrated by pairs such as *writing – riding*, which are both realised as [ˈraɪɾɪŋ] in American English. Coronal Lenition also occurs across word boundaries, as in *shut up* [ʃʌɾʌp] and *get it* [geɾɪt].

Iverson & Ahn (2007) claim that Coronal Lenition can be explained phonologically by assuming that the coronal place of articulation is the least marked. They argue that

> "[i]nherently weak /t/, in any case, is weakened even further in prosodically weak environments by the removal of its Glottal Width dimension, resulting in merger with lenis /d/ and consequent automatic voicing in these voice-friendly contexts" (Iverson & Ahn, 2007: 265).

They thus regard Coronal Lenition as a weakening process which is an extension of flapping and involves the delinking of the Glottal Width dimension from an already weak /t/.

10.3. Prevocalic voicing in Dutch Learner English

10.3.1. Prevocalic voice assimilation involving stops

Word-final voiceless stops in prevocalic context

Most descriptions of Dutch state that word-final stops do not normally become voiced in prevocalic position, except when followed by a clitic. Berendsen (1983) even claimed that only stops which are voiced in the underlying form can be realised as voiced when preceding a vowel. This claim was already falsified by Ernestus (2000) (see Section 10.2.1.), and the present data provide further counter-evidence. The analysis shows that in the Dutch variety spoken by the informants, regressive assimilation is frequent when it is not followed by a clitic (only 21 out of 96 word-final /t/'s which underwent assimilation were followed by a clitic). This is illustrated with the following phrases, in which the vowel is not part of a clitic:

(162) we weten al (h)oe da(t) dat **gaa*t* eindigen** [ɦɔd ˈendəɦən] (WF)
'we already know how this is going to end'

(163) die van Zulte zie'k..zie(n) we (ge)lijk **nooi*t* azo** [noːjd əˈzoː] (WF)
'and the ones from Zulte I..we like never see them' (*azo*: West-Flemish variant of *zo* 'like (that)')

Regressive assimilation not only occurred in intervocalic position, but also when the /t/ was preceded by a sonorant consonant and followed by a vowel, as in the following examples:

(164) rapper dan da(t) ge, allez, dan da(t) ge **wil*t* eigenlijk** [wɪld ˈɛⁱɦələk] (EF)
'quicker than that, well, than you want in fact'

(165) **wan*t* anders** moest 'k ik vier uurkes [wɑnd ˈɑndərs]… (EF)
'because otherwise I had to (…) four hours'

The verb form *heeft* 'has', in which the final /t/ is preceded by a fricative, was also frequently subject to assimilation in prevocalic position, in which case both the fricative and the stop were realised as voiced:

(166) die **hee*ft* al**…drie jaar een vaste relatie [eːvd ɑl] (EF)
'she's had… a steady relationship for three years already'

(167) mijn mijn nicht **hee*ft* ook** een kindje gekregen van de week [eːvd oːk] (EF)
'my my niece also got a baby this week'

It seems that in the variety of Dutch spoken by the East- and West-Flemish informants the process of regressive assimilation before vowels has expanded in two ways: (1) RVA is frequent with prevocalic /t/ which is voiceless in the underlying form and which is part of a short high-frequency word or of a verb form (cf. also De Schutter & Taeldeman, 1986:98), and (2) word-final prevocalic /t/ can also become voiced when it is not followed by a clitic.

The observation that only /t/ and not /p/ or /k/ becomes voiced in the Dutch conversations of the informants is significant, as the coronal stop also behaves differently from the other stops in other environments in Dutch and in English (see Section 9.3., where it was shown that a deleted /t/, but not a deleted /p/, can trigger progressive devoicing in Dutch).

In British English, word-final voiceless /t/ (but not /k/ or /p/) can be realised as a brief tap, and in American English, it can even – as the result of an extremely brief closure – become identical with its voiced counterpart /d/ in intervocalic position. The analysis revealed that 242 out of 400 word-final /t/'s (60.5%) were voiced in word-final prevocalic position. The results for the East- and West-Flemish informants are very similar: 142 out of 230 tokens (62%) were realised with assimilation by the East-Flemish informants; 100 out of 170 (59%) were produced with assimilation by the West-Flemish informants.

Examples of frequent phrases in which /t/ underwent assimilation in intervocalic position are provided in (168)-(170):

(168) lo*t* of	[d]	(occurred 29 times)
(169) bu*t* I	[d]	(occurred 21 times)
(170) a*t* all	[d]	(occurred 7 times)

The word *that* was realised with assimilation in prevocalic position in 17 phrases, as in examples (171) to (173).

(171) tha*t* easy [d]
(172) tha*t* I'm [d]
(173) tha*t* even [d]

Figure 42 shows the production of flapping in the phrase *but I,* produced by an East-Flemish informant (no. 8).

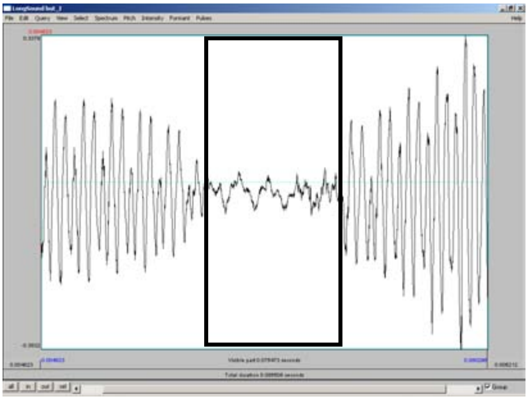


Figure 42. Coronal lenition in the phrase 'but I' (in the rectangle) surrounded by parts of the vowels (informant no. 8).

The frequent voicing of word-final, underlying voiceless /t/ in prevocalic condition might thus be the result of (1) transfer from Dutch, (2) imitation of the British English tap or (3) influence from American English Coronal Lenition. Most probably, all three factors contribute to the high frequency of assimilation of word-final /t/ in the DLE conversations.

It should be noted that the occurrence of prevocalic voicing of /t/ is part of a more general trend not to realise the coronal stops according to their underlying voice specification. The analyses of glottal replacements and prevocalic voice assimilation/coarticulation show that word-final /t/ is often not realised according to its underlying voice specification. Moreover, word-final /t/ was also often deleted. Deletion of a word-final /t/ which occurs in the middle of a three-consonant cluster is a general, regular rule in both Dutch (e.g. *een lift plaatsen* [f_p] 'installing an elevator') and English (e.g. *cleft palate* [f_p], Collins & Mees, 1999: 210). In the English conversations, 484 tokens were coded 'DEL' (< 'deletion'), meaning that the word-final underlying consonant could not be perceived. Of these 484 tokens, 206 involved deletion of a word-final /t/, which often occurred in the middle of a three-term consonant cluster. In such clusters, deletion of /t/ is common in English. Examples of /t/ deletion in the DLE conversations are provided in (174)-(175).

Examples:

(174) in Belgium they don'*t* ask it either, so [dəʊn æsk] (WF)
(175) nex*t* year we might [neks jɪə] (WF)

The voiced counterpart of /t/ – /d/ – was also frequently deleted: in 259 of the 484 tokens the segment that was deleted was word-final /d/. Nearly all of these (253) involved the word *and*. Next to a strong form [ænd], the word has various weak forms in English, i.e. [ənd], [ən], [nd], [n] (and [m] and [ŋ] as the result of place assimilation) (Wells, 2000; Jones, 2003). Since the Dutch equivalent of the word *and* is *en* [ɛn] and since *and* has various weak forms in English, the informants often deleted the final stop and pronounce the word as [æn], or [n̩], but also frequently as [ɛn], as in examples (172)-(173):

Examples:

(176) he just laid all the papers out..on a on some tables **an*d* said** 'well…' [ɛn sed] (WF)
(177) **an*d* also** because the story is that… [ɛn ˈɔːlsəʊ] (EF)

The voiceless stop /t/ differs from /k/ and /p/, which are more often realised according to their underlying voice specification. This is shown in Table 49.

/p/		/t/		/k/	
[p]	15/22 (68%)	[t]	544/1279 (43%)	[k]	178/231 (77%)
[ʔ]	0/22	[ʔ]	185/1279 (14%)	[ʔ]	1/231
[ø]	0	[ø]	206/1279 (16%)	[ø]	6/231 (3%)
[b]	6/22 (27%)	[d, ɾ]	344/1279 (27%)	[g]	46/231 (20%)

Table 49. Word-final /p,t,k/ in the DLE conversations.

Although the data in Table 49 are not differentiated for context, they show that /p/ and /k/ are realised according to their underlying specification in 68% and 77% of the tokens, respectively. Underlying /t/, on the other hand, was realised as [t] in only 43% of the tokens. Glottal replacement and deletion of /t/ also occurred in 14% and 16% of the tokens, but hardly occurred for /p/ and /k/. Finally, /t/ was realised as [d] or [ɾ] in 27% of the tokens, but /p/ and /k/ also became voiced in a number of tokens (though the number of tokens ending in /p/ or /k/ was much lower than the number of tokens ending in /t/). These data are in line with the general finding that /t/ and coronal consonants in general have a weak status and are easily deleted (or used as epenthetic segments) in the languages of the world.

Word-final voiced stops in prevocalic context

Word-final voiced stops preceding a word-initial vowel occur in a voiced environment. Hence, if they are realised as voiceless in DLE, this must be the result of a phonological process and not of phonetic devoicing. In the conversations, 304 word-final, prevocalic voiced stops were coded for the presence or absence of laryngeal neutralisation. If the stop was devoiced, the token was coded FIN (< 'final devoicing'). The results for each stop for the two languages are shown in Table 50:

FIN	Dutch	DLE
b	6/21	1/2
d	56/86 (65%)	44/190 (23%)
g	–	3/5
total	62/107 (58%)	48/197 (24%)

Table 50. Voiced stop + vowel in Dutch and DLE.

Table 50 shows that in the Dutch conversations only 21 word-final, prevocalic /b/'s were coded, six of which were devoiced. Far more tokens with word-final /d/ were coded: of the 86 tokens that were coded, 56 were devoiced (65%). Examples can be found in (178)-(179):

(178) **'k (h)e*b* eigenlijk** maar… [kɛp ˈɛⁱɦlək] (EF)
'in fact I had only…'

(179) bij Magda **(h)a*d* ik** no(g) maa(r) drie woorden gezegd… [ɑt ək] (EF)
'with Magda I'd only said three words…'

Whereas it is argued in the literature that voiced stops fail to undergo laryngeal neutralisation mainly in word-final host + clitic combinations (see Section 10.2.1.), only 14 of the 45 stops that were not devoiced were followed by a clitic. The phrases in (180)-(183) illustrate that the stop remained voiced before clitics as well as before non-clitics.

Host + clitic combinations:

(180) dit jaar **he*b* ik** eigenlijk wat tijd [ɛb ək] (WF)
'in fact, I have some time this year'

(181) **'k ha*d* het** al ooit gelezen [kɑd ət] (WF)
'I had read it once before'

Not followed by a clitic:

(182) 'k (h)e(b) 't nog **gevraag*d* aan** Maaike [xəˈvraɣd an] (WF)
'I have also asked Maaike'

(183) da(t) is toch nie(t) meer dan gewoon logisch **verstan*d* (h)e(bbe)n** [fərˈstɑnd ɛn] (‘hebben’: [ɛn]) (WF)
‘it’s nothing more than just logical thinking’

The analysis thus shows that most stops which are voiced in the underlying form undergo laryngeal neutralisation in word-final, prevocalic context, but that laryngeal neutralisation was also frequently absent (in 35% of the tokens), even when the stop was not followed by a vowel-initial clitic.

In the English conversations, only seven word-final prevocalic /b/’s and /g/’s were coded (see Table 50). This number is too low to draw any conclusions on the realisations of prevocalic labial and velar stops. Of the 190 word-final prevocalic alveolar stops that were coded, 44 (i.e. 23%) underwent laryngeal neutralisation. Laryngeal neutralisation was thus less frequent in prevocalic than in prepausal context (i.e. 23% vs. 41%, see 6.3.1.), which is not surprising, as a prevocalic context is more favourable to voicing than a prepausal one. Examples of word-final prevocalic laryngeal neutralisation are given in (184) to (186):

(184) well, a couple of months of ‘**splendi*d* isolation**’ [ˈsplendɪt aɪsəˈleɪʃn̩] (EF)
(185) have you ever **rea*d* a** book by Jef Geeraerts? [ret ə] (EF)
(186) he **ha*d* an** affair with uh Rachel Hunter or something [hæt ən] (EF)

The fact that even in prevocalic position 23% of the final voiced /d/’s underwent final laryngeal neutralisation means that the tendency to devoice word-final stops is very strong indeed. That almost one fifth of the word-final, prevocalic /d/’s was devoiced in the DLE conversations is especially striking in view of the fact that 35% of the Dutch /d/’s were *not* devoiced (see Table 50).

10.3.2. Prevocalic voice assimilation involving fricatives

Word-final voiceless fricatives in prevocalic context

Dutch word-final voiceless fricatives can become voiced when preceded by a sonorant and followed by a word-initial vowel. This is not the case in English (see Section 10.2.2.). The voicing of fricatives in Dutch was argued to be the result of a constraint which says that voiceless fricatives in the position following a sonorant and preceding a vowel are voiced. There are therefore two possible scenarios in DLE. One is that the informants transfer the constraint from Dutch into English. The result would be voicing of word-final voiceless prevocalic fricatives in DLE, which does not normally happen in L1 English. On the other hand, informants may also have learnt to suppress the constraint, in accordance with the L1 English norm.

In order to investigate which of the two scenarios took place, all tokens containing a word-final voiceless fricative followed by a vowel (535 in total) were coded. Table 51 displays the production of RVA in prevocalic voiceless fricatives following a sonorant consonant or a vowel in the Dutch and DLE conversations for the East- and West-Flemish informants.[5]

RVA	L1 Dutch	DLE
East-Flemish	167/183 (91%)	23/43 (53%)
West-Flemish	143/178 (80%)	11/39 (28%)
Total	310/361 (86%)	34/82 (41%)

Table 51. RVA in prevocalic fricatives in Dutch and DLE.

Table 51 shows that in the Dutch conversations the informants very frequently voiced word-final fricatives in prevocalic position, namely in 86% of the coded tokens. In the DLE conversations, RVA of this type was much less frequent; it occurred in 41% of the tokens. Nevertheless, as voiceless fricatives do not normally become voiced in prevocalic position in English, this means that the informants transferred this type of assimilation from Dutch into English. As can be seen in Table 51, the East-Flemish informants produced somewhat more assimilations than the West-Flemish informants, both in the Dutch and in the DLE conversations. Here are two examples in which the intervocalic voiceless fricative remained voiceless:

Dutch:

(187) da(t) **wa*s* in** diene hittegolf [wɑs ɪn] (EF)
'it was during that heat wave'

DLE:

(188) they're **ni*ce* and** friendly [naɪs ən] (EF)

Examples of intervocalic voicing assimilation are given in (189) to (192).

Dutch:

(189) **pa*s* op**, da's wel, allez, da's wel grappig ze, maa(r).. [pɑz ɔp] (EF)
'mind you, it's, well, it's kind of funny, but..'

(190) ja, **da'*s* ook** wel waar, maa(r) ja [dɑz oːk] (WF)
'yes, that's true too, but well'

DLE:

(191) it's much easier to **wa*sh* it** [wɒʒ ɪt] (EF)
(192) **i*f* everything** goes by plan [ɪv ˈevritɪŋ] (EF) (meaning: if everything goes as planned)

Voiceless fricatives were also realised as voiced when preceded by a sonorant consonant and followed by a vowel, as is illustrated in (193) to (194). In the Dutch conversations, 37 out of 44 coda fricatives preceded by a sonorant consonant and followed by a vowel became voiced. In the DLE conversations, only eight fricatives occurred in this position, three of which became voiced (example 195).

Dutch:

(193) de situatie ook **ander*s*, (h)e** [ˈɑndərz ɛ] (WF)
'the situation (is) also different, right'

(194) **som*s* ee(n)** kee(r)…dubieus [sɒmz ə] (WF)
'sometimes… dubious'

DLE:

(195) **sin*ce* I've** been skating [sɪnz aɪv] (EF)

It should be noted that – although the number of possible assimilation sites differs between the informants – all informants (except informant no. 15)[6] voiced fricatives between a sonorant and a vowel in at least 70% of the tokens in the Dutch conversations. In the DLE conversations the number of possible assimilation sites per informant is much smaller and the differences between the informants are somewhat greater. Informant no. 3, for instance, produced assimilation in 9 out of 11 tokens, while informant no. 9 did so in only 2 out of 9 tokens (though he assimilated 33 out of 37 tokens in the Dutch conversations).

The following section looks at the potential role of phonotactic patterns on the production of assimilation in prevocalic fricatives.

The role of phonotactics

One factor which could possibly have an influence on the production of prevocalic voice assimilation is the phonotactics of Dutch. In Dutch, the contrast between voiced and voiceless fricatives in word-medial position is determined by a phonotactic restriction which says that in word-medial position, voiceless fricatives are generally preceded by short vowels and voiced fricatives by long vowels (cf. e.g. Booij, 1995: 34-35; Kooij & Van Oostendorp, 2003; Van Oostendorp, 2007). The following words illustrate this pattern:

Long vowel + voiced fricative:	*Short vowel + voiceless fricative:*
– *oven* [ˈoːvən] 'oven'	– *offer* [ˈɒfər] 'sacrifice'
– *lezen* [ˈleːzən] 'to read'	– *lessen* [ˈlɛsən] 'lessons'
– *mager* [ˈmaːɣər] 'meagre'	– *lachen* [ˈlɑxən] 'to laugh'

There are relatively few exceptions to this general rule. Some words, in which a voiceless fricative is preceded by a long vowel, are *juichen* [ˈjœʸxən] 'to cheer', *tafel*

[ˈtaːfəl] 'table' and *wafel* [ˈwaːfəl] 'waffle'. Examples in which a voiced fricative is preceded by a short vowel are *puzzle* [ˈpʉzəl] 'puzzle'[7] and *muggen* [ˈmʉɣən] 'mosquitoes'. Jessen (1998: 176) termed this constraint, which also occurs in German, the 'Puzzle Constraint'. In English, the Puzzle Constraint does not hold: voiced fricatives are frequently preceded by short vowels (cf. Van Herreweghe, 1987: 102). Examples in which a voiced fricative in medial position is preceded by a short vowel are *gather* [ð], *mother* [ð], *liver* [v], *giving* [v], *wizard* [z], *drizzle* [z], *leisure* [ʒ], and *measure* [ʒ].

Van Oostendorp (2007) argues that the phonotactic pattern in Dutch can be explained in mora theory. Mora theory offers an alternative model of syllable structure: instead of dividing a syllable in onset, nucleus and coda, the syllable is divided in moras. A mora is a unit of weight: a light syllable (a CV syllable) consists of one mora, a heavy syllable (a CVC or CVV syllable) consists of two moras. Van Oostendorp argues that, if voiceless fricatives are taken to be phonologically long, the phonotactic pattern in Dutch can be accounted for. This means that a voiceless fricative is represented by one mora (in contrast with a voiced fricative, which does not have a mora). If it is assumed that (1) a stressed syllable consists of minimally and maximally two moras, (2) a short vowel occupies one mora and (3) a long vowel occupies two, then a long vowel followed by a voiceless fricative leads to a moraic structure which is too long (three moras) and a short vowel followed by a voiced fricative leads to a structure which is too short (one mora). Van Oostendorp (2007) illustrates the syllable structure in the words *knuffel* [ˈknʏfəl] 'hug' and *heuvel* [ˈhøvəl] 'hill'. This restriction applies not only word-medially, but also word-finally (though exceptions can be found). Whereas words containing long vowels followed by voiced fricatives (VVfric$_{vcd}$: e.g. *kaas* /kaːz/ 'cheese', *zeef* /zeːv/ 'sieve', *hoog* /hoːɣ/ 'high') or short vowels followed by voiceless fricatives (Vfric$_{vcl}$: e.g. *jas* /jɑs/ 'coat', *fles* /flɛs/ 'bottle', *kef* /kɛf/ 'yap – 1 p.sg.) are abundant, words containing a long vowel followed by a voiceless fricative or a short vowel followed by a voiced fricative in the coda are rare.

The phonotactic restriction on fricatives in Dutch was briefly discussed here, because it is one of the factors which could potentially have an influence on the occurrence of prevocalic voice assimilation in Dutch. A hypothesis could be that, as voiceless fricatives are usually preceded by short vowels and voiced fricatives by long ones in Dutch, voiceless fricatives in word-final position are more likely to undergo voice assimilation (and become voiced) when preceded by a long vowel than when preceded by a short one. In order to test this hypothesis, it was examined whether voicing of final fricatives in the Dutch conversations was more frequent when the fricative was preceded by a long vowel than when it was preceded by a short one. If this proves to be the case in the Dutch conversations, then the same pattern might also be found in the DLE conversations, as the participants might transfer the phonotactic restriction from Dutch into English, in which this restriction does not hold. Because long vowels are not normally followed by voiceless fricatives, the number of tokens containing a long vowel + a voiceless fricative in the coda is expected to be very low.

Table 52 summarises the results of voicing of underlying voiceless fricatives in prevocalic position in function of the length of the preceding vowel:

RVA	Dutch	DLE
Long V + voiceless fric.	6/8 (75%)	9/20 (45%)
Short V + voiceless fric.	267/300 (89%)	22/54 (41%)

Table 52. Voicing of intervocalic fricatives in function of the length of the preceding segment.

Table 52 shows that long vowels followed by voiceless fricatives in the coda rarely occurred in the Dutch or in the DLE conversations. Examples of tokens containing a long vowel followed by a voiceless fricative which underwent assimilation in the Dutch conversations are *thuis* 'at home', *graag* 'please; with pleasure' and *foto's* 'photos'. Examples of this type in the DLE conversations are *nice, proof* and *glass.* In the Dutch conversations, 6 out of these 8 voiceless fricatives became voiced; in the English conversations this was the case for 9 out of 20 clusters. Two examples are provided in (196)-(197).

Dutch:

(196) da's thui*s* ook al, dus… [tœʸz oːk] (EF)
'that's the same at home, so...'

DLE:

(197) it's rather gro*ss* actually [grəʊz ˈækʃəli][8] (EF)

Examples of prevocalic voicing of fricatives following a short vowel were already given in (189) to (192). The DLE conversations, but especially the Dutch conversations contained many more tokens in which a voiceless fricative in the coda was preceded by a short vowel than tokens in which a fricative was preceded by a long vowel. In the Dutch conversations, 267 out of 300 fricatives (i.e. 89%) preceded by a short vowel and followed by a vowel underwent assimilation. In the DLE conversations 22 out of 54 fricatives (i.e. 41%) became voiced in this context. Because the number of tokens containing a short vowel followed by a coda fricative was so much higher than the number of tokens in which a long vowel preceded the fricative, it is hard to compare the numbers of intervocalic voice assimilations produced in the two types of structures. It can, however, be seen in Table 52 that in the Dutch conversations the number of assimilations involving fricatives following a short vowel was very high (i.e. assimilation occurred in 89% of the cases). If word-final voiceless fricatives were represented by a mora, then RVA would have to be explained as a process involving the loss of a mora. Such an explanation is not desirable.

The conclusion is that the phonotactic constraint which says that short vowels should be followed by voiceless rather than voiced fricatives only applies within the lexicon and not at the postlexical level (i.e. across word-boundaries) in Dutch. Since the phonotactic restriction proved not to have an influence on the occurrence of voice assimilation in the Dutch conversations, the phonotactic rule could not be transferred into English and no effect of preceding vowel length on the occurrence of prevocalic voice assimilation in the DLE conversations could be found either.

Word-final voiced fricatives in prevocalic context

In all the conversations together, 504 tokens were coded in which a word-final voiced fricative was followed by a word-initial vowel. In (Standard) Dutch, final voiced fricatives become voiceless when followed by a pause, a sonorant consonant or a voiceless obstruent, but can remain voiced when preceded by a sonorant and followed by a vowel. In L1 English, word-final voiced fricatives remain voiced in prevocalic context. Given these facts, word-final voiced fricatives in prevocalic context are expected to be voiced in DLE, either as the result of transfer of the constraint ‘ fricatives following sonorants and preceding vowels should be voiced’ from Dutch into English, or because the informants have acquired the voice realisation of coda voiced fricatives in L1 English.

Table 53 presents the occurrence of final laryngeal neutralisations (coded ‘FIN’) of prevocalic fricatives in the Dutch and DLE conversations.

FIN	L1 Dutch	DLE
East-Flemish	2/59 (4%)	50/226 (25%)
West-Flemish	3/28 (11%)	30/191 (16%)
total	5/87 (6%)	80/417 (21%)

Table 53. Final laryngeal neutralisation in prevocalic voiced fricatives.

In the Dutch conversations, the overall majority of final fricatives preceding a vowel remained voiced, as in examples (198)-(199).

Word-final prevocalic fricative remains voiced:

(198) 11.11.11. (**el*f* el*f* elf**) die zijn gewoon van de jaar nie(t) bij ons geweest (EF) [ɛlv ɛlv ɛlv] (*elf* ~ plural: *elven* [v])
‘11.11.11 [name of a humanitarian organisation] just hasn’t come to our house this year’

(199) en da(t) was (ge)lijk maar een **(h)al*f* uur** in de vlieger of zo (WF) [ɑlv yːr] (*half* ~ adj. *halve* [v])
‘and it was like only half an hour on the plane or something’

The fricative was devoiced in only 5 out of 87 tokens in the Dutch conversations. In these cases there was usually a strong prosodic boundary following the fricative, as in examples (200)-(201):

Word-final prevocalic fricative is devoiced:

(200) maar ik pei(n)***s*** **a**(l)s ik n.n.nu niet meer naar Nederlands ga… [pɛis ˀɑs] (EF) (*peins* ~ inf. *peinzen* [z])
'but I think if I don't go to the Dutch classes anymore…'

(201) 'graag traa***g***, **a**lsjeblieft' [traːx ˈˀɑʃəbliːft] (EF) (*traag* ~ adj. *trage* [ɣ])
'slow down, please'

It should be noted that in both (200) and (201) the vowel was preceded by a glottal stop. As the vocal folds need to be pressed tightly together for the production of a glottal stop, the glottal stop blocks the voicing of the preceding coda fricative.

In the DLE conversations, the majority of fricatives remained voiced. However, Table 53 shows that, contrary to what was expected, about one fifth of the fricatives (21%) were devoiced. The devoicing in 21% of the tokens in DLE indicates that final devoicing is a very strong force in the English interlanguage of the informants. There are three explanations. Firstly, final laryngeal neutralisation is overruled by a constraint against intersonorant voiceless fricatives in L1 Dutch, but emerges (though to a lesser extent) in DLE. Secondly, the informants have been explicitly trained not to devoice final obstruents in English, but nevertheless do it in about one fifth of the final prevocalic fricatives. Thirdly, it is – from a phonetic point of view – easier to maintain voicing in intersonorant position than to switch off vocal fold vibration after the sonorant or vowel and switch it on again after the fricative. By devoicing word-final fricatives in a voiced environment, the speakers thus do not produce the phonetically 'easiest' articulation, suggesting that final laryngeal neutralisation is indeed a strong force.

In examples (202) and (203) the final prevocalic fricative was realised as voiced; in examples (204) and (205) the fricative was voiceless:

Word-final prevocalic fricative remains voiced:

(202) yeah, when I was little **I wa*s* afraid** of him [wɒz əfrɛid]
(203) **fi*ve* or** six o'clock [faɪv ɔː]

Word-final prevocalic fricative is devoiced:

(204) I **wa*s* able** to to.to answer them… [wɒs eɪbl̩] (EF)
(205) so I was getting. more nervous **becau*se* of** her [biˈkɒs ɒf] (EF)

Closer inspection of the tokens containing a prevocalic fricative which was devoiced revealed, however, that in as many as 30 of the 86 tokens in which the fricative was devoiced, it was followed by the hesitation marker *uh* or *uhm*. These markers were treated as normal words, in the sense that a final obstruent followed by *uh(m)* was coded and the phrase was fed into the database. This was done because a hesitation marker can function as any vowel-initial word with respect to assimilation, in that, for instance, a final voiceless fricative can become voiced when following a sonorant and preceding *uhm*. Examples are the phrases *dus uh* 'so uh' and *was uh* 'was uh', which were realised with a voiced [z] in the Dutch conversations (while they would never be voiced when followed by, for instance, a pause or a voiceless obstruent). That 30 out of 86 tokens in which the final fricative was devoiced were followed by the hesitation marker *uh(m)* does, however, indicate that the marker in some cases breaks up the normal assimilation pattern (cf. examples (206) and (207)). Moreover, devoicing of the fricative also often occurred when the fricative-final word was stressed, so that there was a strong prosodic boundary between the word containing the fricative and the following word, as in examples (208) and (209).

Devoicing of final voiced fricative preceding the hesitation marker uh(m):

(206) he'***s*** uhm… [hiːs]
(207) people who study German in second candidature ha***v***e uhm..[hæf]

Devoicing of voiced fricative occurring in the coda of a stressed word:

(208) shè'**s à**ctually [ʃiːs]
(209) they hà***v*****e a** fȏnd hàtred of them [hæf] (EF)

Another factor which could have an influence on the frequency with which word-final, prevocalic fricatives are devoiced is which segment precedes the fricative. Table 54 presents the number of tokens in which a word-final voiced fricative was devoiced in relation to the segment preceding the fricative.

FIN	L1 Dutch	DLE
obstruent + voiced fric. + [vowel	–	4/17 (24%)
sonorant C. + voiced fric. + [vowel	0/32	7/59 (12%)
long V + voiced fric. + [vowel	3/27 (11%)	12/85 (14%)
short V + voiced fric. + [vowel	2/28 (7%)	63/256 (25%)
total	5/87	86/417

Table 54. Final laryngeal neutralisation of coda fricatives in function of the preceding segment.

In Dutch, obstruent + voiced fricative clusters do not occur in the coda[9]. In English, only /z/ can be preceded by an obstruent. When devoicing occurred in this type of cluster in the DLE conversations, both the obstruent and the fricative were devoiced.

This is the result of a constraint which says that obstruents in a cluster should agree in voicing. In the DLE conversations, devoicing occurred in 4 out of 17 tokens containing an obstruent + fricative cluster in the coda. Examples are *slides or* [slaɪts ɔː] and *dogs are* [dɒks ɑː].

In Dutch, none of the 32 coda fricatives following a sonorant consonant were devoiced. Examples are *(h)alf uur* (*half ~ halve*) 'half an hour' [ɑlv yːr] and *twaalf op* (*twaalf ~ twaalven*) 'twelve on' [twaːlv ɔp]. In the English conversations, only 7 out of 59 fricatives were devoiced when preceded by a sonorant. Examples of tokens in which devoicing occurred are *strange and* [streɪnʃ ænd] and *sometimes on* [ˈsʌmtaɪms ɒn].

Table 54 also shows that there was no important effect of preceding vowel length on the occurrence of devoicing. The examination of the possible effect of the phonotactic constraint in Dutch on the occurrence of prevocalic voicing assimilation in word-final fricatives (i.e. voiced fricatives are not normally preceded by short vowels and voiceless fricatives are not preceded by long vowels) showed that the participants very frequently (i.e. in 84% of the tokens) voiced word-final voiceless fricatives following a short vowel. This led to the conclusion that the phonotactic constraint applies at the lexical but not at the postlexical level (see discussion above). This finding is confirmed by the present analysis, as voiced fricatives in the Dutch conversations were not devoiced more frequently when following a short vowel than when following a long one, something which would be expected if the constraint held at the postlexical as well as at the lexical level.

10.4. Regressive voice assimilation before voiced stops, sonorant consonants and vowels: A comparison

This section compares the realisation of three assimilation processes in the Dutch and DLE conversations: regressive assimilation before voiced stops (Chapter 7), before sonorant consonants (Chapter 8) and before vowels (this chapter). Whereas both stops and fricatives can become voiced before voiced stops in Dutch (both in East- and West-Flemish), only fricatives can become voiced before vowels in East-Flemish (except /t/, which can sometimes become voiced in prevocalic context, see Section 10.2.1.) and before vowels or sonorant consonants in West-Flemish. The graphs below present RVA before voiced stops (Figure 43), before sonorant consonants (Figure 44) and before vowels (Figure 45). To facilitate comparison, they represent assimilations in which only fricatives (and not stops) are targeted and in which the fricative is preceded by a sonorant consonant or a vowel. The light bars represent the assimilations produced by East-Flemish informants; the dark bars those produced by West-Flemish informants.

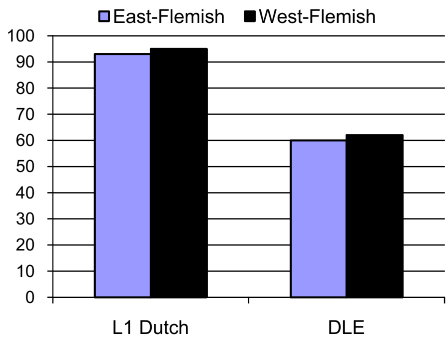


Figure 43. Vowel/son. C. + vcl. fric. + vcd. stop (e.g. /Vf/_b/ → [Vv_b]).

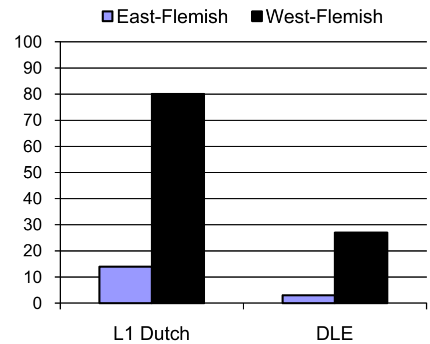


Figure 44. Vowel/son. C. + vcl. fric. + son. C. (e.g. /Vf/_n/ → [Vv_n]).

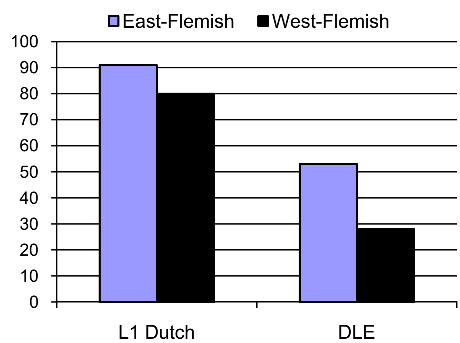


Figure 45. Vowel/son. C. + vcl. fric. vowel (e.g. /Vf/_V/ → [Vv_V]).

A comparison between the production of voice assimilation before voiced stops (Figure 43) and the production of voice assimilation before sonorant consonants (Figure 44) reveals that the former process was transferred into English much more frequently than the latter. RVA before voiced stops was frequently produced in the Dutch conversations by East- and West-Flemish informants. In total, 94% of the tokens produced by East- and West-Flemish informants together underwent assimilation. By contrast, RVA before sonorant consonants was frequently produced by the West-Flemish informants, but not by the East-Flemish ones. The bars in Figures 43 and 44 representing the realisations in the DLE conversations also show that the West-Flemish informants transferred RVA before sonorant consonants to a much lesser extent than assimilation before voiced stops. Whereas the West-Flemish informants produced RVA before voiced stops in 62% of the tokens in the DLE conversations, they realised only 14% of the fricative + sonorant consonant clusters with assimilation. The finding that RVA before voiced stops was transferred to a much greater extent than RVA before sonorant consonants indicates that the former type of assimilation is somehow a stronger one than the latter type. This hypothesis seems to find confirmation in the typological fact that languages which have RVA before sonorants necessarily also have RVA before stops, but not vice-versa. Mascaró notes that

> "it appears that languages present the obstruent-sonorant asymmetry in one direction: there is assimilation of obstruent to obstruent (Russian, (Warsaw) Polish, Dutch) and assimilation from obstruent to obstruent and to sonorant (Catalan, Spanish, (Cracow-Posnán) Polish), but not just obstruent to sonorant alone, or obstruent to vowel alone" (Mascaró, 1995: 297).

This means that, if the (West-Flemish) informants had transferred RVA before sonorant consonants into English, but had not (or to a much lesser extent) transferred RVA before voiced stops, the implicational universal which says that if a language has RVA before sonorants, it also has RVA before obstruents, would have been violated in DLE. This proved not to be the case, which suggests that interlanguages obey the same implicational universal principles as L1 languages. This issue is taken up in Chapter 11[10].

10.5. Summary

This chapter critically compared a number of approaches to the occurrence of prevocalic voicing assimilation languages like Dutch. In approaches which assume underspecification of voice in vowels, prevocalic voicing can only be explained as the result of a phonetic spill-over effect or as the result of a high-ranked constraint which says that obstruents need to be voiced in the context following a sonorant and preceding a vowel. The contexts in which prevocalic voicing occurs in Dutch and English were examined, and an analysis of the production of this type of assimilation in L1 Dutch and DLE conversational speech was presented. The data revealed that prevocalic voicing of word-final /t/ was common both in Dutch and in DLE, presumably as the result of influence from American English coronal lenition. Word-final, prevocalic voiced stops were devoiced only in about one fourth of the tokens, suggesting again that learners had to some extent learnt to suppress prevocalic voicing assimilation in DLE. The results of the fricative analyses confirm this: while the vast majority of word-final, prevocalic voiceless fricatives were realised as voiced in Dutch, only half as many English voiceless fricatives underwent voice assimilation. A comparison of the transferability of regressive voice assimilation preceding different types of segments (voiced stops, sonorant consonants, and vowels) for the East- and West-Flemish learners of English showed that all three types of assimilations were frequently transferred into English by both groups of learners. Assimilation before sonorant consonants was produced frequently by the West-Flemish informants in Dutch only. It was not transferred to the same extent into their DLE. The complete picture of the learners' relative success at suppressing the various Dutch voice assimilation patterns when speaking English is provided in Chapter 11.

Notes

1. In almost all Flemish dialects, however, voicing of the final stop is possible if it is voiced in the underlying form (e.g. *hond is* [hɒnd ɪs]).

2. It should be noted that it remains difficult to determine whether a phonological rule is responsible for the observed assimilation pattern, or whether the pattern needs to be attributed to phonetic spill-over effects (see the discussion in Section 2.5.1). Jansen (2004:102) argues that phonological assimilations, triggered by phonological rules rather than by low-level phonetic processes, are 'discrete' (i.e. there is only a finite number of categories in-between the assimilated and the non-assimilated form) and lead to complete neutralisation. However, this definition is hard to empirically test against a particular assimilation pattern, since it is problematic to determine whether the number of possible realizations between an unassimilated and an assimilated form is finite or not. Moreover, if we apply the complete neutralisation criterion to final laryngeal neutralization in Dutch, we should conclude – on the basis of recent work by e.g. Warner et al. (2004) and Ernestus & Baayen (2006), who showed that neutralization is incomplete in Dutch – that it is a phonetic rather than a phonological process. However, it is generally accepted that 'final devoicing' is part of the phonological system of Dutch (see Chapter 6).

3. The problem of underspecified segments which function as triggers in voicing assimilation processes is discussed in detail in Section 8.3. on obstruent + sonorant sequences.

4. Both taps and flaps are characterised by a very brief closure: the tongue very briefly touches the alveolar ridge. The difference between a tap and a flap is that "[t]he flap is pronounced by flinging the tongue tip forward from a retracted position, while in the tap, the tongue is raised quickly against the alveolar ridge from a position below it and then allowed to drop back down again just as quickly" (Kingston, 2004: 212).

5. In 7 Dutch and 85 English tokens, the fricative was /s/ preceded by an obstruent. Examples in Dutch are *niks aan* 'nothing on' [nɪks aːn] and *iets anders* 'something else' [iːts ˈɑndərs]. Examples in English are *weeks ago* [wiːks əˈgəʊ] and *lots of* [lɒts əv]. Because no assimilation occurred in any of the tokens in which a final fricative was preceded by an obstruent, these tokens are not dealt with in the discussion.

6. The reason why informant no. 15 produced fewer assimilations in the Dutch conversations than the other informants might be that he is a dialect speaker (cf. Appendix A, question no. 6), who is trying to speak Standard Dutch during the conversations. The variety of Dutch he is speaking may thus not be his most natural variety and this might lead to the production of fewer assimilations. However, since this participant was, like all other participants, told that he could speak the variety of Dutch he felt most comfortable speaking, he presumably felt most comfortable speaking a variety of Dutch close to Standard Dutch in the university setting in which the recordings were made.

7. Booij (1995a: 35) notes that this explains why many native speakers of Dutch pronounce the word *puzzle* as [ˈpyzəl], i.e. with a long vowel preceding the voiced fricative.

8. It should be noted that it is possible – especially with less well-known words – that the learner's lexical representation of a word deviates from the L1 representation. In this case, for instance, the informant's representation of *gross* might be */grəʊz/ instead of /grəʊs/.

9. Obstruent + /s/ clusters in the coda are possible, but rare. Examples are *laks* /lɑks/ ('lax') and *ex* /ɛks/.

10. Simon (2010a) compares the transferability of intra-word processes, such as final laryngeal neutralisation, with cross-word voicing assimilations.

Chapter 11

Acquiring laryngeal representations or realisations and suppressing laryngeal processes

11.1. Introduction

This chapter brings together the results of the empirical analyses (Chapters 4-10) to arrive at a characterisation of DLE. By abstracting away from details it sheds light on the general trends in the English interlanguage of the Dutch-speaking informants.

The analysis has dealt with the following linguistic varieties: L1 Dutch (with a distinction between East- and West-Flemish where relevant), L1 English and DLE. In order to find explanations for any characteristics that would be attested in DLE it was necessary to know the characteristics of all possible influencing varieties. The following questions now need to be answered:

(1) What are the laryngeal representations in DLE?
(2) Are the differences between L1 Dutch, L1 English and DLE (mainly) due to different laryngeal representations in these language varieties or are the laryngeal systems/processes responsible for the observed differences?
(3) What does the (laryngeal) system of DLE look like, i.e. which phonological voice assimilation processes occur in DLE and how can they be explained?
(4) To what extent do East- and West-Flemish Dutch differ from each other and are these differences due to different laryngeal representations or to different systems?
(5) Do the East- and West-Flemish informants have different laryngeal representations in DLE or do they have different DLE systems?

The chapter is divided into three main sections. Section 11.2 discusses to what extent East- and West-Flemish learners of English differ in their production of voice and voice assimilation processes in Dutch and DLE. Section 11.3 deals with the laryngeal representations of voiced and voiceless obstruents. It aims to answer the question which laryngeal representations are used in L1 Dutch, L1 English and DLE. This section also examines whether native speakers of Dutch learning English need to acquire new laryngeal representations or just new phonetic realisations of known features. Finally, Section 11.4 aims to answer the question to what extent native speakers of Dutch learning English succeed in suppressing the many voice assimilation processes which occur in L1 Dutch, but not in English. This section is couched in terms of Optimality Theory for two main reasons. First, various rule-based explanations for voice assimilation before sonorant consonants have been proposed in the literature, but all proved to be problematic in some way (see Chapter 8). The main arguments are summarized and further discussed in section 11.3. Secondly, Optimality can explain typological universals better than rule-based approaches can, as is shown in section 11.4.

11.2. Contrasting East- and West-Flemish

The analyses in Chapter 4 have shown that the realisations of onset obstruents in Dutch by the East- and West-Flemish informants were very similar with respect to the realisation of word-initial voiceless stops. The measurements revealed that the average VOTs after voiceless stops followed by a vowel in the Dutch words in isolation were almost the same for both groups: 20.3 ms for the East-Flemish and 21.5 ms for the West-Flemish informants.

As far as voiced stops are concerned, the West-Flemish informants together produced slightly more tokens without prevoicing than the East-Flemish informants. However, this difference was due to one West-Flemish informant and is thus unlikely to reflect a more general trend.

The average duration of onset voiceless fricatives was virtually the same for both groups as well: 179 ms for the East-Flemish and 180 ms for the West-Flemish informants.

Finally, the majority of initial voiced fricatives were produced with partial devoicing by both East- and West-Flemish informants.

Even though the number of participants on which the analysis is based was small, the fact that onset stops and fricatives were realised in a very similar way by East- and West-Flemish informants indicates that there is no reason to assume that East- and West-Flemish Dutch have different laryngeal representations or that obstruents are phonetically realised in a different way.

A comparison between the voice assimilations produced by the East- and West-Flemish informants in the Dutch conversations revealed that the productions of both groups were again very similar. The only notable exception was the realisation of coda fricative + onset sonorant consonant clusters, in which the fricative was usually voiced in the West-Flemish informants' utterances, but voiceless in the East-Flemish informants' utterances.

Figure 46 displays the production of four major types of assimilations produced by the East-Flemish (light bars) and West-Flemish (dark bars) informants in the Dutch conversations: (1) RVA in voiceless obstruent + voiced stop clusters, (2) PVA in voiceless obstruent + voiced fricative clusters, (3) voicing of coda (voiceless) fricatives in prevocalic position following a sonorant ('fric. + V') and (4) voicing of coda (voiceless) fricatives following a sonorant and preceding an onset sonorant consonant ('fric. + son. C').

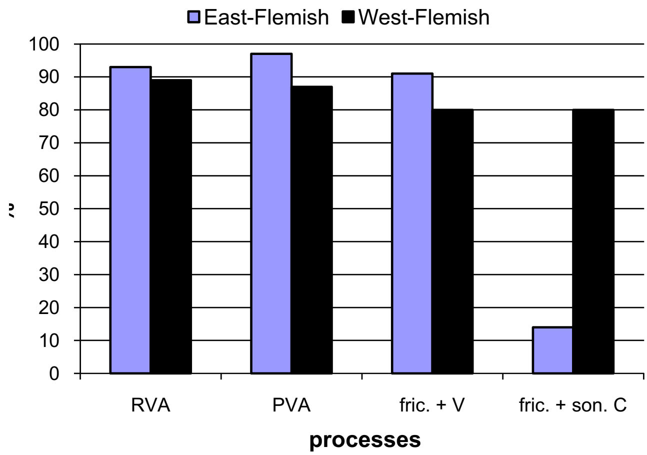


Figure 46. Voice assimilations produced by East- and West-Flemish informants in the Dutch conversations.

The graph in Figure 46 shows that the realisations of the East- and West-Flemish informants were very similar for the first three processes. For the last process, however, there was a striking difference. Voicing of coda fricatives before onset sonorant consonants was produced in only 14% of the tokens by the East-Flemish informants but in 80% of the tokens by the West-Flemish informants. Since the productions of East- and West-Flemish informants only differ from each other in the realisation of coda fricative + onset sonorant consonant clusters, an explanation must be sought in the laryngeal systems or processes of the East- and West-Flemish informants and not in the laryngeal representations in these two regional varieties. The differences in the laryngeal systems of East- and West-Flemish and the extent to which the informants transferred the assimilation processes from their varieties of Dutch into English were described in Chapter 8. Since the analysis of word-initial obstruents pointed in the direction of East- and West-Flemish speakers having the same laryngeal representations, the following account of laryngeal representations is based on data from the East- and West-Flemish participants together.

11.3. Acquiring laryngeal representations

Sections 11.3.1 and 11.3.2 discuss the laryngeal representations of stops and fricatives in L1 Dutch, L1 English and DLE.

11.3.1. Stops

The analysis of the voiceless stops in DLE focused on the production of aspiration and sonorant consonant devoicing. The VOT measurements of single onset voiceless stops and voiceless stops followed by a sonorant consonant indicates that the participants had learnt to produce longer VOTs after English /p, t, k/, and therefore did not transfer their voiceless stops from Dutch into English.

The analyses of word-initial voiceless stops in the database of DLE also showed that there was a difference in performance between the spontaneous conversations and the word reading task: VOTs were considerably higher in the reading task than in the conversations, both when the voiceless stops were followed by a vowel and when they occurred before a sonorant consonant. The discrepancy between the spontaneous conversations and the reading task indicates that the informants have indeed acquired the laryngeal realisation of voiceless stops in English when focussing on pronunciation, but may not reach the target realisation when minimal attention is paid to pronunciation.

The analysis of the voiced stops in the DLE conversations and the reading tasks led to two main findings. First, word-initial voiced stops in the English word lists read by the informants were very frequently prevoiced. Although there was variation in the realisation of voiced stops in English, the finding that the informants produced prevoicing so consistently indicates that they transferred the laryngeal realisation of voiced stops from Dutch into English.

Secondly, the analysis showed that, although RVA does not normally occur in English, the informants produced it in 59% of all voiceless obstruent + voiced stop clusters in the English spontaneous conversations.

What do these results tell us about the laryngeal specifications of stops in DLE? Under the Multiple Feature Hypothesis (see Section 2.4.2.), voiced stops in Dutch are marked for [voice], but are laryngeally unmarked in English. Voiceless stops, on the other hand, are laryngeally unmarked in Dutch, but are marked for [spread glottis] in English. Under this hypothesis, Dutch-speaking learners of English need to learn not to specify voiced stops for [voice], but to specify voiceless stops for [spread glottis]. In other words, they need to 'unlearn' or 'suppress' a specification as well as to acquire a new specification.

As far as the voiced stops are concerned, the analysis of the DLE database strongly suggests that voiced stops in DLE are marked for [voice], i.e. that learners transferred the voice specification from their Dutch stops into English. The production of prevoicing in the overwhelming majority of tokens in the DLE reading task as well as the production of RVA in which voiced stops act as triggers provides evidence for this. Since RVA in Dutch is a phonological process through which the [voice] feature of onset voiced stops spreads to preceding obstruents, the [voice] specification of voiced stops in DLE seems a necessary condition for the production of RVA in DLE.

Deriving information about the laryngeal specification of voiceless stops in DLE is more problematic, as there are no phonological processes in Dutch or English in which voiceless stops act as triggers and from which the laryngeal specification of voiceless stops in DLE could be deduced. However, the production of aspiration and sonorant consonant devoicing seems to indicate that the learners have acquired the [spread glottis] specification of voiceless stops in English.

If one assumes the Multiple Feature Hypothesis, the laryngeal specifications of stops in L1 Dutch, L1 English and DLE would be as in Table 55.

	vcl. stops	**vcd. stops**
Dutch	ø	[voice]
English	[spr. glottis]	ø
DLE	[spr. glottis]	[voice]

Table 55. Laryngeal representations in Dutch, English and DLE.

The laryngeal system of stops in DLE would thus be a mixed system, in which voiceless stops are marked for [spread glottis], as in English, but in which voiced stops are marked for [voice] as in Dutch. There are various factors which could explain why English voiceless stops are acquired by the informants before voiced stops.

A first factor could be that, whereas the acquisition of voiceless stops in English requires the informants to learn a new specification, they have to 'unlearn' a specification for the acquisition of voiced stops. Although voiceless stops are marked and voiced stops unmarked in English, it is more difficult to 'unlearn' a specification than to learn a new specification, i.e. one that is not present in the first language. The reason for this is that, whereas there is evidence for the [spread glottis]-specification of voiceless stops in the form of aspiration, the unmarked nature of voiced stops in English can only be deduced from the absence of prevoicing (at least in the stops of most L1 English speakers) and from the absence of voice assimilations in which voiced stops function as triggers. Fikkert's 1994 study of L1 acquisition showed that properties which children need to acquire only on the basis of "the systematic lack of certain data" (Fikkert, 1994: 304) are acquired later than properties which can be acquired on the basis of the presence of certain structures in the language. The results of the present study show that the same order is found in L2 acquisition.

A second explanatory factor may be the greater acoustic salience of aspiration in contrast with prevoicing. Perception studies have shown that native speakers of English find it easier to discriminate unaspirated, voiceless stops from aspirated voiceless ones in a foreign language than to perceive the contrast between voiced and voiceless stops (cf. e.g. Pisoni et al., 1982; Pater, 2003). However, it is not the case that a prevoiced stop cannot be distinguished from a voiced one on the basis of perception. Van Alphen (2004) has shown that, when native speakers of Dutch were asked to identify (Dutch) tokens as voiced or voiceless, they frequently misjudged voiced tokens lacking prevoicing as being voiceless ones.

This brings us to the third factor. Van Alphen's (2004) study on the perception of prevoicing led to the conclusion that prevoicing is an important cue for the perception of voiced stops in Dutch. This could also explain why native speakers of Dutch do not easily lose prevoicing when speaking English. Whereas native speakers of Dutch can distinguish voiced stops from voiceless ones by the presence of prevoicing in the former ones, for native speakers of English the most important cue is the occurrence of aspiration in voiceless stops and the lack of aspiration in voiced ones. Although the informants have acquired the [spread glottis]-specification of voiceless stops in English, they do not always actually produce aspiration in word-initial voiceless stops. If the informants then completely omit prevoicing, they run the risk of losing the VOT contrast between voiced and voiceless stops altogether. Figure 47 schematically illustrates the VOT values in Dutch, English and DLE. The triangles symbolise voiced stops; the rectangles stand for voiceless stops.

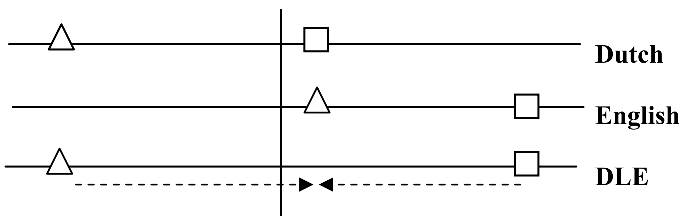


Figure 47. Schematic representation of VOT values in Dutch, English and DLE.

The dotted arrows illustrate what would happen if informants who fail to produce aspirations, omit prevoicings: the two categories overlap. Since VOT is one of the most important acoustic cues to the contrast, the distinction between voiced and voiceless stops would then become hard to perceive. Whether such an overlap would necessarily be problematic for communication is another question. In Van Alphen's (2004) data on the production of prevoicing in Dutch spoken by native speakers of Dutch from the Netherlands, 25% of all word-initial voiced stops lacked prevoicing. Since voiceless stops are unaspirated in Dutch, there was – for these speakers –no VOT contrast between voiced and voiceless stops. However, closure duration and burst intensity of voiced and voiceless stops would still differ and function as cues for the listener.

Finally, the role of explicit teaching is probably not unimportant either. In the pronunciation classes the informants took in the year preceding the recordings, ample attention was paid to the production of aspiration. Prevoicing had not been dealt with in these classes, probably because producing prevoicing in English voiced stops does not strike an English ear as being particularly foreign, because it is not very salient acoustically and because a minority of native speakers of English also produce prevoicing. However, Simon & Leuschner (to appear) investigated the role of explicit instruction by examining the production of voiced and voiceless stops in English by native Dutch speakers with and without formal English pronunciation training. The results revealed that, while participants with training produced significantly longer VOTs than participants without training, the latter produced voiceless stops with

VOTs well within the target long-lag VOT range. This suggests that long-lag, aspirated stops are relatively easy to acquire.

Under the Multiple Feature Hypothesis, the laryngeal system of stops in DLE is thus argued to be a mixed system, combining representations from both Dutch and English. The system is interesting in the light of Dispersion Theory, which states that phonological contrasts are subject to a number of functional goals, summarised by Flemming (1997) as follows:

"(i) Maximize the number of contrasts
(ii) Maximize the distinctiveness of contrasts
(iii) Minimize articulatory effort" (Flemming, 1997: 3).

Since both Dutch and English have a two-way laryngeal contrast between voiced and voiceless stops, it is the second and the third goals which are of importance here. The [voice]- [spread glottis] laryngeal system that occurs in DLE fulfils the second goal, in that there is a significant difference between the VOT values for voiced and voiceless stops. However, the production of prevoicing requires extra articulatory effort (see Section 1.5.2.) and the third goal is thus not really achieved. Although the three goals listed above will of course always be in conflict (as Flemming also remarks), it may be that a system which contrasts prevoiced with aspirated stops attaches too much importance to the second goal and not enough to the third goal and is thus not an 'optimal' laryngeal system. How frequent L1 languages (as opposed to L2 languages or interlanguages) contrast voiced with voiceless aspirated stops is unclear. In the UPSID database[1], only 7 out of 451 languages contrast voiced with voiceless aspirated stops. Keating, Linker & Huffman (1983), however, compiled a database with phonetic details for 51 languages, 13 of which showed this contrast (Kingston, in preparation). Since the smaller sample in Keating et al.'s (1983) study contains more phonetic detail and is thus likely to be more accurate, languages contrasting voiced with voiceless aspirated stops might thus not be as exceptional as the UPSID database suggests. However, as Kingston (in preparation) notes, Keating et al.'s (1983) sample does not represent the language families in equal ways, as 17 of the 51 languages are Indo-European, which might have an influence on the numbers.

The laryngeal system in DLE – which makes a contrast between stops marked for [voice] and stops marked for [spread glottis] – may thus be a marked system, which might be unstable. It is also possible that other factors, such as the perceptual distance between contrasting categories, are more important in interlanguages than in first languages and that a system which contrasts stops marked for [voice] and stops marked for [spread glottis] is not unstable from an interlanguage perspective.

11.3.2. Fricatives

The analysis of word-initial voiced and voiceless fricatives in Dutch and English revealed that, while Dutch fricatives tend to be longer than their English counterparts, there were no obvious differences in their laryngeal realisations. The analysis of fricatives in the word reading task showed that there was variation in the way native speakers of English and Dutch realised onset voiced fricatives in their L1's, which were either realised as fully voiced, fully voiceless or partly devoiced. As a result, native speakers of Dutch learning English are not faced with a learning task and transferring their fricatives from Dutch into English would not seem problematic, though it was noted that fricatives in (some varieties of) Dutch may be more energetic than English fricatives and learners would thus need to aim for these less energetic phonetic realisations. The analysis of the fricatives in the DLE reading task showed that the participants did not produce longer fricatives when speaking English, and that, just as in L1 Dutch and L1 English, there was variation in the extent to which initial voiced fricatives were realised with vocal fold vibration.

In terms of laryngeal representations, the picture is complex as far as fricatives are concerned. The following sections discuss the representations in L1 Dutch, L1 English and DLE.

L1 Dutch

Since fricatives do not trigger voice assimilation processes in Dutch, there is little evidence on their laryngeal representations. If the representations of fricatives in Dutch mirrored those of stops, voiceless fricatives would be laryngeally unspecified and the laryngeal system would be an exclusively Romance system, in which voiced obstruents are marked for [voice] and voiceless obstruents are unmarked, as is shown in the Table 56.

Voiceless fric.	Voiced fric.
ø	[voice]

Table 56. A Romance system of representations in Dutch.

Iverson & Salmons (2003) claimed, however, that fricatives are overdifferentiated in Dutch. They suggested that Dutch has a mixed system in which voiced fricatives are marked for [voice] and voiceless fricatives are marked for [spread glottis], as shown in Table 57.

Voiceless fric.	Voiced fric.
[spread glottis]	[voice]

Table 57. A mixed Romance-Germanic system of representations in Dutch.

They based this proposal on Vaux's claim that it is unmarked for voiceless fricatives to be specified for [spread glottis]. Iverson & Salmons elaborated on this idea (first formulated as Vaux's Law by Avery & Idsardi, 2001) and claimed that fricatives which are unspecified become specified for [spread glottis] in a system in which [spread glottis] is not contrastive. Since voiced fricatives are specified for [voice] in Dutch (and the contrast is thus not one of [spread glottis]), the unspecified voiceless fricatives become marked for [spread glottis]. However, two arguments can be put forward against the mixed system proposed by Iverson & Salmons (2003).

First, although Vaux (1998) indeed showed that in some languages (such as Armenian), voiceless fricatives and voiceless aspirated stops pattern together, a fact which can easily be accounted for if it is assumed that both types of obstruents are specified for [spread glottis], there does not seem to be a reason to assume that voiceless fricatives need to be specified for [spread glottis] in Dutch too. On the contrary, since sonorant consonants do not become voiceless after an onset voiceless fricative in Dutch (i.e. no devoicing in words like *slee* 'sledge'), this may indicate that voiceless fricatives in Dutch are not marked for [spread glottis]. Voiceless stops in Dutch are clearly not specified for [spread glottis] (they are not aspirated and the contrast between voiced and voiceless stops is one of [voice]). It is therefore perhaps more likely that voiceless fricatives in Dutch are laryngeally unspecified and that the Dutch laryngeal system is a purely Romance system than that – as Iverson & Salmons (2003: 13) claim – the GW ([spread glottis]) specification of Dutch voiceless fricatives is a "representational legacy of the language's Germanic heritage".

A second argument against the [spread glottis] specification of voiceless fricatives in Dutch is the following. If voiceless fricatives were specified for [spread glottis] in Dutch, native speakers of Dutch speaking English would have no problem in specifying voiceless stops in English for [spread glottis], since that feature is already present in their mother tongue (though they would of course still have to extend it to a new segment type). Although the informants in the present study fairly frequently aspirated word-initial voiceless stops in the DLE conversations (see Section 4.2.), there were considerable differences between informants, and non-proficient learners of English tend not to produce long-lag VOT's after voiceless stops in English (Flege & Eeftink, 1987). In sum, there is little evidence for either a [spread glottis] specification of fricatives or for unspecified fricatives in Dutch.

The laryngeal representations of voiced fricatives are even more complicated. In order to arrive at the most suitable solution, it is necessary to take into account not only fricatives, but also stops and sonorants. Three options of laryngeal representations need to be discussed, which are schematised in Table 58. The first option is that there are two different features which represent voicing. This option has been proposed by, among others, Steriade (1995). In the second option, voiced stops have a different laryngeal specification from voiced fricatives. This option offers an explanation for the voicing of fricatives preceding onset sonorant consonants in West-Flemish, as opposed to East-Flemish (see Section 8.3.). Finally, the third option presents a division between obstruents, which are laryngeally marked, and underspecified sonorants. The division between obstruents and spontaneously voiced sonorants has been used by Chomsky & Halle in *SPE* (1968).

Option I

vcd. stops	[phar. exp.]
vcd. fric.	[voice]
sonorant C.	
vowels	
vcl. stops	ø
vcl. fric.	

Option II

vcd. stops	[phar. exp.]
vcd. fric.	[voice]
sonorant C.	
vowels	
vcl. stops	ø
vcl. fric.	

Option III

vcd. stops	[phar.exp.] or [voice]
vcd. fric.	
sonorant C.	ø
vowels	
vcl. stops	
vcl. fric.	

Table 58. Laryngeal features in Dutch: three options.

Option I

The first option is that there is a three-way contrast in the laryngeal phonology of Dutch: voiced stops and fricatives are specified for [pharyngeal expansion], sonorants (both consonants and vowels) are specified for [voice] and voiceless stops and fricatives are laryngeally unspecified. Obstruents, unlike sonorants, require extra articulatory gestures (leading to pharyngeal expansion) in order to be realised with vocal fold vibration and this proposal thus neatly captures that difference. Moreover, voicing assimilation in which sonorant consonants act as triggers can then be accounted for in an autosegmental approach (see Section 8.3.3), as in this approach all sonorants are marked for [voice] and can thus spread [voice] to a fricative, as illustrated in Figure 48.

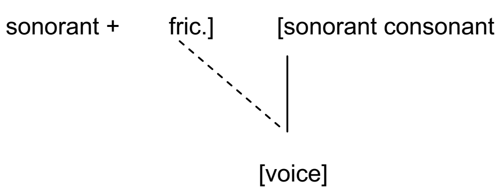


Figure 48. RVA in presonorant position in West-Flemish as a spreading rule.

A consequence of this approach is also that, since vowels are not laryngeally unspecified (as in option III), but specified for [voice], the process through which voiceless fricatives become voiced after a sonorant and before a vowel in Standard Dutch and in East- and West-Flemish, can be explained as an autosegmental spreading rule rather than as an OT constraint. The assimilation pattern is, in other words, assumed to be phonological, rather than phonetic. The rule spreads [voice] from a sonorant to a preceding or following fricative:

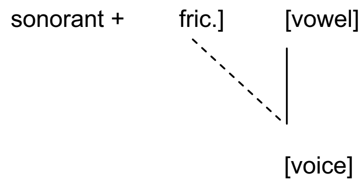


Figure 49. Voicing of fricatives as a spreading rule.

Both the voicing of fricatives in prevocalic context (which occurs in Standard Dutch, East- and West-Flemish) and the voicing of fricatives before a sonorant consonant (which only occurs in West-Flemish) are then explained as spreading rules.

Table 59 illustrates the application of the two processes in West-Flemish, Standard Dutch/East-Flemish, and English. The fricative /f/ is taken as an example:

Context	West-Flemish	Standard Dutch/ East-Flemish	English
vowel + /f/ + vowel	[v]	[v]	[f]
son. C. + /f/ + vowel	[v]	[v]	[f]
vowel + /f/ + son. C.	[v]	[f]	[f]
son. C. + /f/ + son. C.	[v]	[f]	[f]

Table 59. Intersonorant voicing assimilation of fricatives.

While in West-Flemish coda voiceless fricatives can become voiced in all intersonorant positions, English fricatives remain voiceless in all contexts. In Standard Dutch (and East-Flemish Dutch), the assimilation pattern is asymmetrical: a coda fricative can become voiced when following a vowel or sonorant consonant and preceding a vowel, but not when preceding a sonorant consonant. This brings us to the question which segment(s) actually trigger(s) the assimilation process. In Figures 48 and 49, both the sonorant preceding the fricative and the sonorant (consonant or vowel) in the onset of the next word were presented as triggers. However, the pattern in Standard Dutch/East-Flemish shows the importance of the onset consonant following the voiceless fricative: while the segment preceding the fricative may be a vowel or a sonorant consonant, a sonorant consonant in the onset of the next word blocks the assimilation process. Although the segment preceding the fricative is relevant (if it is a stop, the assimilation process is blocked, see Section 8.4.1.), it is the following onset sonorant (consonant or vowel) which actually triggers the voicing of the fricative. The fact that the segment preceding the fricative can be either a vowel or a sonorant consonant is in accordance with Fikkert's (1994: 180) claim that syllable-final sonorants are part of the nucleus rather than the coda. Fikkert investigated the acquisition of Dutch prosodic structure by children and found that, whereas onset sonorants are acquired early on in the acquisition process, sonorants in syllable-final position are acquired late. She argues that this fact can be accounted for if sonorants are analysed as part of the nucleus rather than the coda, since her study showed that branching nuclei are acquired late. If sonorants are part of the nucleus, the fact that in Dutch a voiceless coda fricative can become voiced when preceded by either a vowel or a sonorant consonant is then accounted for, as both are part of the nucleus.

The disadvantage of this option is, however, that it does not offer a fully satisfactory explanation for the assimilation process in fricative + sonorant consonant clusters in West-Flemish, since (1) if voiced fricatives are marked for [pharyngeal expansion], they cannot become voiced by receiving the feature [voice] from a following sonorant, and (2) it remains to be explained why fricatives and not stops become voiced preceding an onset sonorant consonant in West-Flemish.

Option II

The second option is to specify only voiced stops for [pharyngeal expansion] and to specify voiced fricatives and sonorants (both consonants and vowels) for [voice]. Voiceless obstruents remain laryngeally unspecified, as in Option I. The advantage of this approach is that it is able to explain the West-Flemish voice assimilation process in fricative + sonorant consonant clusters: [voice] spreads from the sonorant to the preceding fricative. Fricatives but not stops become voiced when preceding an onset sonorant consonant, since stops need the feature [pharyngeal expansion] in order to be voiced (see Section 8.3.3.).

However, this option has a serious disadvantage: it creates a division between voiced stops, which are marked for [pharyngeal expansion] on the one hand, and sonorant consonants and voiced fricatives, which are marked for [vocal fold vibration] (or [voice]), on the other hand. This division is not desirable, as it goes against the traditional phonetically-based division between sonorants, which are spontaneously voiced, and obstruents, which are not. Moreover, the approach implies that there is a three-way contrast in the laryngeal system of obstruents in Dutch: voiceless stops and fricatives are laryngeally unspecified, voiced stops are marked for [pharyngeal expansion] and voiced fricatives are marked for [voice][2].

Option III

The third option is to specify voiced stops and fricatives for [voice] or [pharyngeal expansion] and to leave sonorants and voiceless obstruents laryngeally unspecified. Since there is only one feature to represent voicing, it is irrelevant whether that feature is called [voice] or [pharyngeal expansion]. The advantage of this approach is that the distinction between sonorants, which are spontaneously voiced, and voiced obstruents, for which extra articulatory gestures are needed in order to produce voicing, is maintained.

A consequence of this model is that neither prevocalic voicing (in Standard Dutch, East- and West-Flemish) nor assimilation before sonorant consonants (in West-

Flemish) can be explained as autosegmental spreading rules, since all sonorants are laryngeally unspecified. Both processes can, however, be explained as phonological constraints in the framework of Optimality Theory.

One way to account for the difference between East- and West-Flemish is to assume two context-sensitive markedness constraints. A first constraint should state that fricatives are voiced in the position between vowels. A constraint such as Inter-V-Voice: 'Intervocalic consonants are voiced' (cf. e.g. Kager, 1999:325) is too general, as only fricatives and not stops become voiced in West-Flemish. The following constraint is therefore proposed:

Inter-V-Voice(fric): Intervocalic fricatives are voiced.

A second constraint should target fricatives in intersonorant position:

Inter-S-Voice(fric): Intersonorant fricatives are voiced.

These two constraints in interaction with a constraint which bans voiced obstruents from the coda position (e.g. *Voiced-Coda: 'Coda obstruents are not voiced', cf. Kager, 1999: 14) can explain the difference between the assimilation patterns in East- and West-Flemish Dutch. Both in East-and West-Flemish, Inter-V-Voice is ranked high, as fricatives become voiced in intervocalic position in both regiolects. The ranking of Inter-S-Voice and *Voiced-Coda is, however, different in the two varieties: whereas Inter-S-Voice is ranked above *Voiced-Coda in West-Flemish, the ranking is the reverse one in East-Flemish, which means that assimilation before sonorant consonants is blocked by the higher-ranked constraint against voiced obstruents in the coda.

However, the disadvantage of these constraints is that they cannot account for the implicational universal that if a language has assimilation before sonorants, it also always has assimilation before obstruents, but not the other way round (see Section 10.4.). Section 8.3.6. contained a discussion of Nagy's (2000) proposal of an OT analysis to account for the difference between languages which have assimilation before voiced stops and sonorants, and those languages which have only assimilation before stops, but not before sonorants. Two different Agree-constraints were needed: one which requires agreement in voice specifications between obstruents (AgreeObsVoice) and one which requires agreement in voice specifications between sonorants and obstruents (AgreeVoice). If these two constraints are dominated by a constraint against voiceless sonorants (*[–S-voice]), see Section 8.3.6.) and interact with a faithfulness constraint requiring voice specifications in the output to be identical to those in the input (which can be called IdLar, cf. Lombardi, 1995a:2), the following attested patterns can be accounted for:

Languages with assimilation before obstruents, but not before sonorants:

AgreeObsVoice >> IdLar >> AgreeVoice

Languages with assimilation before obstruents and sonorants:

> AgreeVoice, AgreeObsVoice >> IdLar

Languages without assimilation before obstruents or sonorants:

> IdLar >> AgreeVoice, AgreeObsVoice

Because in West-Flemish, coda fricatives but not stops need to agree in voicing with an adjacent onset sonorant, this needs to be stipulated in the formulation of the constraint:

> AgreeVoice: Adjacent obstruents and adjacent fricatives and sonorants agree in voicing[3].

According to Option III, voiceless fricatives are laryngeally unspecified and voiced fricatives are marked for [voice]. The laryngeal representations of Dutch fricatives thus look as presented in Table 60:

Voiceless fric.	Voiced fric.
ø	[voice]

Table 60. Laryngeal representations of fricatives in Dutch.

L1 English

As far as English is concerned, voiceless fricatives in English are specified for [spread glottis] and thus have the same specification as voiceless stops under the Multiple Feature Hypothesis. Although sonorant consonant devoicing after fricatives has not been analysed in the present study, it has been reported to be possible in English, but not in Dutch (see Section 1.5.1.). This would be in accordance with the fact that voiceless fricatives are specified for [spread glottis] in English, but are unmarked in Dutch.

If voiced fricatives are unspecified, this means that the specifications of fricatives and stops are the same in English. However, voiced stops and fricatives differ in some respects, which may mean that they need to be specified differently. Two main arguments are given here in favour of the assumption that voiced fricatives in English are specified for [voice].

One argument is that voiced fricatives – in contrast to voiced stops – incur a certain amount of voicing in a preceding, word-final segment in English. Jansen (2004) therefore called voiced stops passively voiced, but voiced fricatives actively voiced sounds. If voiced fricatives spread voice to a preceding segment, they could be argued to be specified for [voice].

The second argument for the specification of voiced fricatives in English is the observation that, whereas most speakers do not produce vocal fold vibration in word-initial voiced stops in English, voiced fricatives are normally realised with vocal fold vibration in this context. Because it is difficult to produce vocal fold vibration and friction simultaneously (cf. e.g. Smith, 1997: 472), word-initial fricatives are usually voiced at the beginning (though initial devoicing also sometimes occurs, cf. Smith, 1997: 497[4]), but become devoiced towards the middle or end. It was argued by Beckman & Ringen (2005) that German fricatives which are voiced in utterance-initial position need to be specified for [voice], as utterance-initial position is not a context in which spontaneous voicing occurs.

However, both arguments for specifying voiced fricatives for [voice] in English are phonetic in nature. The observation that onset voiced fricatives are usually realised with vocal fold vibration, which can also spill over to a preceding coda segment does not necessarily mean they need to be specified for [voice] phonologically. Even if voiced fricatives in English are phonologically unspecified, the contrast between voiced and voiceless fricatives in English is maintained, since voiceless fricatives are specified for [spread glottis], as is shown in Table 61.

Voiceless fric.	Voiced fric.
[spread glottis]	ø

Table 61. Laryngeal representations of fricatives in English.

In this view, voiceless fricatives are specified for [spread glottis]. This hypothesis is in line with, but not proven by the phonetic observation that sonorant consonants can (slightly) devoice when following voiceless fricatives in the onset (as in, for instance, *fly*), as a result of the wide open state of the glottis during the production of the fricative. Since voiced fricatives do not function as triggers of (phonological) assimilation processes, they are presumably phonologically unspecified, just like voiced stops in English.

Dutch Learner English

If voiceless fricatives – just like voiceless stops – are unspecified in Dutch, but specified for [spread glottis] in English, native speakers of Dutch speaking English have to learn a new specification. While the aspiration of voiceless stops in English provides an important cue for the listener about the laryngeal specification of the stops, no such cue is available in the case of fricatives (except the slight devoicing which is possible in voiceless fricative + sonorant consonant clusters, in such words as *fly* and *sly*).

Two contexts were discussed in which voiceless fricatives usually become voiced in (varieties of) Dutch, but not in English (see Chapters 8 and 10).

First, the voicing of final fricatives following a sonorant and preceding a vowel in Dutch (both in East-Flemish and in West-Flemish) was argued to be due to a constraint which says that voiceless fricatives in this position should be voiced. The frequent voicing of fricatives in this context in the DLE conversations was then considered to be the result of transfer of this constraint from Dutch into English (see Section 10.3.2.).

The second assimilation process discussed involved the voicing of word-final fricatives preceding sonorant consonants. The process occurs in West-Flemish, but not in East-Flemish, Standard Dutch or English (see 8.3 for a discussion of various proposals). Steriade's (1995) proposal, in which voiced obstruents are marked for [pharyngeal expansion][5], while sonorant consonants are marked for [vocal fold vibration] offers a good solution: sonorants can act as triggers of voice assimilation as the result of a process which spreads [vocal fold vibration] from the sonorant to a neighbouring obstruent. However, two questions remain, which are repeated here:

(1) If voiced obstruents are marked for [pharyngeal expansion] because extra articulatory gestures are needed to produce voicing in obstruents, how can voiceless obstruents become voiced by receiving the feature [vocal fold vibration] only (and not the feature [pharyngeal expansion])?
(2) Why do fricatives but not stops become voiced preceding sonorant consonants in West-Flemish?

One explanation, which would answer both questions at the same time, could be that stops but not fricatives need to be marked for [pharyngeal expansion] in order to be voiced. The incongruence between the requirement that all voiced obstruents need to be marked for [pharyngeal expansion] and the assumption that spreading of [vocal fold vibration] from sonorants to voiceless obstruents leads to the voicing of these obstruents would then be solved. Moreover, if it were the case that voiced stops but not voiced fricatives are marked for [pharyngeal expansion], the fact that West-Flemish fricatives but not stops become voiced before sonorant consonants is also explained: even if the feature [vocal fold vibration] spreads to preceding fricatives and stops alike, it will not lead to the voicing of the stops, as these need extra articulatory gestures (i.e. the feature [pharyngeal expansion]) in order to become voiced. The question then arises how plausible it is that voiced stops but not voiced fricatives are marked for [pharyngeal expansion]. There are two reasons to believe that this solution is a plausible one.

First, the complete closure during the production of stops leads to a rapid increase in supraglottal air pressure, so that (passive and/or active) expansion of the oral cavity is immediately needed in order to keep the vocal folds vibrating. As there is never a complete closure during the production of fricatives, the air pressure in the oral cavity does not rise as quickly as during the production of stops. In this sense, it is plausible that stops but not fricatives are marked for [pharyngeal expansion].

Secondly, voiced fricatives are particularly hard to produce from an aerodynamic point of view, because the production of friction requires the glottis to be sufficiently open, while the production of vocal fold vibration requires it to be sufficiently closed. Whereas the difficulty in producing voicing in fricatives might be an argument for the proposal that an extra feature is necessary for voiced fricatives as well, it is clear that the nature of the difficulty in producing voicing in stops and fricatives is essentially different. Whereas in voiced stops, maintaining the pressure drop between sub- and supralaryngeal cavity is the source of difficulty, in voiced fricatives the difficulty arises from the size of the glottal opening: if the glottis is too wide open, friction will be produced, but the vocal folds will stop vibrating. The difference between voiced stops and fricatives thus makes it plausible that voiced stops are marked for [pharyngeal expansion], while voiced fricatives are marked for [vocal fold vibration]. Consequently, if in West-Flemish Dutch, the feature [vocal fold vibration] spreads from a sonorant consonant to a preceding voiceless fricative, the fricative becomes voiced.

It was argued that the informants had acquired the phonological laryngeal specification of voiceless stops in English (see Section 11.3.1.). This conclusion was based on the finding that most informants produced longer VOTs in word-initial voiceless stops and in stop + sonorant consonant clusters in English than in Dutch. Because voiceless fricatives are not aspirated in English, the learner has no clear cues for the [spread glottis] specification of voiceless fricatives in English. The only cue might be the slight devoicing that is possible in sonorant consonants following onset voiceless fricatives. However, because the peak glottal opening in fricatives is earlier than in stops (see Section 1.5.1.), sonorant consonant devoicing is much less salient after voiceless fricatives (as in *fly*) than after voiceless stops (as in *play*).

The same problem arises in the case of the acquisition of voiced fricatives, since there are no cues available to the learner for the unmarked specification of voiced fricatives in English. It was shown that voiced fricatives in the onset are realised as partly devoiced in both L1 Dutch and L1 English and that, in contrast to voiced stops, voiced fricatives are not active as triggers of voice assimilation in either Dutch or English.

Since there are so few cues available to the learner for the laryngeal specifications of fricatives in English, two strategies are theoretically possible.

One possibility is that the learner transfers the laryngeal specifications of fricatives from Dutch into English. Since there are no cues for the specifications of fricatives in English, the learner has no reason to assume that the laryngeal contrast between fricatives in English is different from the one in Dutch. The laryngeal representations in DLE will then be as in Table 62.

Voiceless fricatives	Voiced fricatives
ø	[voice]

Table 62. Fricatives in DLE: strategy I.

The second theoretical possibility is that learners employ the contrast they use for stops in DLE for fricatives, too. Since it was argued that voiceless stops in DLE are marked for [spread glottis] and that voiced stops are marked for [voice], the specifications of fricatives in DLE are then as shown in Table 63.

Voiceless fricatives	Voiced fricatives
[spread glottis]	[voice]

Table 63. Fricatives in DLE: strategy II.

This would be an economical solution, since the contrast for stops and fricatives is then the same in DLE. Clements (2003) argues that feature economy is a major principle in the organisation of sound systems. He states that

> "according to this principle, languages tend to maximise the combinatory possibilities of features across the inventory of speech sounds: features used once in a system tend to be used again" (Clements, 2003: 287).

If the informants use the laryngeal contrast for stops for fricatives in DLE, too, they do not economise on features, since the features [spread glottis] and [voice] are used to contrast voiced and voiceless stops in DLE with each other and the total number of laryngeal features in DLE is thus two, no matter whether the informants have a [voice] – [spread glottis] constrast or a [voice] – [ø] contrast between voiced and voiceless fricatives. However, specifying voiceless fricatives for [spread glottis] and voiced fricatives for [voice] is economical, in the sense that a contrast that is already used in the laryngeal system in DLE (for stops) is used again (for fricatives)[6].

In both of the above possibilities, voiced fricatives are marked for [voice]. Voiceless fricatives, on the other hand, are laryngeally unspecified if the informants transfer their specifications from Dutch into English, but are marked for [spread glottis], if they use the DLE system for stops for fricatives, too.

In order to find out which strategy the informants actually employed (or whether different informants employed different strategies), a detailed phonetic study of voiceless fricatives would be necessary. An examination of the differences in energy between voiceless fricatives in Dutch and English and the extent to which onset voiceless fricatives cause devoicing in a following sonorant consonant in L1 English and DLE is needed in order to determine the laryngeal realisation of voiceless fricatives in DLE. However, only phonological processes involving fricatives as triggers could provide evidence on the laryngeal representations of voiceless fricatives.

11.3.3. Summary of laryngeal representations

Under the Multiple Feature Hypothesis, according to which the feature [spread glottis] is active in English and the feature [voice] in Dutch, a summary of the potential laryngeal representations in L1 Dutch, L1 English and DLE is provided in Table 64.

	stops		fricatives	
	voiceless stop	voiced stop	voiceless fric.	voiced fric.
L1 Dutch	ø	[voice]	ø	[voice]
L1 English	[spread glottis]	ø	[spread glottis]	ø
DLE	[spread glottis]	[voice]	ø or [spread glottis]	[voice]

Table 64. Laryngeal representations in L1 Dutch, L1 English and DLE under the Multiple Feature Hypothesis.

Table 64 shows that the laryngeal representations in Dutch and English are radically different: whatever is marked in Dutch is unmarked in English and vice versa. Moreover, the active feature is [voice] in Dutch and [spread glottis] in English. The laryngeal system in DLE would then be a mixed system, which combines the active laryngeal features from the source and the target languages. Whereas Dutch and English have one active laryngeal feature each, DLE has two active features, [voice] and [spread glottis], and no unmarked segments.

However, the discussion above has illustrated the difficulties involved in deriving information on laryngeal representations from an analysis of production data. While the representations in Table 64 are plausible, only active phonological processes in which, for instance, laryngeal features spread from one segment to another, can provide evidence for the laryngeal specification of segments. When no such phonological processes are present, we have to rely on phonetic realisations, which per definition can never provide us with evidence on phonological specifications. As a result, the only specification about which there can be little doubt is the [voice] specification of voiced stops in L1 Dutch and DLE, as in these varieties, voiced stops trigger regressive voice assimilation in obstruents. A unary or privative single-feature account in which all voiced obstruents in Dutch and English are marked for [voice] and all voiceless obstruents are either unmarked or marked for [–voice] can therefore not be excluded (though arguments for the Multiple Feature Hypothesis were provided in Section 2.4.2.). In a Single Feature account native speakers of Dutch learning English could use their L1 laryngeal representations, but would just need to learn new phonetic realisations, such as the production of a time lag after onset voiceless stops and the absence of prevoicing in voiced stops. The results would then be as presented in Table 65, in which the phonetic realisations are given in italics.

	stops		fricatives	
	voiceless stop	voiced stop	voiceless fric.	voiced fric.
L1 Dutch	[–voice] or ø *unaspirated*	[voice] *prevoiced*	[–voice] or ø *unaspirated*	[voice] *variation in vocal fold vibration*
L1 English	[–voice] or ø *aspirated*	[voice] *unprevoiced*	[–voice] or ø *unaspirated*	[voice] *variation in vocal fold vibration*
DLE	[–voice] or ø *usu. aspirated*	[voice] *prevoiced*	[–voice] or ø *unaspirated*	[voice] *variation in vocal fold vibration*

Table 65. Laryngeal representations in L1 Dutch, L1 English and DLE under the Single Feature Hypothesis.

In such an account, native speakers of Dutch learning English would need to learn new phonetic realisations for stops but not for fricatives. The production of aspiration and sonorant consonant devoicing in DLE shows that the learners have learnt that voiceless stops in English are realised with a long voicing lag. Since aspiration is not a phonological process but a phonetic realisation, evidence for either a [spread glottis] or [–voice] specification (or for a lack of a specification) could only be provided if more phonological spreading processes involving voiceless stops were available.

11.4. Suppressing laryngeal processes

In Dutch, voice neutralisations and assimilations occur in various contexts in which they do not occur in English (Chapters 6-10). This section focuses on five contexts in which different realisations occur in Dutch and English and one context which is realised the same in East-Flemish Dutch and English, but differently in West-Flemish Dutch. In the following three sections, these contexts are discussed in Dutch, English and DLE, in that order.

11.4.1. L1 Dutch

Five types of voice assimilations occur in East-Flemish, West-Flemish and Standard Dutch. These are:

(1) (a) Voiced coda stops become voiceless in utterance-final position.
(b) Voiced coda fricatives become voiceless in utterance-final position.
(2) Voiced coda stops become voiceless preceding onset sonorant consonants.

(3) Voiceless coda obstruents become voiced preceding onset voiced stops.
(4) Voiced onset fricatives become voiceless following coda voiceless obstruents.
(5) Voiceless coda fricatives become voiced in the position following a sonorant and preceding a vowel.

A sixth process occurs in West-Flemish Dutch, but not in East-Flemish Dutch or Standard Dutch.

(6) Voiceless coda fricatives become voiced in the position following a sonorant and preceding an onset sonorant consonant.

Through the first two processes, (1) and (2), word-final obstruents are devoiced in utterance-final position. This devoicing can be explained as the result of a constraint *Voiced-Coda, which directly prohibits voiced obstruents in coda position and which is ranked above a faithfulness constraint which requires identity between voice specifications in the input and the output (cf. e.g. Kager, 1999:14). However, Lombardi (1995a: 2) proposes an analysis which accounts for coda devoicing in Dutch in a different way. She uses the following constraints:

IdOnsLar:	"Onsets should be faithful to underlying laryngeal specification."
*Lar:	"Don't have laryngeal features."
IdLar:	"Consonants should be faithful to underlying laryngeal specification."

Instead of Lombardi's constraint *Lar, the constraint VOP ('Voiced Obstruent Prohibition') is used in the analysis below, as this constraint specifically targets obstruents:

> Voiced Obstruent Prohibition ('VOP'): "No obstruent must be voiced" (Kager, 1999:40).

In Dutch the contraints are ranked as follows: IdOnsLar >> VOP >> IdLar. Because the markedness constraint VOP is ranked above the faithfulness constraint IdLar, candidates with voiceless obstruents will be preferred over candidates with voiced obstruents. The positional faithfulness constraint IdOnsLar, which is ranked above VOP, makes sure that only obstruents in codas and not those in onsets devoice.

As a result of the third and fourth process, adjacent obstruents which do not agree in voicing are assimilated in the direction of voicedness (process 3) or voicelessness (process 4). Coda voiceless obstruents were realised as voiced in the position preceding onset voiced stops in 92% of the tokens in the Dutch conversations and onset voiced fricatives became voiceless in 93% of the tokens in which they were preceded by a coda voiceless obstruent. Both processes can be explained as the result of the constraint AgreeObsVoice, which states that obstruents in clusters should agree in voicing. The constraints AgreeObsVoice and IdOnsLar do not directly conflict and thus remain unranked with respect to each other. Since AgreeObsVoice is ranked at the top of the hierarchy, obstruents in clusters will always agree in voicing and the high-ranked postional faithfulness constraint IdOnsLar will ensure that assimilation is always regressive.

The ranking in L1 Dutch, which accounts for processes (1) to (3) is thus the following: AgreeObsVoice, IdOnsLar >> VOP >> IdLar (cf. also Lombardi, 1999:282). The following tableau illustrates how the ranking accounts for regressive voice assimilation in obstruent clusters:

	/tb/	AgreeObsVoice	IdOnsLar	VOP	IdLar
	tb	*!		*	
→	db			**	*
	tp		*!		*
	dp	*!	*	*	**

However, Lombardi notes that

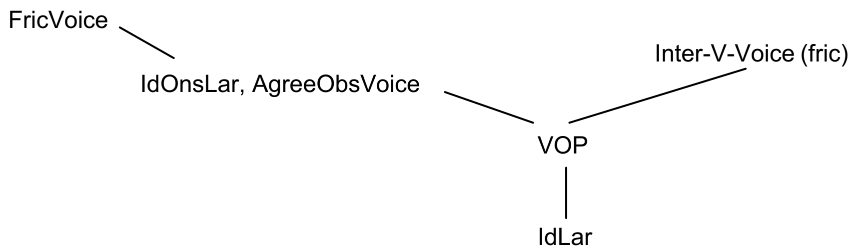
> "because the AGREE constraint is not inherently directional, progressive assimilation will still be possible, but only if higher-ranked constraints intervene to override the effect of IdOnsLar" (Lombardi, 1999: 288).

In order to account for the progressive devoicing in (4), an additional constraint is thus needed which is ranked above AgreeObsVoice. Lombardi (1995a) proposes the markedness constraint FricVoice, which bans candidates in which an obstruent is followed by a voiced fricative. This constraint is ranked above AgreeObsVoice and IdOnsLar, so as to ensure that obstruents in clusters agree in voicing and that assimilation will be regressive unless a coda obstruent is followed by a voiced fricative. In the latter case FricVoice will result in progressive devoicing of the fricative. The constraint ranking proposed by Lombardi (1995a, 1999) for Dutch is then the following:

FricVoice >> AgreeObsVoice, IdOnsLar >> VOP >> IdLar

Even though the constraint *Voiced-Coda deals with coda devoicing in a more direct way, Lombardi's analysis has the advantage of explaining the direction of the assimilation processes and the constraints introduced above will prove to adequately account for the interlanguage stages in DLE.

A fifth process was mentioned above: voiceless fricatives become voiced in the context following a sonorant and preceding a vowel. In the Dutch conversations, 86% of the coda fricatives became voiced in this context. This process is the result of a constraint which can be called Inter-V-Voice(fric), which states that fricatives should be voiced in intervocalic position[7]. Because Inter-V-Voice(fric) targets coda intervocalic fricatives, it is not in conflict with FricVoice, AgreeObsVoice or IdOnsLar. However, it needs to be ranked above VOP, which bans all voiced segments from the output. The constraint hierarchy thus looks as follows:



FricVoice is ranked above IdOnsLar, which is unranked with respect to AgreeObsVoice. AgreeObsVoice is ranked above VOP, which in its turn is ranked above IdLar. The constraint Inter-V-Voice(fric) is ranked above VOP and IdLar, but is unranked with respect to FricVoice, AgreeObsVoice and IdOnsLar.

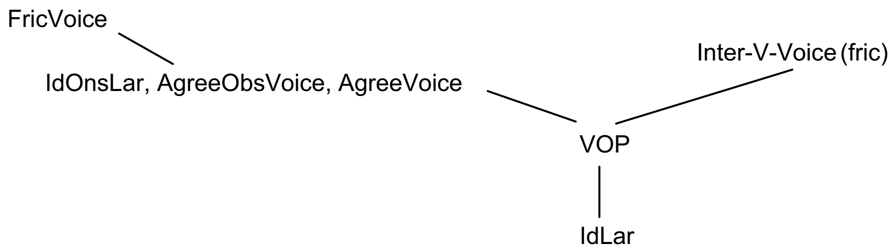
The assimilation patterns indicate that the markedness constraints FricVoice, AgreeObsVoice and Inter-V-Voice(fric) are ranked high in Dutch, as it is often not important for obstruents to be realised according to their underlying voice specifications. The faithfulness constraint which says that obstruents should be realised according to their underlying laryngeal representations, IdLar, is ranked at the bottom of the hierarchy, below all markedness constraints mentioned above. Although it is not important for obstruents in Dutch to be realised according to their underlying voice specifications, changes in codas are preferred over changes in onsets (except in coda obstruent + voiced fricative clusters) and the positional faithfulness constraint IdOnsLar is ranked above the markedness constraint VOP. The laryngeal grammar of Dutch is highly unmarked, as the general faithfulness constraint IdLar is ranked below all relevant markedness constraints.

In section 11.2 it was argued that the laryngeal representations in East- and West-Flemish Dutch are the same and that the different realisations of coda fricatives preceding onset sonorant consonants in the two regiolects are due to differences in the laryngeal processes of the varieties. The voicing of fricatives preceding sonorant consonants in West-Flemish was argued to be due to the constraint AgreeVoice, which states that adjacent obstruents and adjacent fricatives and sonorants should agree in voicing. In West-Flemish, AgreeVoice needs to be ranked above VOP in order for fricatives to be voiced preceding onset sonorant sonorants, as is illustrated in the following tableau:

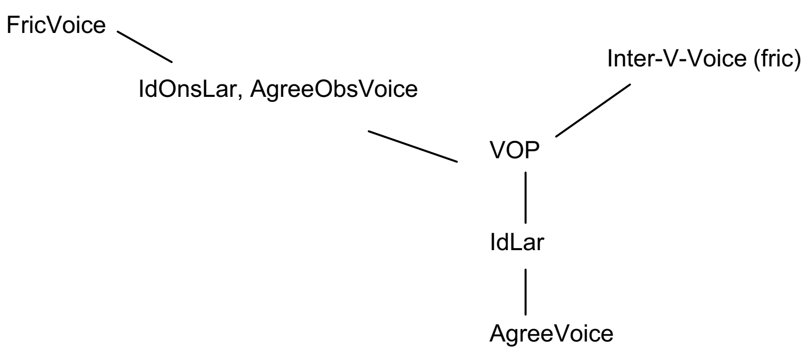
	/sw/	AgreeVoice	VOP
	sw	*!	
→	zw		*

The faithful candidate [sw] violates the high-ranked AgreeVoice, which is not violated by the optimal candidate and is thus rejected. The optimal candidate is [zw], which violates VOP but satisfies the higher-ranked AgreeVoice.

AgreeVoice needs to be ranked below FricVoice to allow progressive devoicing of fricatives following coda obstruents but does not conflict with AgreeObsVoice or IdOnsLar and is thus unranked with respect to these two constraints. The constraint hierarchy for West-Flemish looks as follows:



In East-Flemish, coda fricatives are voiceless before onset sonorant consonants and AgreeVoice therefore needs to be ranked below IdLar, as is shown in the following constraint hierarchy of East-Flemish:



11.4.2. L1 English

The English laryngeal system is completely different from the Dutch one. None of the six assimilation processes mentioned in Section 11.4.1. occur in English. Since the assimilation processes in Dutch were argued to be the result of two markedness constraints, these constraints must be ranked below the faithfulness constraint requiring that the laryngeal representations of obstruents in the output correspond to those in the input. Because neither obstruents in clusters nor obstruent and sonorants in clusters need to agree in voicing, because voiced obstruents in coda position are not devoiced and because voiceless fricatives are not realised as voiced in intervocalic or intersonorant position, the following ranking is posited for English:

> IdLar, IdOnsLar >> FricVoice, AgreeObsVoice, Inter-V-Voice(fric), AgreeVoice, VOP

The general faithfulness constraint IdLar and the positional faithfulness constraint IdOnsLar are thus ranked higher than all five markedness constraints. No ranking is posited for FricVoice, AgreeObsVoice, Inter-V-Voice(fric), AgreeVoice and VOP, as these constraints remain dominant in English across word-boundaries[8].

11.4.3. Dutch Learner English

East- vs. West-Flemish DLE

It was shown that the laryngeal grammars of East- and West-Flemish are the same, except for the constraint AgreeVoice, which has a different place in the constraint hierarchies of the two regiolects (see Section 11.4.1. above). It was therefore expected that the two groups of informants would also have largely the same interlanguage systems. The following table presents the realisation of the first five processes mentioned in 11.4.1. in the DLE conversations by the East- and West-Flemish informants:

	East-Fl. DLE	West-Fl. DLE
(1) (a) vcd. stop → vcl. / __ # #	42%	35%
(b) vcd. fric. → vcl. / __# #	72%	79%
(2) vcd. stop → vcl. / __[son. C.	11%	10%
(3) vcl. obstruent → vcd. / __[vcd. stop	62%	55%
(4) vcd. fric. → vcl. / vcl. obstruent]__	0%	14%
(5) vcl. fric. → vcd. / __[vowel	53%	28%

Table 66. Assimilation processes in DLE: East- vs. West-Flemish informants.

The largest difference between East- and West-Flemish informants occurred in the realisation of coda fricatives in the position following a sonorant and preceding a vowel (process 5). However, the raw figures showed that the East-Flemish informants in fact produced assimilation in only 12 more tokens than the West-Flemish informants (see Table 51, section 10.3.2.). The observation that the East-Flemish informants did not produce any progressive devoicings (process no. 4), while the West-Flemish informants produced devoicing in 14% of the tokens might seem to be an important difference between the two groups. However, the raw figures again show that the difference is in fact minimal: the East-Flemish informants produced progressive devoicing in none of the 33 tokens; the West-Flemish informants produced it in 5 out of 37 tokens. It can therefore be concluded that there were no considerable differences in the productions of voice assimilations in the DLE of the East- and West-Flemish informants.

Apart from assimilation in coda fricative + onset sonorant consonant clusters, the DLE grammars of the East- and West-Flemish informants thus proved to be the same. The following discussion deals with the English interlanguage grammar of the East- and West-Flemish informants together.

Demotion of markedness constraints

Whereas in Dutch, the markedness constraints FricVoice, AgreeObsVoice, Inter-V-Voice(fric) and VOP are all ranked above the faithfulness constraint IdLar (though VOP is ranked below the positional faithfulness constraint IdOnsLar), the ranking is the reverse one in English. This means that native speakers of Dutch learning English have to demote the markedness constraints below the faithfulness constraint. This situation parallels the task in first language acquisition. It has been argued by Smolensky (1996), who based himself on a proposal by Prince (via personal communication), that in the initial state[9] the entire group of markedness constraints must dominate the group of faithfulness constraints (M >> F). This statement derives from the issue of learnability in OT: if M >> F in the initial state, the child can – when confronted with marked structures in the target language – rerank the relevant faithfulness constraints between the markedness constraints and can thus gradually arrive at the target constraint ranking. When the child is confronted with unmarked structures in the target language, the markedness constraints remain ranked above the faithfulness constraints[10]. Empirical evidence for the initial ranking M >> F has been provided by, for instance, Gnanadesikan (2004), who investigated the development of the grammar of one child. Velleman & Vihman (ms), on the other hand, found that at the onset of word production the target language has already influenced the grammars of the children and no evidence could be found for the hypothesis that at that point in the acquisition all markedness constraints dominate all faithfulness constraints.

It is generally assumed that the initial state in second language acquisition is the final state of first language acquisition. In terms of Optimality Theory, this means that the initial state in the second language acquisition process is the constraint ranking of the source language. As in L1 acquisition, the learners will gradually rerank constraints in order to arrive at the ranking of the target language. When the learner is confronted with target structures which do not occur in the source language, markedness constraints which are always dominated in the source language may emerge in the interlanguage (as was shown by Broselow, Chen & Wang, 1998, see Preface, endnote III).

In the case at hand, the ranking is such that M >> F in the source language (though the positional faithfulness constraint IdOnsLar is ranked above the markedness constraints VOP in Dutch), and F >> M in the target language. This means that native speakers of Dutch learning English are faced with a difficult task, since they have to acquire structures in the target language which are different from and more marked than the corresponding structures in the source language (cf. the Markedness Differential Hypothesis, which states that structures which are different from and more marked than corresponding structures in the native language are difficult to acquire, see the Preface to this book). In order to arrive at the English constraint ranking, native speakers of Dutch thus have to demote the relevant markedness constraints below the faithfulness constraints. In the discussion below, we assume the Constraint Demotion Algorithm (CDA), a learning algorithm proposed by Tesar & Smolensky (1998). In this algorithm, re-ranking of constraints is triggered by positive evidence of a constraint violation in the optimal output. The grammar compares the optimal form with the suboptimal form and, on the basis of this comparison, determines which constraints should be demoted (Hancin-Bhatt, 2008: 125).

Demotion of AgreeObsVoice and FricVoice?

The constraint AgreeObsVoice is violated whenever an obstruent cluster, whose members do not agree in voicing, occurs in the output. It was mentioned that in Dutch there are two types of assimilation processes resulting in structures which satisfy AgreeObsVoice: regressive voice assimilation in voiceless obstruent + voiced stop clusters and progressive devoicing in obstruent + voiced fricative clusters. The positional faithfulness constraint IdOnsLar ensures that assimilation is normally regressive. The fact that progressive rather than regressive voice assimilation occurs in coda obstruent + onset voiced fricative clusters is the result of FricVoice, which prohibits voiced fricatives following coda voiceless obstruents and which is ranked above AgreeObsVoice in Dutch. In English, all obstruents in clusters are faithful to their specifications in the output and thus violate AgreeObsVoice and/or FricVoice.

In order to find out whether the Dutch-speaking informants have learnt to demote AgreeObsVoice and FricVoice below IdOnsLar and IdLar, it was examined to what extent the informants produced obstruent clusters which agreed or did not agree in voicing in DLE.

First, the analysis has shown that the informants produced RVA in 59% of all voiceless obstruent + voiced stop clusters in the DLE conversations. Although RVA was more frequent in the Dutch conversations (in which it occurred in 92% of the tokens), the high frequency of RVA in the DLE conversations indicates that AgreeObsVoice is (often) ranked higher than IdLar in the English interlanguage of the informants:

AgreeObsVoice >> IdLar[11]

Secondly, the analysis of the Dutch conversations revealed that progressive devoicing occurred in nearly all tokens (93%) containing a coda voiceless obstruent followed by an onset voiced fricative. Progressive devoicing was, however, very rare in the DLE conversations. In contrast with voiceless obstruent + voiced stop clusters, a significant part of all (voiced and voiceless) obstruent + voiced fricative clusters was realised according to the underlying voice specifications of the obstruents. The reason why regressive voice assimilation was transferred much more frequently than progressive devoicing might be that the former is a less salient process than the latter. Whereas RVA changes the voice specification of a coda segment, PVA involves a change in specification of an onset segment. The advanced learners of English might thus avoid transferring the more salient process of progressive devoicing into the foreign language.

This means that the positional faithfulness constraint IdOnsLar, which in Dutch is ranked below FricVoice, is ranked above this markedness constraint in DLE. The (partial) ranking in DLE is therefore the following:

IdOnsLar

FricVoice, AgreeVoice

IdLar

Because AgreeObsVoice is ranked above IdLar, obstruents in clusters will agree in voicing in DLE and IdOnsLar will make sure that the assimilation is regressive. The lack of progressive devoicing in DLE results from the high-ranked IdOnsLar, which prohibits changes in voice specifications of onsets and which is ranked above FricVoice. This ranking results in regressive voice assimilation in all types of clusters. However, only 6% of all obstruent + voiced fricative clusters underwent RVA in the DLE conversations (in contrast to the Dutch conversations, in which only 1% underwent RVA and in which 93% was subject to progressive devoicing). To account for the 87% of tokens in which the coda voiceless obstruent and onset voiced fricative were realised according to their underlying voice specifications, IdLar needs to be ranked above AgreeObsVoice and FricVoice.

Demotion of VOP?

In Dutch, coda obstruents are always voiceless, except when followed by an onset voiced stop or, in the case of coda fricatives, when preceded by a sonorant and followed by a vowel. In English, coda obstruents are realised according to their underlying specifications. This means that native speakers of Dutch learning English have to demote the constraint VOP below IdLar. The analysis has shown that the informants devoiced 41% of the utterance-final voiced stops and 75% of the utterance-final voiced fricatives in the DLE conversations. The fact that voiced fricatives are more marked than voiced stops is masked in Dutch in coda position, in which neither voiced stops nor voiced fricatives are allowed, as well as in English, in which voiced stops as well as voiced fricatives occur in the coda. It does, however, to some extent emerge in the English interlanguage of the informants.

If the faithfulness constraint IdLar is ranked above VOP, all utterance-final obstruents will be realised according to their underlying voice specification. This is the desired result for the majority of stops, but not for fricatives, which were devoiced in the overall majority of tokens. The difference between stops and fricatives can be explained through a markedness constraint which bans voiced fricatives and which can – on the analogy to the Voiced Obstruent Prohibtion – be called the Voiced Fricative Prohibition (cf. e.g. Bermúdez-Otero, 2001):

> Voiced Fricative Prohibition ('VFP'): No fricative must be voiced.

This constraint is both phonetically and typologically motivated, since it is articulatorily difficult to produce vocal fold vibration in fricatives, and since voiced fricatives are cross-linguistically less frequent than voiced stops. If IdLar is ranked below VFP and above VOP, utterance-final voiced fricatives will devoice and utterance-final voiced stops will remain voiced. This accounts for the majority of realisations of utterance-final voiced obstruents in the DLE conversations.

The constraint ranking in DLE consequently looks as follows:

IdOnsLar

FricVoice, AgreeObsVoice

VFP

IdLar

VOP

This ranking also accounts for the realisation of voiced coda obstruents before onset sonorant consonants. Whereas voiced stops devoice in coda position preceding an onset sonorant consonant in Dutch, they remain voiced in English. In the overall majority of tokens in the DLE conversations (89%), the informants did not devoice coda stops preceding sonorant consonants. Since AgreeObsVoice requires obstruents in clusters to agree in voicing, neither clusters of voiced stops (marked for [voice] in DLE) nor voiceless stops (marked for [spread glottis] in DLE) followed by laryngeally unspecified sonorant consonants violate AgreeObsVoice. The ranking above leads to the correct output, since IdLar is ranked above VOP and devoicing of coda stops is thus prevented.

Demotion of Inter-V-Voice(fric)?

Whereas in Dutch voiceless fricatives frequently become voiced following a sonorant and preceding an onset vowel, they remain voiceless in English. In the constraint ranking for DLE proposed above, VFP dominates IdLar, which means that coda fricatives will be devoiced in DLE. While the majority of final prevocalic voiceless fricatives (59%) indeed remained voiceless in the DLE conversations, 41% became voiced. The voicing of coda voiceless fricatives in prevocalic position was argued to be due to the constraint Inter-V-Voice(fric), which is ranked high in Dutch. If this constraint needs to be able to play a role, it must be ranked above VFP, since candidates with a voiced fricative in the coda would otherwise be rejected. In those tokens in which a coda voiceless fricative remained voiceless, Inter-V-Voice must be ranked below VFP.

Demotion of AgreeVoice?

Since coda voiceless fricatives remain voiceless preceding onset sonorant consonants in both East-Flemish Dutch and English, the constraint AgreeVoice is ranked below the faithfulness constraint IdLar. The East-Flemish informants thus do not have to demote AgreeVoice when speaking English. The analysis has shown that the East-Flemish informants indeed voiced only 3% of the voiceless coda fricatives preceding onset sonorant consonants in DLE, which means that AgreeVoice is dominated by higher ranked constraints in the English interlanguage of the East-Flemish informants.

It was argued that AgreeVoice is ranked above VOP and IdLar in West-Flemish Dutch, since 80% of the coda voiceless fricatives were realised as voiced preceding onset sonorant consonants. This type of assimilation was, however, not frequently transferred into English: the West-Flemish informants produced it in only 27% of the tokens. RVA in fricative + sonorant consonant clusters is a non-salient process, which is illustrated by the observation that West-Flemish speakers hardly ever suppress it when speaking Standard Dutch. It is therefore unlikely that the informants consciously avoided production of the process when speaking English. The reason why this process was not frequently transferred into English might be that it is a marked process. Since every language that has assimilation before sonorant consonants also has assimilation before voiced stops, but not the other way round, it means that assimilation before sonorant consonants is typologically more marked than assimilation before voiced stops (see Section 10.4.). If typological markedness plays a role in second language acquisition, the expectation would be that the West-Flemish informants transferred either both RVA before stops and RVA before sonorant consonants into English or transferred only RVA before voiced stops and not RVA before sonorant consonants. The analysis has shown that the West-Flemish informants transferred the less marked type of assimilation (assimilation before voiced stops) much more frequently than the more marked type (assimilation before sonorant consonants). Since the West-Flemish informants did not frequently transfer assimilation before sonorant consonants into English, they demoted AgreeVoice below IdLar and the interlanguage systems of East- and West-Flemish informants are thus the same, barring occasional transfers reflecting West-Flemish influence.

This means that the English interlanguage of the informants did not present an unnatural language system in which there was assimilation before sonorant consonants, but not before voiced stops. The analysis, which made use of the Agree constraints AgreeVoice and AgreeObsVoice and the faithfulness constraint IdLar, thus correctly predicted that a system in which there is assimilation before sonorants, but not before obstruents, is unattested.

The following tableaux illustrate the three attested patterns:

(1) Languages with assimilation before obstruents, but not before sonorants: L1 Standard and East-Flemish Dutch, DLE of East- and West-Flemish informants.
Ranking: AgreeObsVoice >> IdLar >> AgreeVoice
Assimilation before obstruents:

	/tb/	AgreeObsVoice	IdLar	AgreeVoice
	tb	*!		*
→	db		*	

No assimilation before sonorants:

	/sw/	AgreeObsVoice	IdLar	AgreeVoice
→	sw			*
	zw		*!	

(2) Languages with assimilation before obstruents and before sonorants: West-Flemish Dutch
Ranking: AgreeObsVoice, AgreeVoice >> IdLar
Assimilation before obstruents

	/tb/	AgreeObsVoice	AgreeVoice	IdLar
	tb	*!	*	
→	db			*

Assimilation before sonorants:

	/sw/	AgreeObsVoice	AgreeVoice	IdLar
	sw		*!	
→	zw			*

(3) Languages without assimilation before obstruents or before sonorants: L1 English
Ranking: IdLar >> AgreeObsVoice, AgreeVoice
No assimilation before obstruents:

	/tb/	IdLar	AgreeObsVoice	AgreeVoice
→	tb		*	*
	db	*!		

No assimilation before sonorants:

	/sw/	IdLar	AgreeObsVoice	AgreeVoice
→	sw			*
	zw	*!		

The fourth possible ranking, namely AgreeVoice >> IdLar >> AgreeObsVoice leads to the same result as the ranking in (1), since AgreeVoice requires both obstruents and sonorants to agree in voicing. The result of this ranking is thus a system in which there is assimilation before obstruents as well as before sonorants.

The constraint ranking in DLE

The analysis led to a constraint ranking which accounts for the main part of the DLE data. This ranking is the following:

> IdOnsLar >> FricVoice >> AgreeObsVoice >> Inter-V-Voice(fric) >> VFP >> IdLar >> VOP >> AgreeVoice

Whereas the ranking accounts for the majority of realisations in DLE, it was shown at various points in the analysis that there was a great deal of variation. For example, although RVA in voiceless obstruent + voiced stop clusters was very frequent, 41% of the voiceless stops did not undergo assimilation in DLE. Similarly, although a large number (46%) of the voiced obstruent + voiced fricative clusters were realised according to the underlying specifications of the segments, the obstruent became voiceless and the fricative remained voiced in 39% of the tokens. Moreover, while the majority of the utterance-final voiced stops were realised as voiced, devoicing still occurred in 41% of the tokens. This means that the ranking of IdLar and VOP is very variable in DLE and that the constraints regularly change places in the constraint hierarchy. The position of Inter-V-Voice(fric) also proved to be variable, as 41% of the coda fricatives became voiced in this context and 59% remained voiceless.[12]

The conclusion which must be drawn from this is that there is actually not one constraint ranking in DLE as there is not one interlanguage system. Although the assimilation processes in Dutch discussed above are mostly optional, they were all produced with a very high frequency in the Dutch conversations. The English interlanguage of the informants, however, is very variable. This variability may be due to differences between informants (i.e., some informants will have an interlanguage system which is closer to the target language grammar than others), as well as to intra-speaker variation (i.e., informants may sometimes transfer the ranking from their source language and sometimes use a ranking which is closer to the target language ranking). Inter- and intra-speaker variation are typical characteristics of interlanguages. Since this study is mainly based on natural, running speech data, the number of possible assimilation sites greatly differs between speakers. The study has therefore focused on group results, rather than on the performance of individual speakers. However, one interesting topic for future research would be to examine whether the production of non-target assimilation patterns correlates with an individual's overall L2 pronunciation and L2 proficiency. An accent judgment task, in which native speakers of English rate the learner's overall accent and a general proficiency test performed by the participant would be suitable to investigate whether the variation between the informants is the result of variation in overall proficiency in English and/or in overall pronunciation performance.

11.5. Summary

This chapter has provided answers to the five questions formulated in Section 11.1. The answers are summarised below.

First, the discussion on laryngeal representations revealed that it is difficult to find evidence for phonological representations on the basis of production data, as phonetic realisations (such as the production of aspiration after voiceless stops) do not provide evidence for phonological representations. If we assume the Multiple Feature Hypothesis, the laryngeal system in DLE proved to be a mixed system, which combines representations from the source and the target languages. Whereas only [voice] is active in Dutch and only [spread glottis] is active in English, both features are employed in DLE: voiceless stops and fricatives are marked for [spread glottis][13] and voiced stops and fricatives are marked for [voice]. This means that DLE is a marked system, as no segments are laryngeally unspecified as in Dutch and English. While strong evidence for the [voice] specification in DLE voiced stops was provided, an alternative account for the laryngeal specifications of voiceless stops and fricatives, in which all voiced segments are specified for [voice] and all voiceless segments are specified for [–voice] or are unspecified, is also possible.

Secondly, the differences between Dutch, English and DLE are not only due to different laryngeal representations, but also to different laryngeal processes. In Dutch, various assimilation processes lead to unmarked output structures. The markedness constraints AgreeObsVoice, FricVoice, VFP, VOP and Inter-V-Voice(fric) are all ranked above the faithfulness constraint IdLar. In English, the ranking is the reverse one, since the faithfulness constraint is ranked above all markedness constraints and no assimilation processes which involve changes in laryngeal representations of segments between the input and the output occur across word-boundaries.

Thirdly, it was shown that there is a great deal of variation in DLE and that there is thus not one fixed interlanguage system. In the constraint ranking which accounts for the largest part of the DLE data, the faithfulness constraint IdLar is ranked above VOP, which accounts for the fact that the majority of utterance-final voiced stops were realised as voiced in the DLE conversations. The constraint IdLar is, however, ranked below FricVoice, Inter-V-Voice(fric) and VFP in DLE. This explains the observation that in DLE, fricatives are frequently not realised according to their underlying voice specifications. Further, AgreeObsVoice is ranked above IdLar in DLE, which accounts for the frequent production of voice assimilation in obstruent clusters. However, unlike in Dutch, the positional faithfulness constraint IdOnsLar is ranked above the markedness constraints FricVoice and AgreeObsVoice, which accounts for the absence of progressive devoicing in DLE.

The interlanguage system of DLE is thus variable and unstable. The constraint ranking in DLE is a mix between the ranking in L1 Dutch and the one in L1 English. It was also shown that the fact that voiced stops are less marked than voiced fricatives, which is masked in L1 Dutch and L1 English, emerges in the English interlanguage of the informants, since voiced fricatives were devoiced much more frequently than voiced stops.

Fourthly, the analysis revealed that the laryngeal representations in East- and West-Flemish Dutch are the same. The different realisations of coda fricatives followed by onset sonorant consonants are due to a difference in the systems of these two regiolects. Whereas in East-Flemish, VOP is ranked above AgreeVoice, the ranking is the reverse one in West-Flemish, which causes fricatives to become voiced preceding onset sonorant consonants.

Finally, the DLE systems of the East- and West-Flemish informants proved to be very similar. Whereas the West-Flemish informants frequently voiced coda fricatives before onset sonorant consonants in Dutch, they did not as frequently transfer this assimilation process into DLE. The observation that assimilation before sonorant consonants was not frequently transferred into DLE (in contrast to, for instance, assimilation before voiced stops) was argued to be due to the marked nature of voice assimilation before sonorant consonants, which is cross-linguistically rare.

Notes

1. The UCLA Phonological Segment Inventory Database was developed by Maddieson at the University of California, Los Angeles (and presented in Maddieson, 1985).
2. In Option I, there is also a three-way laryngeal contrast, but the contrast between obstruents is one of [pharyngeal expansion] versus [ø] (the third specification, [voice], is used for sonorants).

3. It should be noted that Nagy's (2000) proposal is based on two types of voice: S-voice, which is present in both sonorants and voiced obstruents, and O-voice, which is present only in voiced obstruents. Since Option III assumes that sonorants are unspecified for [voice], the constraint formulated here does not refer to the laryngeal representations of sonorants.

4. Smith remarks that in tokens with devoicing at the beginning, "the absence of voicing is presumably due to hysteresis: the threshold of transglottal pressure that is required to initiate voicing is higher than that required to sustain voicing already in progress (Lucero, 1995)" (Smith, 1997: 497).

5. It should be noted that in Section 2.4 the feature [voice] was used throughout. Since the discussion dealt only with stops (and not with sonorants), only one feature to represent voicing was needed and as long as this was the case, it was irrelevant whether that feature is [voice] or [pharyngeal expansion]. At this point, however, the distinction becomes relevant.

6. As Pater (2009) points out, more research needs to be carried out on featural economy or, more generally, systemic simplicity (simplicity in structures which can only be assessed on the level of the whole system) (see Pater, 2009, for an approach from learnability and typology).

7. Note that this constraint is actually too narrow, in that the preceding segment can also be a sonorant consonant, but see section 11.3.2. for Fikkert's claim that syllable-final sonorant consonants are part of the nucleus instead of the coda.

8. The effects of these constraints may be noticed within words in English. The plural suffix /z/, for instance, is realised as [z] or [s] depending on the preceding segment as a result of AgreeObsVoice (see Section 9.2.2).

9. The term *initial state* is used to refer to the language system of a speaker before the acquisition process has begun.

10. The opposite statement, that all faithfulness constraints dominate all markedness constrainst in the initial state (F >> M), has been proposed by Hale & Reiss (1997), who argue that the unmarked structures that appear in the child's outputs are the result of a lack of processing skills rather than of high-ranked markedness constraints.

11. It should be noted that, whereas this ranking accounts for the majority of tokens, it does not reflect the fact that informants produced RVA less frequently in the DLE conversations than in the Dutch conversations. The ranking is thus in fact variable.

12. As an anonymous reviewer rightly pointed out, the variability of the constraint ranking in the learners' interlanguage obviously also needs to be explained in formal terms. However, a discussion of the algorithm which could account for the variable outputs lies outside the scope of the present study (but see, e.g. Pater, 2005, for a discussion of the advantages of the General Learning algorithm (GLA), Boermsa 1998, Boersma & Hayes, 2001, over the CDA in its ability to deal with variable outputs).

13. It was argued that a phonetic examination of voiceless fricatives in DLE is needed in order to determine whether they are laryngeally unmarked (as in Dutch) or marked for [spread glottis] (as in English). However, since voiceless stops and fricatives behaved very similarly with respect to voice assimilation processes in DLE, they presumably have the same laryngeal representations and are marked for [spread glottis].

Chapter 12

General conclusions: What this study has revealed and what needs to be done

12.1. Introduction

In the Preface to this book, it was stated that the present study was embedded in different strands of research and aimed to contribute to the body of research in each of these fields. The objectives are briefly repeated here.

First, the study is embedded in contrastive phonology and aimed to provide a thorough description and analysis of the laryngeal systems in two languages in which the laryngeal contrast is realised in different ways, viz. Dutch and English.

Secondly, the study was argued to be embedded in research on second language, or interlanguage phonology. The objective was to provide a description of the laryngeal representations and laryngeal processes in the English interlanguage of native speakers of Dutch, thereby taking into account the role of cross-linguistic influence and universal principles of markedness and investigating the distinction between competence ('knowledge') and performance ('mastery').

Thirdly, this study builds on and contributes to specific research on laryngeal phonology. The aim was to discuss a number of questions and issues which are controversial or still debated in the literature on laryngeal featurs and laryngeal representations.

In this chapter, the objectives and questions formulated in the preface are taken up again and the major empirical and theoretical conclusions of the study are summarised (Section 12.2). Suggestions for further research are offered in Section 12.3.

12.2. Answers to the questions: What we can conclude from this research

Contrastive Phonology

The first main objective of the research reported on in this volume was to provide a detailed comparison of the Dutch and the English laryngeal systems. The comparison led to two main conclusions.

First, the contrastive analysis of the laryngeal systems of Dutch and English revealed that these two languages differ in the way in which the contrast between obstruents is realised. It was shown that under the Multiple Feature Hypothesis, Dutch and English have different laryngeal representations: whereas in (Belgian) Dutch, voiceless obstruents are unmarked and voiced obstruents are marked for [voice], in English, voiceless obstruents are marked for [spread glottis] and voiced obstruents are unmarked. It was argued that both in Dutch and in English, the laryngeal representations of stops parallel those of fricatives.

Secondly, the comparison of the Dutch and English laryngeal systems led to the observation that the two languages are fundamentally different with respect to the application of laryngeal processes: whereas in Dutch high-ranked markedness constraints cause a complex set of assimilation processes across word-boundaries, in English, obstruents are normally realised according to their underlying laryngeal representations. In Dutch, various assimilation processes lead to unmarked surface structures: utterance-final obstruents are always voiceless and obstruent clusters across word-boundaries always agree in voicing. In English, obstruents are normally realised according to their underlying representations, which causes marked structures to appear in the output: the contrast between voiced and voiceless obstruents is maintained in utterance-final position and obstruents clusters across word-boundaries do not agree in voicing if the segments are specified differently in the input. Although in English, there is (partial) devoicing in, for instance, utterance-final position, and there is phonetic spill-over of voice from an onset voiced fricative to a preceding coda segment, these processes are phonetic processes, which are not normally neutralising and which are thus different from the phonological voice assimilation processes in Dutch, through which the voice contrast is usually completely neutralised.

Another objective of this study was to assess the wider implications of the results for typological research, where relevant information is available. Typology emerged in the discussion of the voice assimilations preceding sonorant consonants. This type of assimilation is present in one dialect of Dutch, West-Flemish, and absent in another dialect, East-Flemish, which led to a discussion on the emergence of implicational universals in L2 acquisition. The two dialects differ in the way coda fricatives occurring before onset sonorant consonants are realised: while they are always voiceless in East-Flemish, they are usually voiced in West-Flemish. This difference must be attributed to a difference in the laryngeal processes of the two varieties. Various proposals have been put forth to account for the process of voice assimilation before sonorant consonants. Steriade (1995), for instance, proposed that obstruents are marked for [pharyngeal expansion] (because extra articulatory gestures which expand the oral cavity are needed in order to produce vocal fold vibration in obstruents) and that sonorants are marked for [voice]. This option is attractive in that it captures the difference in voicing between obstruents and sonorants and explains how [voice] can spread from sonorants to neighbouring segments. However, when applied to the East- vs. West-Flemish case, the question remained how coda fricatives can become voiced by receiving [voice] from onset sonorants, since obstruents need to be marked for [pharyngeal expansion] in order to be produced with vocal fold vibration. Moreover, the approach does not account for the fact that only coda fricatives and not coda stops become voiced preceding onset sonorant consonants.

An alternative proposal which was examined was that voiced stops but not voiced fricatives are specified for [pharyngeal expansion] and that voiced fricatives and sonorants are specified for [voice]. The advantage of this proposal is that the difference in voicing between stops and fricatives is accounted for and that it explains the observation that in West-Flemish only fricatives and not stops become voiced preceding onset sonorant consonants, since the latter need to be specified for [pharyngeal expansion] in order to be voiced. However, the disadvantage of this proposal is that the distinction between sonorants, which are spontaneously voiced, and obstruents, for which extra articulatory gestures are needed, is lost.

A third possibility was therefore explored. It was argued that in Dutch, voiced obstruents are marked for [voice] and voiceless obstruents and sonorants are laryngeally unspecified. The laryngeal representations of East- and West-Flemish were argued to be the same. Because stops and fricatives in the word reading task were realised in a similar way by the East- and West-Flemish informants, the difference between East- and West-Flemish must be attributed to a difference in the laryngeal grammars of these two regiolects. It was argued (on the basis of Nagy, 2000) that a constraint which says that adjacent obstruents and adjacent fricatives and sonorants agree in voicing specification is ranked higher than a constraint against voiced obstruents in West-Flemish, but that the ranking is the reverse one in East-Flemish. The OT analysis provided was able to account for the typological observation that languages with assimilation before sonorant consonants always have assimilation before voiced stops, but not the other way round, i.e. assimilation before voiced stops does not imply assimilation before sonorant consonants.

Interlanguage Phonology

The book examined the voicing contrasts as realised in the English of native speakers of Dutch. As such, it is embedded in research on interlanguage phonology. The thesis advanced in the Preface was that an interlanguage is shaped by three main influences: the target language (the language that the speaker aspires to acquire), the source language (the speaker's mother tongue) and universal principles of markedness. This means that on the one hand 'transfer' from the source to the target language will be responsible for certain features in the interlanguage. On the other hand, some phenomena in interlanguages cannot be attributed to the source or the target languages, but arise from general principles of markedness. A third question arising in the field of interlanguage studies is the distinction between competence ('knowledge') and performance ('mastery'). These three factors are taken up below.

Cross-linguistic influence

When learning a foreign language, speakers transfer structures from their source language into the target language. The study provided ample evidence of such cross-linguistic influence, both of phonological *features* and of phonological *processes*.

The study revealed that the advanced native speakers of Dutch produced English voiceless stops with aspiration, especially in a controlled reading task. While under a Single Feature Hypothesis this indicates that the learners have acquired the new phonetic realisation of voiceless stops, but not those of voiced stops, under the Multiple Feature hypothesis this could be taken to mean that the learners have acquired the [spread glottis] specification of voiceless stops in English, but transfer the [voice] specification of voiced stops into English. There are three reasons why the learners did not acquire the target realisation of voiced stops in English.

First, the acoustic difference between prevoiced Dutch stops and unprevoiced English stops is minimal and as a result of the acoustic similarity between the two types of stops, the informants did not create a new phonological category.

Secondly, there is variation in English between stops produced with and without prevoicing.

Thirdly, native speakers of Dutch have to deduce the unmarked nature of voiced stops in English from the lack of prevoicing in stops produced by the majority of L1 English speakers, and from the lack of regressive voice assimilations in which voiced obstruents function as triggers.

The analysis thus showed that, under the Multiple Feature Hypothesis, there are no laryngeally unmarked obstruents in DLE: the informants transferred the active laryngeal feature [voice] from Dutch and acquired the active laryngeal feature [spread glottis] in English, but did not transfer or acquire the laryngeally unmarked obstruents.

Examples of transfer of phonological processes were abundant. The analysis has shown that the informants transferred various voice assimilation processes from Dutch into English, but that the extent to which the assimilation processes were transferred differed considerably.

Utterance-final devoicing of fricatives, for instance, was far more frequent than utterance-final devoicing of stops. Similarly, regressive voice assimilation before voiced stops was much more common in the DLE conversations than progressive devoicing of onset fricatives after coda obstruents. It was argued that the more frequent devoicing of fricatives in comparison to stops is due to the fact that a constraint against voiced fricatives, the Voiced Fricative Prohibition (VFP) is ranked above the faithfulness constraint IdLar, which in its turn is ranked above the Voiced Obstruent Prohibition (VOP).

The near absence of progressive devoicing in DLE was considered to be the result of the constraint IdOnsLar ('Onset laryngeal representations in the output should be identical to those in the input'), which is ranked above AgreeObsVoice ('Obstruents in clusters should agree in voicing') and FricVoice ('There should be no clusters of obstruents followed by voiced fricatives'). Whereas the high-ranked AgreeObsVoice in DLE is responsible for the frequent production of regressive voice assimilation in coda obstruent + onset voiced stop clusters, the ranking of the faithfulness constraint IdOnsLar above the markedness constraints AgreeObsVoice and FricVoice explains the absence of progressive devoicing in DLE.

Markedness

In Dutch various assimilation processes occur which lead to unmarked structures in the output. In English, on the other hand, laryngeal representations of obstruents in the output normally correspond to those in the input. Thus, the markedness constraints FricVoice, AgreeObsVoice, Inter-V-Voice(fric) and VOP are all ranked higher than the faithfulness constraint IdLar in Dutch (i.e. M >> F), but not in English, where the ranking is F >> M. This means that native speakers of Dutch learning English have to demote the markedness constraints below the faithfulness constraint. It was shown that the constraint ranking in the English interlanguage of the Dutch-speaking informants was a mixture between the Dutch and the English rankings. The constraint AgreeObsVoice, for instance, was ranked high in DLE (in contrast to L1 English), which led to RVA before voiced stops in the DLE conversations, but clusters in which the obstruents did not agree in voicing were preferred over progressive devoicing of onset fricatives.

The study has also revealed that the English interlanguage of the informants adheres to certain universal principles of markedness which do not emerge in L1 Dutch or L1 English:

First, the fact that voiced stops are universally more marked than voiced fricatives emerged in DLE, since utterance-final voiced fricatives were devoiced much more frequently than voiced stops.

Secondly, the fact that coda segments are universally more marked than onset segments also emerged in the interlanguage of the informants. Because coda segments are marked, they are more easily subject to deletion or assimilation than onset segments. Because it is more important for onset segments to remain faithful to their underlying specifications than for coda segments, progressive devoicing across word-boundaries, which occurred in nearly all obstruent + voiced fricative clusters in the informants' Dutch conversations, hardly occurred in DLE.

Another issue which was raised was whether the typological markedness of assimilation processes has an influence on the extent to which they are transferred. This topic was discussed in relation to the processes of RVA before voiced stops and RVA before sonorant consonants. Whereas the former process occurs in East- and West-Flemish, as well as in Standard Dutch, the latter only applies in West-Flemish. Mascaró

(1995) remarked that there do not seem to be languages which have RVA before sonorants but not before stops, which indicates that RVA before sonorants is typologically more marked than RVA before stops. The analysis showed that RVA before stops was transferred much more frequently than RVA before sonorants, which confirms the fact that marked structures are less easily transferred than unmarked structures (but see section 11.3.2 below for suggestions for further research).

Phonological acquisition vs. phonetic implementation

The difference between phonological acquisition ('knowledge') and phonetic implementation ('mastery') was discussed at various points in the course of this study. The analysis of aspiration of voiceless stops, for instance, revealed that the average VOTs in DLE were much higher in the word reading task than in the spontaneous conversations. This difference is partially explicable from the fact that the informants paid more attention to pronunciation in the word reading task, and could be taken to mean that they were more successful in implementing the newly acquired [spread glottis]-specification in reading than in spontaneous conversations.

More generally, the study revealed how difficult it is to derive evidence on phonological representations from production data. Unless phonological processes involving the spreading of features can provide information about the laryngeal specifications of features, an alternative account in which different realisations are not the result of different phonological specifications but rather of different phonetic implementations cannot be excluded. This observation is interesting in the light of the current emergence of phonological corpora. While such corpora will without any doubt be of immense value for the description of various languages and language varieties, learner language corpora alone may not be sufficient to give insight into phonological representations and will need to be complemented with experimental research. Perception experiments, for instance, have been assumed to be more suitable for the study of competence than production data (Brown, 1998).

Laryngeal Phonology

A more theoretical goal of this study was to critically examine three specific questions with respect to laryngeal features and laryngeal contrasts.

The first of these questions is whether laryngeal features are unary or binary. Although the present study does not provide direct evidence for either unary or binary laryngeal features, at no point in the analysis has there been a need for negative values of features, such as [–voice] or [–spread glottis]. Since no negative values were needed, the laryngeal features used in this study are assumed to be unary.

The second subsidiary question which was explored in this book is whether there is a single feature ([voice]) involved in both Dutch and English, or whether [voice] is operative only in Dutch and an additional feature, namely [spread glottis], is found in English. Whereas Kingston & Diehl (1994) provided arguments in favour of one feature [voice] for both languages, Iverson & Salmons (1995) argued that the feature [voice] is needed for voicing languages (such as Dutch), but that another feature, [spread glottis], is needed to account for the laryngeal system in aspirating languages (such as English). Evidence for the latter view was provided by Kager et al. (2007) on the basis of first language acquisition data and by Honeybone (2005) on the basis of historical processes in German and English. The analysis of the word reading task showed that the Dutch-speaking informants produced nearly all onset voiced stops in the Dutch words with prevoicing and that the majority of onset voiced fricatives were produced with vocal fold vibration (usually followed by a period of voicelessness). Moreover, nearly 90% of all voiceless stops in word-final position preceding an onset voiced stop in the Dutch conversations became voiced as the result of regressive voice assimilation. These results indicate that the feature [voice] is active in Dutch.

In English, the feature [voice] is never active: phonologically voiced stops in onset position were produced without vocal fold vibration in the overall majority of tokens by the L1 English informants and there are no assimilation processes in English in which [voice] spreads from a voiced obstruent to a neighbouring segment. It was therefore concluded that voiced obstruents in English are laryngeally unspecified and that the feature [spread glottis] is needed to mark the contrast between voiced and voiceless obstruents in English.

The laryngeal system of Dutch was thus argued to be a purely Romance system (with a [voice]-ø contrast), in contrast to the English system, which is purely Germanic (and has a [spread glottis]-ø contrast). Two proposals for mixed laryngeal systems were critically examined and rejected:

First, Iverson & Salmons (2003) argued that the laryngeal system in Dutch is a mixed one, in which voiceless fricatives are marked for [spread glottis] and voiced fricatives are marked for [voice]. They based this statement on Vaux's (1998) proposal that it is unmarked for voiceless fricatives to be specified for [spread glottis] and formulated the generalisation (which they called Vaux's Law) that unspecified voiceless fricatives in a system which employs [voice] become specified for [spread glottis]. According to Iverson & Salmons (2003), the mixed system in Dutch can be explained diachronically, as Dutch is a Germanic language which has been influenced by Romance language varieties. However, it was argued that, although voiceless fricatives are phonetically realised with a spread glottis, there is no reason to assume that voiceless fricatives in Dutch are phonologically specified for [spread glottis]. There is, for instance, no devoicing of sonorant consonants after voiceless fricatives in the onset in Dutch (in contrast to English, in which devoicing has been reported to occur). Moreover, although there has been a great deal of contact between French (or Romance dialects) and Dutch, the historical evidence for a mixed Germanic-Romance laryngeal system is rather weak. There has, for instance, also been a lot of intensive contact between French and English, yet the English system is a purely Germanic one.

Secondly, Beckman & Ringen (2005) argued for a mixed system in German, in which the contrast between stops is one of [spread glottis] (i.e. voiceless stops are marked for [spread glottis] and voiced stops are unmarked), but the contrast between fricatives one of [spread glottis] and [voice] (i.e. voiceless fricatives are specified for [spread glottis] and voiced fricatives are specified for [voice]). They argue that the observation that voiced fricatives in German are realised with vocal fold vibration in onset position, in which spontaneous voicing does not occur, implies that they must be specified for [voice]. The same argument could then be applied to English, as the present study has shown that native speakers of English usually produced onset voiced fricatives with a period of vocal fold vibration at the beginning. Jansen (2004) also showed that in English onset voiced fricatives, but not onset voiced stops, spread voice to a preceding coda segment. This could lead to the proposal that, whereas the contrast between aspirated voiceless and phonetically devoiced stops in English is one of [spread glottis], voiceless fricatives are marked for [spread glottis] and voiced fricatives are marked for [voice]. However, it was argued that these arguments are purely phonetic in nature and that the fact that onset voiced fricatives are realised with vocal fold vibration in English or that there is some phonetic spill-over from voiced fricatives onto neighbouring segments does not imply that they need to be phonologically marked for [voice].

The third question raised in the study concerns the comparison between first and second language acquisition of laryngeal contrasts. A remarkable difference between L1 and L2 acquisition of laryngeal contrasts is that children tend to show a preference of short-lag stops over prevoiced or long-lag stops. As Kager et al. (2007) remark, children learning a voicing language as well as children learning an aspirating language tend to produce short-lag, unaspirated stops before they learn to produce aspirated or prevoiced stops. The results of the present study, however, revealed that the learners' interlanguage lacked precisely the category of unaspirated, short-lag stops: the L2 learners in this study produced prevoiced and long-lag stops, but no short-lag stops. This suggests that

> "[w]hile the tendency to produce unmarked short-lag stops is important in first language acquisition, in second language acquisition this drive towards unmarked structures is overridden by the pressure to keep the perceptual cue of voiced stops in the L1, namely prevoicing, intact in the L2" (Simon, 2009a).

In other words, it is hypothesized that L1 acquisition of laryngeal contrasts may differ from L2 acquisition in that in the former the most important drive may be the avoidance of marked structures, while in the latter the role of the L1 becomes more dominant. This is also in line with the results of a recent longitudinal case study on early L2 acquisition, which examined the production of Dutch and English voiced and voiceless stops produced by a three-year old Dutch child who was immersed in an English-speaking environment when he and his parents moved from the Netherlands to the U.S (Simon, 2010b). The case study revealed that, just like the late learners in the present study, the child fairly easily acquired the English aspirated stops. However, the child, who had acquired prevoicing in Dutch at the outset of the study, did not transfer prevoicing into English to the same extent as the late learners. On the contrary, the child gradually (over a period of seven months) lost prevoicing in Dutch and produced all voiced stops in both languages in the short-lag VOT region. Consequently, the suggestion made in the present study that once prevoicing has been acquired it is hard for L2 learners to get rid of it does not seem to hold for very young L2 learners, whose phonological L1 system is easily influenced by an L2.

12.3. What needs to be done: Suggestions for further research

By investigating the laryngeal system in the English interlanguage of native speakers of (two Flemish varieties of) Dutch, the study arrived at a characterisation of the laryngeal representations and laryngeal grammar of DLE. In the following two sections suggestions are advanced for further research which would help to deepen our understanding of the L2 acquisition of laryngeal contrasts.

12.3.1. The role of perception

The present study examined the acquisition of the English voice contrast by native speakers of Dutch on the basis of production data. Acquiring the phonological system of a second language involves two tasks: (1) producing the foreign language and (2) perceiving the new contrasts. Many studies on second language production, including the present study, have shown that, when speakers produce a second language, they often transfer elements from the phonological system of their mother tongue into the foreign language. However, transfer has also been shown to play a role in speech perception: when listeners hear a foreign language, they tend to be biased by their knowledge of the sounds of their first language (cf. e.g. Escudero & Boersma, 2002, 2004; Cho & McQueen, 2006).

The present study has shown that the Dutch-speaking informants produced longer VOTs in initial voiceless stops in English than in Dutch, but did not omit prevoicing in onset voiced stops in English. These production data might be the result of the fact that the informants do not perceive a difference between prevoiced Dutch stops and (usually) unprevoiced English stops. The perception of prevoicing has been investigated by Van Alphen (2004), who showed that, when native speakers of Dutch were asked to identify (Dutch) tokens as voiced or voiceless, they frequently misjudged voiced tokens lacking prevoicing as voiceless ones. This indicates that native speakers of Dutch can perceive the difference between stops with and stops without prevoicing and that prevoicing functions as a strong cue for the recognition of voiced stops in Dutch. Even though the Dutch-speaking informants in the present study produced prevoicing in nearly all Dutch and English onset voiced stops in the word reading task, they might nevertheless – when confronted with both prevoiced and unprevoiced English words in a perception experiment – identify the unprevoiced stops as being 'more English' than the prevoiced ones. An experiment in which native speakers of Dutch are asked to identify prevoiced and unprevoiced stops as being English or Dutch may give insight into the role of perception in the acquisition of the English laryngeal system by native speakers of Dutch,. This is an aspect which has not been dealt with in the present study.

12.3.2. The role of cross-linguistic universals

The study has touched upon the influence of implicational universals on second language acquisition. This topic was discussed in relation to two assimilation processes: assimilation before voiced stops (which occurred in the Dutch speech of the East- and West-Flemish informants) and assimilation before sonorant consonants (which was only produced by the West-Flemish informants). Neither of the processes normally occurs in native English. Mascaró (1995) formulated an implicational universal which says that the presence of RVA before sonorant consonants in a language implies the presence of RVA before stops. The role of this implicational universal in the acquisition process has been examined by investigating if and to what extent the informants transferred the two processes into their English interlanguage. If the informants transferred RVA before stops, but not RVA before sonorant consonants into English, the interlanguage would contain an unattested pattern. This would prove that interlanguages can violate implicational universal principles of first languages. However, the analysis showed that, while RVA before stops was transferred very frequently, RVA before sonorant consonants occurred much less frequently in the DLE conversations. This means that the interlanguage system did not contain an unattested pattern, but it does not provide direct evidence for the influence of attestedness on second language acquisition, which has been discussed by, among others, Pycha et al. 2003, Pater & Tessier 2003, Carpenter 2005, and Wilson, 2006. One way to gain insight into the role of implicational universals of assimilation patterns would be to conduct constructed language learning experiments in which informants are taught different assimilation rules and to investigate whether implicational universals emerge in the acquisition process. For instance, informants (who need to be native speakers of a language which has neither assimilation before obstruents nor assimilation before sonorants, such as English) could be taught a language which has assimilation in obstruent + sonorant clusters, without receiving information about obstruent + voiced stop clusters. When in the second part of the experiment the subjects are confronted with obstruent + voiced stop clusters, it could then be examined whether they extrapolate the assimilation rule to this new type of cluster. From a typological point of view, the informants might be predicted to produce automatically RVA before voiced stops as well, as the occurrence of RVA before sonorants implies the occurrence of RVA before stops. On the other hand, RVA before sonorants is not easily transferred into another language and it is also possible that this weak type of assimilation does not automatically trigger the stronger type of assimilation, i.e. RVA before stops. Further research along these lines is needed in order to gain insight into the role of universal principles of markedness in second language acquisition.

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Appendix

Appendix A. The native speakers of Dutch: Summary of the questionnaire

The answers of the informants are reproduced exactly the way they were written down by the informants, including grammatical and spelling errors. The questionnaire was completely in English.

(1) *What's your mother tongue? 16 students: Dutch*

(2) *What's the mother tongue of your parents?*

Mother: 16 students: Dutch
Father: 16 students: Dutch

(3 *In which village/city do you live?*

1 Eeklo
2 Zelzate
3 Gent (Oostakker)
4 Oudenaarde
5 Sint-Gillis Waas
6 Lokeren
7 Maarkedal (Nukerke)
8 Zottegem (Erwetegem)
9 Oostduinkerke
10 St. Lodewijk (near Kortrijk)
11 Bredene
12 Ostend
13 Kortemark
14 Poperinge
15 Westouter
16 Menen

(4) In which village/city have you been to school?

1 Eeklo
2 Zelzate
3 Gent (Oostakker)
4 Oudenaarde and now Gent
5 Sint-Niklaas
6 Lokeren
7 Oudenaarde
8 Zottegem
9 Nieuwpoort/Veurne
10 St. Lodewijk / high school: Avelgem
11 Oostende / Gent
12 high school: Ostend; university: Ghent
13 Kortemark (primary) and Torhout (secondary)
14 Poperinge
15 Poperinge
16 Menen

(5) Which dialect/accent do you think has influenced your Dutch most?

1 Eeklo's dialect / tussentaal.
2 Zelzaats
3 Oostakker/Ghent
4 Deinze and Oudenaarde
5 the one from Lokeren
6 Sint-Niklaas
7 Gents
8 Zottegems
9 W-Vlaams
10 West Flemish
11 West-Vlaams
12 West-Flemmish
13 West-Vlaams
14 West-Flamish
15 French
16 French

(6) Do you consider yourself to be a speaker of
(a) a dialect
(b) Standard Dutch
(c) Standard Dutch with some regional characteristics ('tussentaal')

Comments?..

....

....

1	c	--
2	c	--
3	c	well, a lot of regional characteristics actually, but not enough to say I speak the Ghent dialect
4	c	--
5	c	--
6	c	--
7	c	--
8	c	--
9	c	mostly towards Standard Dutch, depending on listener and situation
10	a	very heavy dialect speaker (great influence on my Standard pronunciation)
11	a	At home and with friends I speak dialect, but I can perfectly speak Standard Dutch.
12	a, c	depends on the person you're talking with → at home and with friends dialect; in Ghent and with fellow students (c)
13	a	phonologically ± dialect; concerning vocabulary: Standard Dutch.
14	a	
15	a	and standard as well
16	c	When I'm at home in Menen, I speak more often a dialect, in Gent less → more Standard

(7) If you speak a dialect, how often do you speak it?

(a)	often:	8 informants (of which 6 from West-Flanders and 2 from East-Flanders)
(b)	sometimes:	4 informants
(c)	rarely	2 informants
(d)	I don't speak a dialect	2 informants

(8) Which variety of English do you prefer? (Please tick the appropriate number)

1-British English:	11 informants
2-American English:	2 informants
3-Australian English:	1 informant
4-another variety, namely ……:	1 informant: Canadian English
5-I don't have a preferred variety:	1 informant

(9) Have you ever been in an English-speaking country? YES/NO

If so, how long have you stayed there? ....

....

....

1 YES. 4-5 days

2 YES. 5 weeks (and now ± 5 months) (note: reading of sentences + questionnaire: one year after recording of spontaneous conversation; student participated in an exchange programme in England)

3 YES. 5 months (note: reading of sentences + questionnaire: one year after recording of spontaneous conversations; student participated in an exchange programme in England)

4 YES. Only for two weeks, I was on holiday.

5 YES. 3x Canada (3 x 3 weeks)

6 YES. 3 weeks

7 YES. 10 days.

8 YES. 7 days.

9 YES. Just a few days at a time.

10 YES. 1 day (school trip to Canterbury)

11 YES. 1 week.

12 YES. 1 week.

13 NO

14 NO

15 YES. one day

16 YES, ± 1 week.

(10) Have you had much contact with native speakers so far? Where and when?

....

....

1 Not that much. London; shopping and ordering a meal in a restaurant etc.
2 During the months I spent in England I have.
3 Yes, Liverpool (although one can wonder whether they actually speak English…), 2004
4 Well I do have some professors who are native speakers, so in class. Otherwise I don't have much contact with native speakers.
5 I have family in Canada & my father has a lot of American friends that stay with us regularly.
6 not really
7 vacation travels, electronic communication
8 rarely. Only with staff-members of the hotel and owners of shops.
9 Hardly any, except for some teachers at the university over the last few years (e.g. Edward Monster).
10 not that much, but I occasionally talk to band members, e.g. last year a member of the Irish band Primordial came over for a couple of days.
11 Not that much. On my summerjob this year my boss was from Australia.
12 Yes. Canadian pen pall; I was surrounded by different nationalities for 1 month, so I had to speak English.
13 no
14 no
15 At university, festivals, places, …
16 not very much, in shops, restaurants or the hotel

(11) When you speak English, who/what serves as your model? (Please tick the appropriate number(s))

1-a particular person or group (eg. a pop-group), namely…
ticked 2 times ((1) my parents, both teachers, (2) hiphopslang, The Streets (Cockney))

2-my teacher(s) of English at secondary school:
ticked 3 times

3-my professors of English at university:
ticked 9 times

4-the English you hear on the BBC:
ticked 6 times (one student adds: 'Monty Python')

5-the English you hear on CNN:
not ticked at all

6-the English you hear on MTV:
not ticked at all

7-the English spoken in English films in general:
ticked 8 times

8-another person/group/variety, namely……
ticked 2 times ((1) my father, ex-teacher of English, (2) the native speakers I know (apart from English teachers)).

(12) Do you think that it is important for you to have a native-like competence in English? Why/Why not?

1 For comprehensiveness, not only in England, but all over the world
2 Yes, I think the goal of every language-learner at university level is to speak the language as good as possible, which is native-like.
3 Yes, because I want to speak the language as good as possible, but then again, I will never be able to speak like a native speaker… (thank god, I wouldn't want people to think I'm British)
4 Yes, I do. I study English-Dutch at a higher level, so I think it is necessary to be competent.
8 I think so, as a student of English, but I don't think that is very realistic.
9 Yes, since probably about 1/3rd of my communication is in English (internet).
5 I do. It's an important language spoken and understood all over the world.
6 We have to know the language as good as possible, but I don't think we can ever reach a native-like competence.
7 cf. next question
10 Yes, because it lessens the risk of being misunderstood and it also creates a more relaxed and easy conversation.
11 I think it is very important as a student of the English language to have a native-like competence of English.
12 Yes, when you do this kind of studies, it's only normal you can talk about any subject.
13 Yes, because they've learned/acquired it as a child and have almost no problem with the language; they talk it without having to think about it.
14 Yes, because that's why I chose for Germanic languages, because I want to master the language perfectly.
15 Yes, to be understood, to be able to state your case clearly.
16 No, I don't think it influences your spoken English a lot.

(13) Do you think that it is important for you to have a native-like pronunciation of English? Why/Why not?

1 I think it's more important in England than elsewhere (for integration & to be accepted). In other situations, it's more important to make yourself clear.

2 I think this is less important than vocabulary & grammar but it would be nice anyway.

3 Yes, same reason as above.

4 Yes I do. I refer to question 12 for this.

5 I don't think you should sound exactly like a native because you aren't but you should do your best to speak correct.

6 Yes, idem (cf. previous question)

7 I don't. If people understand you, and you can express yourself, details of pronunciation don't matter.

8 Yes, because it is a necessarily part: you can't study literature or grammar without having the right pronunciation.

9 Yes, because a flawed pronunciation seems to indicate an incompetence to the listener.

10 Accent is I think of lesser importance than competence. You can still make yourself understood when your pronunciation is not native-like. It's very hard to achieve an excellent pronunciation, it's something that has to grow.

11 Yes, same reason as for the previous question.

12 I guess I would like people to say 'you can speak very good English', but some 'couleur locale' doesn't hurt as long as native speakers can understand you.

13 No, because those things change pretty quickly.

14 It may be important, but I know that I'll never have such a correct pronunciation.

15 No; as long as they understand you.

16 No, I don't think it is that important because there are so many varieties in English; what do they mean with native-like.

(14) Have you heard of the phonological process of assimilation? Could you define it? Can you give one example?

nr.	definition	example
1	Yes. Assimilation occurs when one phoneme influences another phoneme in its neighbourhood.	In Dutch: zakdoek /k/ → /g/
2	yes, you speak of assimilation when one sound influence the sound of another (approximant) vowel/consonant	---

nr.	definition	example
3	Yes, oh please NO, not again…well here we go: if I am not mistaken, assimilation occurs when the pronunciation of a word is influenced by an adjacent word (don't shoot me when I'm wrong)	pff… hmm let's think… not really… it's weird, but really, that course is so far away
4	Assimilation is a phenomenon in which one sound adopts itself to its surroundings.	I cannot find a very good one, but maybe: 'because of the ' → becomes a v
5	I've heard about it in class, but I am not sure about it. Is it what you sometimes get in connected speech? « elision	---
6	It's when you put an 'r' between two words to make pronunciation easier.	no
7	Assimilation is the change of a sound influenced by a preceding or following sound.	of apples → [əv]
8	The next sound is influenced by the previous one or vice versa.	on paper (ɒmˈpeɪpə)
9	It is the process in connected speech by which certain sounds in a particular language are changed under the influence of the preceding or following sounds (progressive or regressive)	zakdoek
10	It's the alteration of a sound under the influence of the sound preceding it, following it, or both at the same time.	a hot meal → t becomes p under the influence of m
11	If you talk you link words and you pronounce some parts of the words different because of the influence of the surrounding sounds.	linking-R
12	Euhmm...In connected speech you change the pronunciation of words, you add or leave out a sound.	the idea 'r' of it
13	Yes, two phones standing next to each other who 'change' in pronunciation towards each other (one phone is dominant).	in the room → [ɪnnə ruːm]
14	no	no
15	Yes, I guess like: cf. example	schip-breuk → p is omitted - you only hear the lenis b
16	When you have two words and you have to drop the last lettre of the 1st word to make a direct connection between the 2 words in pronouncing it.	---

(15) *Have you heard of the process of aspiration? Could you define it? Can you give one example?*

nr.	definition	example
1	Yes. Aspiration is when you pronounce your /h/'s.	a <u>h</u>uman
2	When you add a little breath to the pronunciation of sound.	---
3	I suppose it has to do with the voiced/voiceless difference?	honestly no, I'm still amazed I made it through the phonology course without bribing the lecturer
4	Aspiration is a phenomenon in which a sound is more aspirated (receives more air) than it normally does.	a 't' can be aspirated in for instance 'talking'
5	The pronouncing of some phonemes with more breathing out than usual.	/p/ pronounced with some air involved - party?
6	no	no
7	A short utterance of an h-like sound after a plosive.	pony
8	It means that you hear an 'h' after a plosive.	tea
9	This is a feature that some sounds in f.i. English tend to have, nl. a pronunciation with extra force, resulting in an /h/-like sound.	/khæt/
10	It's the adding of a slight puff of air, an h-like sound, after voiceless plosives like p,t and k (but not when these sounds occur after an s).	a p(h)air of shoes (noted like this $p^{[h]}$?)
11	If a plosive stands at the beginning of a word and is followed by a vowel, there is some friction in the pronunciation.	p^{h}ot
12	after a plosive you take a short break & put an 'h'-sound behind it.	p^{h}ot
13	Yes, the beginning of a word starting with a vowel that is added with an [h].	what → [hwat]
14	the 't' in English sounds like 'th', you pronounce a 'h'	It takes = thakes
15	Yes. Air can escape along with other sounds.	Tommy: T is aspirated
16	When you don't have to pronounce the 'h'?	---

(16) Have you heard of the process of final devoicing? Could you define it? Can you give one example?

nr.	definition	example
1	Yes, this is the phenomenon of uttering the final phonemes of words without voice.	In Dutch: bed → /bɛt/
2	When the end of of word/sequence is pronounced with less 'voice' than usual.	---
3	yes/no	euhm..not really by heart now, I should restudy some things (hehe)
4	At the end of a word, a sound loses its original strength and becomes a lenis (instead of a fortis).	sorry, I really can't think of one.
5	That you pronounce a word with less voice on the end.	---
6	no	no
7	Pronouncing a voiced sound in a word-end.	cold
8	---	---
9	This is the process by which voiced consonants in the auslaut become voiceless.	/<paard>/ = /<paart>/
10	a voiced consonant becomes voiceless when it's followed by a pause or a voiceless consonant	leg
11	A voiced consonant at the end of a word or syllable is slightly or partly devoiced when followed by a voiceless sound or no sound at all.	a big task
12	Devoicing of the last consonant in a word with 'soft' vowels like d,z,..	bed is pronounced bedd
13	Yes, voiced plosives and fricatives become voiceless at the end of a word.	goed → [gut]
14	---	---
15	Yes; the final cluster(s) are devoiced, there's no trembling of the epiglottis.	lip stick: p is devoiced
16	---	---

Appendix B. Word reading task: Lists of Dutch and English words

* In the following tables the words are grouped according to their onset consonant(s). In the experiment, the words were presented in such a way that words which started with the same consonant were not presented after each other, so as to prevent the informant's attention to be drawn to this consonant. The translations of the Dutch words are given between brackets.

/b/ + vowel	*/d/ + vowel*	*/b/ + vowel*	*/d/ + vowel*
bind ('bind') [bɪnt]	dik ('fat') [dɪk]	bit	did
bed ('bed') [bɛt]	denk ('think') [dɛŋk]	bid	diet
beek ('stream') [beːk]	deel ('part') [deːl]	bite	died
bal ('ball') [bɑl]	dans ('dance') [dɑns]	bide	deal
bak ('bin') [bɑk]	dal ('valley') [dɑl]	bet	dirt
baan ('road; job') [baːn]	dol ('crazy') [dɔl]	bed	date
bol ('ball, sphere') [bɔl]	dom ('stupid, dull') [dɔm]	bean	dance
bod ('bid') [bɔt]	doos ('box') [doːs]	ball	doll
bot ('bone') [bɔt]	deuk ('dent') [døk]	bought	dot
boom ('tree') [boːm]	duin ('dune') [dœʸn]	boy	doom
voiceless stop + vowel:	*voiceless stop + consonant:*	*voiceless stop + vowel:*	*voiceless stop + consonant:*
paar ('pair') [paːr]	plek ('spot') [plɛk]	pie	play
test ('test') [tɛst]	pruim ('plum') [prœʸm]	take	pray
kaak ('cheek') [kaːk]	trui ('jumper') [trœʸ]	cake	try
	klok ('clock') [klɔk]		clean
	kreeft ('lobster') [kreːft]		crew
voiced fricative + vowel:		*voiced fricative + vowel:*	
veel ('many') [veːl]		very	
zee ('sea') [zeː]		zero	
		these	
voiceless fricative + vowel:	*voiceless fricative + consonant:*	*voiceless fricative + vowel:*	*voiceless fricative + consonant:*
fout ('mistake') [fɑᵘt]	fles ('bottle') [flɛs]	fire	fly
saai ('boring') [saːj]	fris ('fresh') [frɪs]	sir	slow
	slag ('blow') [slɑx]	think	smile
	smaak ('taste') [smaːk]		snack
	snoep ('sweets') [snup]		

List of Dutch words **List of English words**

Appendix C. The native speakers of English: Summary of the questionnaire

(1) Age range: 23-67

(2) Country of origin

1 Scotland
2 Scotland
3 England
4 United Kingdom
5 Ireland
6 Wales
7 Britain
8 Ireland
9 UK
10 UK

(3) Mother tongue(s): all informants: English

(4) Which variety of English do you speak (e.g. British English, American English, Canadian English)?

1 Scottish (slightly diluted by living in England)
2 British English
3 British
4 British English
5 Irish English (general)
6 British English
7 British English
8 Irish English
9 British
10 British

(5) *Do you have a (strong) local accent? From which city/region?*

1 Scottish
2 BBC Scotland. I come from Aberdeen, but don't have a pronounced Aberdeen accent.
3 Northern England – Lake District
4 I have a mild Yorkshire accent.
5 Dublin
6 No.
7 No
8 No
9 No, Received Pronunciation Southern England
10 No

(6) *Which other languages do you speak? (Please indicate if you're bilingual)*

1 French, German (very basic)
2 French
3 Dutch/French/German
4 Dutch (at pre-intermediate level)
5 Dutch, French
6 Dutch, French, some German (I also have some knowledge of Welsh and Spanish, but I couldn't claim to speak either.)
7 German, (French)
8 Spanish, French, Gaelic
9 French, Italian
10 French, Spanish – not bilingual!

Appendix D. Number of tokens coded for each informant

The informants are listed in order of decreasing numbers of tokens coded.

Dutch conversations:

Inf.	Tokens coded
No. 6	525
No. 4	521
No. 8	493
No. 9	398
No. 2	374
No. 16	372
No. 12	358
No. 1	342
No. 13	295
No. 11	235
No. 14	222
No. 3	211
No. 15	188
No. 5	151
No. 7	136
No. 10	109
total	4930

DLE conversations:

Inf.	Tokens coded
No. 4	493
No. 1	463
No. 12	440
No. 9	407
No. 3	365
No. 6	336
No. 8	334
No. 2	331
No. 13	315
No. 15	288
No. 16	246
No. 11	203
No. 7	171
No. 10	140
No. 14	140
No. 5	128
total	4800

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