The Sound System of Dutch in a General Phonetic Perspective

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0. Introduction

Dutch is a language spoken by about 20 million people in The Netherlands and Belgium. This region is not only characterised by a complex dialect situation, but also by the use of two institutionalised varieties of the Standard language: the Southern variety is spoken in Flanders or the northern part of Belgium, while the Northern variety is confined to The Netherlands. Apart from minor lexical and syntactic differences, there are significant phonetic differences between the two varieties as well as substantial regional variability within the two speech communities[1].

Over the years, the phonetic characteristics of Dutch have been studied in considerable detail. Historically, most experimental research has been carried out on the Northern variety, while analyses of the Southern variety have generally been impressionistic and are at present outdated. An aspect that –remarkably- has never received any attention is the question as to how the sound system of Dutch compares to that of other languages of the world. This will be the subject of this paper, in which the sound system of the Southern Standard variety of Dutch will be discussed against the background of a substantial collection of phoneme inventories of the world's languages. These results may be of interest to amongst others language typologists, teachers of Dutch as a Foreign Language, and phoneticians/phonologists who are fundamentally concerned with the distinction between language and medium.

1. The General Phonetic Framework

The phonetic framework this paper relies on is discussed in detail in Laver (1994) and Laver (2001), who explicitly adopts a production perspective to sound classification. In order to describe speech sounds, four interacting production mechanisms are distinguished: the airstream mechanism which generates the energy for speech; the mechanism of phonation which converts the silent airstream into acoustic energy; the articulatory mechanism further modifies the airstream in the pharynx, oral and nasal cavities; the mechanism of co-ordination finally describes the fine detail in the

[1] The historical background to this distinction is discussed in Kloots (this volume).

transitions between speech sounds. Superficially, this taxonomy closely resembles the traditional classification of speech sounds by the International Phonetic Association, (IPA) which is nevertheless primarily perceptually oriented.

In Laver's taxonomy, the articulation of sound is classified on the basis of the traditional dimensions *stricture type* and *place of articulation*. With respect to stricture type, Laver distinguishes between stops, fricatives and resonants.

A **stop** is defined "as a segment whose medial phase is characterized by a stricture of complete **oral closure** made by the active articulator against the passive articulator" (Laver, 1994: 205). This articulatory definition has important taxonomic consequences in that the class of stops in Laver's perspective is substantially bigger than that of traditional IPA classification. It does not only cover IPA plosives, but also includes IPA nasals and trills, since all these sounds are made on a stricture of complete closure in the oral cavity.

Fricatives are defined in much the same way as in the IPA: "A necessary condition for a segment to be classified as a fricative is that the degree of stricture reached and held during the medial phase of the segment must be that of close approximation. That is, for any given rate of airflow, the cross-sectional area of the constricted aperture has to be small enough to cause audible frication" (Laver, 1994: 244).

Resonants, finally, have a stricture of open approximation. "A necessary condition for the performance of resonants is that the airstream passes through the vocal tract in a smoothly laminar flow, with no audible local frication" (Laver, 1994: 269). This class of sounds includes traditional approximants and vowels.

This three-way classification of speech sounds reflects Laver's fundamental belief that "stops, fricatives and resonants (…) are regarded (…) as the basic entities in the structure of every spoken language" (Laver 1994: 140). Although we basically support this idea, Laver's definition of these classes creates an important classification inconsistency: fricatives and resonants are characterised in terms of an articulatory as well as a perceptual criterion. In both cases reference is made to stricture type ("open" and "close approximation), and the perceptual impression in the listener in terms of the presence or absence of audible friction. The result of this is that each of these sound classes represent a perceptually homogeneous category. This, however, does not hold for stops: since they are solely characterised on the basis of an articulatory criterion, i.e. complete closure of the oral cavity, three perceptually very different sound classes are pooled together. Plosives correlate with an impression of a momentaneous silence followed by an explosion, nasals are characterised by a continuous humming sound, while trills create a rattling impression. From a taxonomic point of view, it would therefore have been more appropriate to define above-mentioned sound classes solely

on the basis of articulatory criteria, while observing that a single articulatory criterion may yield very different perceptual impressions in stops, while giving rise to a perceptually homogeneous class in fricatives and resonants.

In terms of the dimension place of articulation, Laver distinguishes between *place-neutral* and *displaced* articulations as superordinate categories. In the former, the sounds are made by means of the active articulator interacting with its anatomically neutral passive articulator, such as in alveolar, palatal or velar articulations. In displaced articulations, the active articulator moves away from its anatomically neutral position. A good example of this is a linguo-labial stop, where the tip of the tongue moves towards the upper lip to form a stricture of complete closure.

Apart from classifying sounds in terms of the traditional dimensions of stricture type and place of articulation, Laver introduces a third dimension in phonetic description, i.e. aspect of articulation. Aspect of articulation refers to "matters of general conformation of the total air-channel, details of the topographical shape of the surface of the active articulator, and the nature of articulatory transitions and their timing." (Laver, 1994: 140).

The **conformational** aspects "cover the detailed routing of the air channel" (Laver, 1994: 140). These include **oral** vs. **nasal** airflow, and the **central** vs. **lateral** routing of the airstream. The former can be used to distinguish oral stops (IPA plosives) from nasal stops (IPA nasals), while the latter is particularly useful in distinguishing central vs. lateral fricatives. This aspect of articulation also specifies whether sounds involve a single or a multiple articulation.

The **transitional** aspect of articulation captures that fact that the active articulator adopt a relatively stable position in some sounds, while the articulation of other sounds is characterized by continuous variation in positioning the active articulator. An example of the latter are IPA trills and diphthongs: during the medial phase of these sounds the active articulator is in transition, rather than occupying a single stable position.

The final aspect is a **topographical** aspect of articulation. This describes "categories of the shape of the tongue surface which are distinct from its convex curvature in the neutral configuration." (Laver, 1994: 141). This aspect covers phenomena such as retroflexion, grooving and cupping of the tongue surface. This aspect of articulation can be used to clearly distinguish between e.g. palatal and retroflex stops. In the traditional IPA framework these stops are regarded as having two different places of articulation, while in Laver's framework both have a palatal place of articulation, while the retroflex differs from the real palatal in the topographical aspect, i.e. the tongue surface is concave in retroflex stops.

2. Reference Materials

The reference data for all comparisons have been calculated on the basis of data available in the UCLA Phonological Segment Inventory Database (UPSID) reported in detail in Maddieson (1984). This database contains explicit phonetic transcriptions of the sound inventories of 317 languages of the world and was designed on the basis of the quota rule, which holds that "only one language may be included from each small family grouping" (Maddieson, 1984: 5). The corpus is assumed to be representative for phonemic variation in the languages of the world and has produced quantifiable generalisations about phonological phenomena in languages of the world. Although UPSID's representativeness for phonemic variation is open to substantial criticism[2], it provides a good starting point for comparative work.

3. The Sound System of Dutch

The consonantal system of Southern Standard Dutch is summarized in table 1:

Table 1: the consonant system of Southern Standard Dutch.

STRICTURE TYPE	ASPECT OF ARTICULATION	PLACE OF ARTICULATION						
Stops	**Oral**		p b	t d			k	
	Nasal		m	n			N	
	Transitional		r					{
Fricatives	**Central**	f v		s z	S Z		x F	h
Resonants	**Central**					j	w	
	Lateral		l					

The voiceless oral stops are unaspirated, while the voiced stops are fully voiced. All nasal stops are voiced and for the fricatives a clear voicing contrast is present. The latter tends to be less outspoken or even fully absent in the Northern variety of Dutch. It should be pointed out that purely phonetically, stops at other places of articulation do occur in Dutch, but they are restricted to certain phonetic contexts. Quite common is the

[2] The main problem with UPSID in our view is the idea that languages are sampled on the basis of linguistic/typological criteria (language families) in order to obtain insights into the characteristics of the sound repertoire of mankind. It thus implicitly assumes a natural relationship between the typological affiliation of languages and phonemic/phonetic structure. It is unlikely that such natural relationship exists. This issue is also discussed in Van Hout (this volume).

voiceless palatal stop [c] in e.g. the diminutive form of nouns ending in / t / or / d /, e.g. *bootje* {little boat}, *paardje* {little horse} and the labio-dental stop in words like *opvallen* {to stand out}, *opvoeren* {to perform}. [ɡ] occurs in words like *zakdoek* {handkerchief}, *dakbedekking* {roofing}, *dekbed* {quilt}. This phonetic realisation, however, originates from an assimilation process to the following consonant.
The traditional classification of Dutch vowels in the Flanders region is given in figure 1:

Figure 1: the traditional classification of Dutch vowels in the Flanders region (Blancquaert, 1950).

Closed	i× y×	¦	u×
Half closed	e. O× I		o.
Half open	E ø	´	U
Open	Q	a× A	ç
	Palatal	**Medial**	**Guttural**

All the vowels are clearly realised as monophthongs and this is one of the most obvious pronunciation differences with the Northern variety of Standard Dutch where [eˇ], [oˇ] and [Oˇ] are generally realised as closing diphthongs (Gussenhoven, 1999).
Thus, the Southern Standard variety of Dutch has a total of 33 sound segments, i.e. 12 vowels and 21 consonants. The number of sound segments in languages of the world varies between 11 and 141. The most typical size of sound inventories ranges between 20 and 37 segments: 70% of the languages fall within these limits and it is clear that Dutch is no exception to this general rule.

4. Stops

It was indicated earlier that stops can be defined as sounds which are produced on a stricture of complete closure in the oral cavity: the active articulator moves towards a passive articulator and obstructs the passage of the airstream through the mouth. In terms of their conformational aspect of articulation, stops can be oral or nasal. In oral stops the velum is raised during the stricture of complete closure in the oral cavity so

that the airstream is completely obstructed during the articulation of these sounds. In nasal stops, however, the velum is not raised. As a result of the complete obstruction in the oral cavity, the airstream is directed via the nasal cavity.

4.1. Oral stops

The total number of phonetically different oral stop phonemes in languages of the world as reported in Maddieson (1984) stands at 212. The number of oral **stop series** in languages varies between 1 and 6. The most frequently observed number of series is two: 51 % of the UPSID languages distinguish between two series of oral stops, which in most cases concerns a contrast between a series of (unaspirated) voiceless stops and a series of plain voiced stops.

The number of **places of articulation** exploited languages varies between 2 and 6, the most frequent number being 3 (53.9%). The most commonly observed places of articulation are labial, dental/alveolar and velar, i.e. three place-neutral articulations which involve "(…) an active articulator interacting with its anatomically neutral passive articulator (…)" (Laver, 1994: 137). The most common system thus involves articulators which are regionally clearly separated from each other, i.e. lips vs. tongue and in the latter case a clear separation between the blade and back of the tongue.

The sound system of Southern Standard Dutch distinguishes between two stop series: an unaspirated voiceless series with stops at three places of articulation ([p][t][k])and a plain voiced series with stops at two places of articulation ([b][d])[3]. In this respect, the Dutch sound system conforms extremely well with what is common in languages of the world except for the fact that the velar place of articulation is only represented in the voiceless series, while it is absent from the voiced series. According to Maddieson (1984) this is an extremely unusual feature of sound systems: the UPSID corpus only contains 21 languages (6.6%) with such a system of oral stops. In most cases the languages with a missing [g] are Austro-Asian, Austro-Thai or American Indian languages. In this sense Dutch also clearly occupies a unique position amongst the other Germanic languages in that they all have oral stops at three places of articulation in both the voiced and voiceless series[4].

4.2. Nasal stops

[3] It was mentioned earlier that [g] does occur phonetically in Dutch, but is restricted to only one context where it results from a process of assimilation.

[4] It should be noted that the actual phonetic realisation of the phonological distinction voiced/voiceless differs considerably in Germanic languages. Danish e.g. contrasts phonetically voiceless and voiceless aspirated stops to create the phonological voicing distinction.

As far as the nasal stops are concerned, Maddieson (1984) notes that a total of 47 phonetically different nasal phonemes are found in the languages of the world: by far the largest number of nasals are voiced (88%) and their number varies between 0 and 6, with nasals at two or three places of articulation being the most frequent (31.9% and 30 %). The most frequently found places of articulation are in decreasing order dental/alveolar (33.68%), labial (32.73%) and velar (19.97%), which are again three place-neutral articulations.
The inventory of nasal stops in Standard Dutch is thus one which is most commonly observed in languages of the world with nasals at three places of articulation, i.e. labial, alveolar and velar. As can be expected, all nasals are voiced and this conforms with the other Germanic languages except for Icelandic, which has a set of voiceless nasals besides the normal set of voiced nasals.

4.3. Transitional stops

Besides oral and nasal stops, languages may have stops with a transitional aspect of articulation. Such **trills** are characterised by a stricture of complete closure which repeats itself over time as the active articulator trills against the passive articulator. 88.95% of the languages in the UPSID corpus contain r-like sounds, 47.5% of which are reported to be trills. The overwhelming majority of trills (97%) are voiced. In terms of place of articulation, the vast majority of languages in the world have a trill at a dental/alveolar place of articulation (83.2%), while only 0.9% have a uvular trill. The presence of two trills at different places of articulation in the same language to realise linguistic contrasts is extremely rare. The only reports in the literature to report linguistically contrasting trills are Laver (1994) and Ladefoged (1977).
Speakers of standard Dutch in Flanders use either of two trills: an alveolar one or a uvular one. Regarding the distribution of both types Gussenhoven (1999) observes that ‘the phoneme /r/ tends to be alveolar in Belgium, in Amsterdam and in the north-east of The Netherlands, but uvular elsewhere’ (p. 74). Although there are no recent quantifications of the distribution of the alveolar and uvular trills in the Dutch language area, it seems that the uvular trill is getting increasingly widespread. Van Reenen (1994) suggests that the occurrence of uvular trills relates to the south-east of The Netherlands with pockets in the provinces North-Brabant, Scheveningen, Vlissingen and The Hague. But also in Flanders the occurrence of uvular-r is frequent in the province Limburg and the town of Ghent. Concerning the latter Rogier (1994) has found that the uvular trill is in fact spreading very rapidly from Ghent into the surrounding countryside.
From the frequency figures in Maddieson (1984), is clear that the presence of a uvular trill in the Dutch sound system is exceptional, but is not uncommon in other Western

European languages. He concludes that "(…) uvulars are quite rare (and mainly restricted to prestige dialects of Western European languages)." (p. 84)

5. Fricatives

Fricatives are made on a stricture of close approximation: the active articulator narrows the vocal tract to such an extent that the airstream is forced through a very narrow opening between the articulators which gives rise to audible friction. The total number of phonetically different fricative phonemes in languages of the world stands at 118. In terms of the actual number of fricatives in languages, variation is observed ranging between 0 and 28, the most frequent number being 2. Generally, Maddieson (1984) observes that voiceless fricatives are predominant: small fricative systems clearly prefer voiceless fricatives and there is an outspoken tendency to avoid voiceless and voiced fricatives at the same place of articulation. Maddieson further argues that if voicing is introduced in a fricative system, there is a strong likelihood that it will be extended to fricatives at more than one place of articulation.

The southern standard variety of Dutch has 8 fricatives at 4 places of articulation. In this variety clear voicing distinctions are maintained, while they are less outspoken in the northern standard variety. Only 1.6% of the languages in UPSID have such an elaborate system with 8 fricatives and the majority of such systems have a voicing contrast at four places of articulation.

It is furthermore interesting to note that all fricatives in Dutch have a central conformational aspect and this is consistent with what is common in other languages of the world, where fricatives with a lateral aspect of articulation are exceptional.

6. Resonants

Resonants are made on a stricture of open approximation whereby the constriction between the active and passive articulator is relatively loose so that the air can flow relatively freely through the vocal tract. This articulation does not give rise to audible friction. This class covers the IPA approximants and vowels.

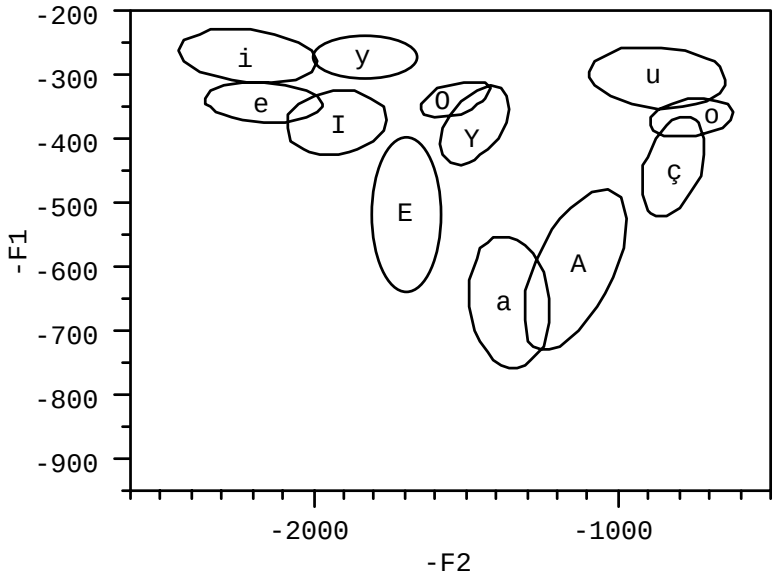
As far as the **approximant resonants** are concerned [j], [w] and [l] occur in the majority of languages of the world with proportions of 86%, 75% and 74.7% respectively. It is clear that the conformational aspectual distinction between central and lateral is rather common in approximant resonants and Dutch is no exception to this rule.

In terms of **vocalic resonants**, the total number of phonetically different vowel phonemes in languages amounts to 154. The most frequently observed vowel system typically has 5 oral vowels. The southern standard variety of Dutch has 12 oral vowels

which differ in acoustic quality with concomitant length distinctions: [e], [y], [O], [a] and [o] are long, while [i], [I], [E], [A], [Y], [ç] and [u] are short. All the vocalic resonants mentioned here are monophthongs, unlike some of the vowels of the northern standard variety.

In a recent investigation of the Dutch vowels in Flanders, Verhoeven and Van Bael (2001) made acoustic measurements of the vowels produced by 30 native speakers of Dutch. One of the results of this investigation suggests that the southern standard variety has vowels at 5 degrees of opening, unlike the 4 degrees suggested in earlier descriptions (Blancquaert, 1950). This is clearly illustrated in figure 2 :

Figure 2: Scatterplot of formant values (F1 and F2) for the 12 Dutch monophthongs in Flanders.



The total number of vowels in the Dutch sound system is relatively high as compared to what is commonly observed in other languages of the world. This is reflected in the vowel-to-consonant ratio, i.e. the number vowels divided by the number of consonants in any given language. In UPSID the median this ratio amounts to 0.36, i.e. that a typical inventory contains less than half as many vowels as consonants. The vowel ratio for Dutch is 0.57 which deviates significantly from the median observed for the world's languages. This means that Dutch has more than half as many vowels as consonants. In this respect the Dutch system goes against a strong trend set by languages of the world generally, but shares this characteristic with other Germanic languages, except for

Icelandic (Afrikaans: 0.65; Danish: 0.55; English: 0.48; Frisian: 0.50; German: 0.64; Icelandic: 0.25; Norwegian: 0.61 ; Swedish: 0.94)[5].

The second characteristic in which Dutch stands out from the other languages of the world has to do with the degree of opening along which vowels are distinguished. 5 degrees of opening is highly exceptional and it has been the subject of much speculation whether languages actually may distinguish vowels at five degrees of opening. Ladefoged & Maddieson (1996) raise the "(…) possibility that there might be a language with five vowel heights." To our knowledge vowel systems with five degrees of opening have only been observed in the Bavarian dialect of Emstatten (Traunmüller, 1984) and the Limburg dialect of Weert (Heijmans and Gussenhoven, 1998).

Besides monophthongs, the southern standard variety of Dutch also has 8 diphthongs which in Laver's perspective can be described as vowels with a transitional aspect of articulation. Although diphthongs only get marginal attention in UPSID, the following generalisations can be made. The total number of phonetically different diphthongs in the world's languages amounts to 58. The number of diphthongs in languages ranges between 1 and 22, the most frequently occurring number being 1. Maddieson (1984) points out that '(…) the diphthongal segments reported are rather heterogeneous and do not show much clear patterning." (p. 133) It is clear that the number of diphthongs in Dutch is exceptionally high.

Many Dutch researchers on the subject of diphthongs feel the need to distinguish between genuine diphthongs and pseudo-diphthongs on the basis of phonological criteria. The former are regarded as unitary segments characterized by a swift transition between two articulatory targets, while the latter are considered as combinations of a tense vowel and a semivowel. The evidence for this distinction derives from amongst others Collier, Bell-Berti & Raphael (1982), who found muscular activation patterns consistent with unitary segments in genuine diphthongs, while pseudo-diphthongs behaved like sequences of two segments. Recent acoustic data collected by Verhoeven & Van Bael (forthcoming) confirm that the distinction between genuine and pseudo-diphthongs is justified. The data clearly indicate that the pseudo-diphthongs in southern standard Dutch involve trajectories through the acoustic vowel space between two targets which occur as independent vowels in the vowel system. This suggests that these diphthongs are the result of the combination of two vowels. Genuine diphthongs, however, have trajectories between targets that do not represent independent vowels in the acoustic vowel space.

[5] These figures are based on phonetic descriptions of German in Kohler (1999), English in Gimson (1980), Frisian in Tiersma (1985), Afrikaans in De Villiers (1970) and Danish, Icelandic, Norwegian and Swedish in Campbell (2000).

7. Conclusion

In this paper an attempt was made to discuss the sound system of Dutch with respect to the sound systems of other languages in the world on the basis of data collected by Maddieson (1984). From this discussion it is quite clear that some aspects of the sound system of southern standard Dutch conform extremely well to what is commonly observed in the languages of the world generally. This is particularly the case for the total number of phonemes in its sound inventory, the subsystem of nasal stops and that of approximant resonants. In other respects, however, the Dutch sound system is remarkably different. With respect to consonant sounds, the most striking features are the absence of [g] in the oral stop subsystem, the wide distribution of uvular-r and the elaborate fricative system. As far as the vowels are concerned, a high number of monophthongs in a system with five degrees of opening is a strikingly exceptional feature. Furthermore, a large number of diphthongs was observed to be a characteristic feature of Dutch.

At least some of these observations indicate that the sound inventory of languages which constitutes the medium of spoken language does not necessarily bear a direct relationship with a language's typological or areal affiliation. This is exemplified by the absence of the /g/-phoneme in the oral stop subsystem, a feature which Dutch shares with Austro-Thai, Austro-Asian and American Indian languages.

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