Regional variation in the pronunciation of /s/ in the Dutch language area

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Abstract

This paper reports on an explorative sociophonetic study of the phoneme /s/ in the Dutch language area. Our aim is to investigate the regional variation in the realisation of this phoneme, and to test experimentally the observation of Collins & Mees (2003) that /s/ is sometimes pronounced more like [ʃ], especially in the Randstad area (called *s-retraction*). One hundred native speakers of Dutch produced nineteen monosyllabic words containing /s/ in different syllabic contexts. The speakers were born and raised in one of five regions of the Dutch language area (West Flanders, Flemish Brabant, Netherlands Limburg, South Holland and Groningen). Spectral centre of gravity (CoG) and duration were used to measure the degree of s-retraction. CoG values turned out to be significantly lower (consistent with more retraction) in the regions in The Netherlands than in the Flemish regions. Speakers from South Holland produced significantly shorter /s/ than the other speakers. In conclusion, /s/ shows patterns of regional variation that are not fully in line with the observation forwarded by Collins & Mees (2003). The difference between the Flemish and Dutch regions shows that s-retraction is found in an area larger than the Randstad, possibly pointing towards a North-South pattern of variation.

Keywords: s-retraction, alveolar fricatives, regional variation, sociophonetics

1   Introduction

Dutch is usually described as a language with a pluricentric nature, especially when it comes to the study of its pronunciation standards. The standardisation history of Dutch in the Low Countries[1] (see Willemyns, 2003, for an overview) has given rise to what most Dutch linguists now agree to call two divergent pronunciation norms: Belgian Dutch in the south (Flanders) and Netherlandic Dutch in the north. Not only between, but also within these two poles, the pronunciation of Dutch shows clear patterns of regional variation.

Van Heuven & Van de Velde (2010) presented an overview of quantitative studies focusing on the phonological differences between Belgian and Netherlandic Dutch, and on the regional variation patterns within both varieties. From these studies it appeared that the most salient differences between Netherlandic and Belgian Dutch are: the pronunciation of loanwords (Van de Velde & van Hout, 2002), the amount of voicing in fricatives (Kissine, Van de Velde & van Hout 2003, 2005; Pinget 2015; Van de Velde 1996; Van de Velde, Gerritsen & van Hout 1996), the place of articulation of (g) (van der Harst & Van de Velde 2007; van der Harst, Van de Velde & Schouten 2007; Van de Velde 2006), the deletion of word final (n) (Van de Velde & van Hout 2001, 2003), the pronunciation of (r) (Sebregts 2015; Tops 2009; Van Bezooijen 2005; Van Bezooijen, Kroezen & Van den Berg 2002; Van de Velde & van Hout 1999), and the pronunciation of long mid vowels with different degrees of diphthongisation (van der Harst 2011; Van de Velde 1996). Van Heuven & Van de Velde (2010: 23) concluded from these studies that:

> De standaardtaal in de Lage Landen kent massale variatie, niet alleen grensoverschrijdend tussen Nederland en België maar ook intranationaal, waar variatie wordt aangetroffen van regio tot regio binnen elk van beide landen. [The standard language of the Low Countries shows massive variation, not only between The Netherlands and Belgium, but also intranationally, where variation is found from region to region within each of the countries.] [*Our translation*].

The aim of this article is to investigate whether there is regional variation in the pronunciation of the voiceless alveolar fricative /s/, which would add this phoneme to the list of variables showing salient pronunciation

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1   We do not discuss the situation of Dutch spoken in Surinam in this paper.

variation within the Dutch language area. Collins & Mees (2003) observed some fifteen years ago that /s/ is sometimes pronounced more like [ʃ] – at least by some speakers of Dutch and in certain linguistic contexts:

> In fact, with many speakers of Netherlands Dutch (notably with urban Randstad accents but also with certain affected ABN speakers), D [Dutch] /s/ can strike an English ear as resembling E [English] /S/; this effect is often apparent in (1) clusters, e.g. *spel, stel, bioscoop;* (2) final /s/, especially following rounded vowels, e.g. *bus, huis, mos* and (3) also after /r/, e.g. *krakers.* (Collins & Mees, 2003, p.190)

To our knowledge, this observation has never been tested experimentally. We present an exploratory sociophonetic study to investigate to which extent the voiceless alveolar fricative /s/ shows regional variation in the Dutch language area. Based on this observation by Collins & Mees (2003), we hypothesized that /s/ is pronounced more like [ʃ], most notably in the Randstad (i.e. the central area in the Netherlands consisting of the urban zone in the western provinces North Holland, South Holland and Utrecht).

1.1 The voiceless alveolar fricative /s/ in the Dutch fricative system and s-retraction

Aside from the glottal /h/, the Dutch fricative system consists of three voiced-voiceless pairs: labiodental /f/ and /v/, alveolar /s/ and /z/, and velar/uvular /x/ and /ɣ/. The major cue for the voicing distinction is the presence or absence of vocal cord vibration in the fricative (Slis & Cohen 1969; van den Berg 1988). Voiced fricatives however are more and more often pronounced as devoiced as a result of a merger in progress (Kissine et al. 2003, 2005; Pinget 2015; Van de Velde 1996; Van de Velde et al. 1996). In addition to these six fricatives, the voiceless postalveolar /ʃ/ and voiced palato-alveolar /ʒ/ are common in Dutch, but primarily occur in loanwords (Booij 1999). /ʃ/ can mostly be found in word-initial position, in words like *sjaal* 'scarf' and *sjouwen* 'to carry' – and rarely in word-final position, in words like *crèche* 'crèche' and *hasj* 'hash'. Dutch /ʃ/ can also result from assimilations of /s/ or /z/ with /j/, as in *kies je* (/kiʃə/, 'choose you', 'do you choose') or *tasje* (/tɑʃə/, 'purse-dim', 'little purse') (Collins & Mees 2003). Moreover, voiceless palatal fricatives were observed in some Limburgian dialects (e.g., in the dialect of Weert; Heijmans & Gussenhoven 1998) and in ethnolects like Gouda Moroccan Dutch (Mourigh 2017).

The process described by Collins & Mees (2003), in which /s/ is pronounced more like [ʃ] and for which we seek evidence in this paper, is

often called *s-retraction* by (socio)phoneticians. The place of articulation of /s/ shifts more towards the postalveolar region; i.e. the pronunciation is more 'retracted'. S-retraction has been observed in several varieties of spoken English: New Zealand English (e.g., Lawrence 2000), British English (e.g., Cruttenden 2014), American English (e.g., Baker, Archangeli & Mielke 2011; Kraljic, Brennan & Samuel 2008) and Australian English (e.g., Stevens & Harrington 2016). In American English it seems to occur primarily in word-initial /stɹ/ cluster contexts, such as in *street* (Baker et al. 2011; Stevens & Harrington 2016), but also in word-initial clusters /skɹ/ and /spɹ/ such as in *screw* and *spread*, and the word-medial /sɹ/ cluster, such as in *grocery*. Baker et al. (2011: 348) therefore concluded that s-retraction appears to be the most probable when /s/ is in the vicinity of /ɹ/. Moreover, there seems to be regional variation within American English in the extent to which /s/ is retracted to [ʃ] (Kraljic et al. 2008). Retracted /s/ in /stɹ/ for example is extremely common in the variety spoken in Long Island (Kraljic et al. 2008). In a range of varieties of American English, s-retraction has actually become the standard in word-initial clusters. Rutter (2011: 28) documented Louisiana English and showed that for these speakers the spectral maximum of /s/ in /stɹ/ falls within the normal range of /ʃ/. Furthermore, Stevens & Harrington (2016) reported clear patterns of s-retraction in the pronunciation of several word-initial clusters in Australian English. They also examined the perception of s-retraction and found an effect of speaker gender on the listeners' categorisation of [s]. Even though no gender differences were found in the amount of s-retraction in speech production, listeners categorised [s] more often as /ʃ/ when uttered by male than female speakers. They explained this finding by proposing that listeners find it difficult to ignore the inherent anatomical differences between male and female speakers affecting the frequency composition of [s], where males tend to have longer filters and therefore produce lower frequency components. This means that male speakers were more strongly associated with a retracted pronunciation in this perception task than females.

The /ʃ/ fricative differs from /s/ in terms of the place of articulation: /ʃ/ is a postalveolar fricative, meaning that it is pronounced more towards the back of the mouth than /s/. This difference is reflected phonetically in several acoustic measurements, because more backward pronunciation yields a longer acoustic filter, which in turn is associated with lower resonance frequencies (see Stevens 2000: chapter 8 for details). This also relates to the abovementioned biological difference between males and females. There have been several studies into the acoustic differences between /s/ and /ʃ/, both within and across languages. Gordon, Barthmaier & Sands (2002)

conducted a cross-linguistic acoustic study of voiceless fricatives in six languages having the /s/-/ʃ/ contrast (Apache, Chickasaw, Scottish Gaelic, Hupa, Montana Salish and Toda). They showed that the best measurements to distinguish /s/ and /ʃ/ are spectral ones, the spectral centre of gravity and the spectral maximum, and to a much lesser extent the duration of these fricatives. The centre of gravity (CoG) is a measure of central tendency of a spectrum, taken over a certain frequency range within the spectrum. The spectral maximum is the frequency where the intensity maximum is found, also referred to as spectral peak. Firstly, Gordon et al. (2002) showed that [s] had a higher spectral centre of gravity than [ʃ] in five of the six languages. Secondly, [s] consistently showed a higher spectral maximum than [ʃ] in all six languages. This measure showed gender differences: the spectral maximum was higher for female speakers than for male speakers. Thirdly, [s] appeared to have a longer duration than [ʃ], but only in three out of the six languages. [s] tended to be longest, but mainly relative to the non-sibilant fricative [f], which is consistent with durational differences between sibilants and non-sibilants reported by Behrens & Blumstein (1988) and Jongman, Wayland & Wong (2000). For Dutch, Rietveld & Van Heuven (2009: 157-159) describe similar differences between /s/ and /ʃ/.

1.2   Hypotheses

In addition to the observation on regional differences in the pronunciation of /s/, Collins & Mees (2003) also made some claims about the linguistic contexts in which they thought that s-retraction is more probable in Dutch (i.e. in clusters, in final position and after /r/). Even though these linguistic factors will be taken into consideration in this paper, we primarily focus on the question whether s-retraction is found in the Dutch language area altogether and whether it shows regional variation.

Our main hypothesis concerns the existence of regional variation in the pronunciation of /s/ within the Dutch language area, here represented by five selected regions (taken from Pinget 2015, see Section 2.1). Based on the original observation of Collins & Mees (2003), we expect speakers from South Holland (Randstad) to show a more retracted [s] (i.e. a more [ʃ]-like pronunciation of /s/) than speakers from other regions, here West Flanders, Flemish Brabant, Netherlands Limburg, and Groningen. As explained in Section 1.1, s-retraction can be revealed by:

1.   a lower spectral centre of gravity for [s] in South Holland than in the other regions;
2.   a shorter duration for [s] in South Holland than in the other regions.

Besides the regional factor, there could also be gender differences in the /s/ realisations. Previous studies on English (e.g. Koenig, Shadle, Preston & Mooshammer 2013; Munson, McDonald, DeBoe & White 2006) reported differences in spectral centre of gravity and spectral maximum between male and female speakers: the centre of gravity of [s] uttered by female speakers was higher than that of [s] uttered by male speakers (but see Gordon et al., 2002). It is therefore possible that we find a gender difference in spectral centre of gravity in Dutch (with a lower centre of gravity for male than female speakers); differences are less probable for duration (see e.g., Behrens & Blumstein 1988; Jongman et al. 2000). In addition to biological/anatomical differences between males and females that may cause gender differences in acoustic measurements, there also is a sociolinguistic factor that predicts differences between male and female speakers: it is traditionally thought that females are more likely to lead changes, as first argued by Labov (2001). If this factor influences our measurements, we expect larger regional differences between the female than the male speakers.

2   Method

2.1   Speakers and regions

Five regions in the Dutch language area (here: Flanders and the Netherlands) were chosen (see the map in Figure 1): West Flanders, Flemish Brabant, Netherlands Limburg, South Holland and Groningen. Each region belongs to one of the five main dialect groups of Dutch, respectively: Flemish, Brabantic, Hollandic, Limburgian and Low Saxon (Taeldeman & Hinskens 2013).

West Flanders (WF) is a peripheral region in the western part of Flanders bordering the North Sea, France and Wallonia. The chosen area is situated in the South of the province West Flanders around the towns of Kortrijk and Roeselare. Flemish Brabant (FB) is the central area in Flanders, and is situated in the economic, cultural, political and strongly urbanised heart of present-day Flanders. Netherlands Limburg (LI) is a peripheral region situated to the South of the Netherlands. South Holland (SH) lies in the Randstad, the central area in the Netherlands consisting of the urban zone in the western provinces of the country. The selection of this region allows testing of the primary hypothesis we formulated based on Collins & Mees (2003: 190). The chosen region centres around

Figure 1   Map of the Dutch language area (The Netherlands and Flanders) and of the five selected regions. Each dot represents the home town of one or more speakers.

the towns of Leiden and Delft. Groningen (GR) is situated in the North of the Netherlands and the participants were recruited from the area around the cities of Groningen and Assen.

The participants were one hundred native speakers of Dutch born and raised in these five regions (see Figure 1). Within each region, 10 males and 10 females participated in the study. The factors age and educational background were kept constant in the participant pool. The participants were all highly educated young adults. All of them were attending or recently graduated from a university or a university of applied sciences. They were aged between 18 and 28 years with a mean of 22.03 years (see Pinget 2015 for more information).

2.2 Speech recordings

Participants were recruited at the university campuses of Groningen, Leiden, Nijmegen, Ghent and Brussels. They were recorded and tested in a lab at these different universities in the course of the year 2013. Participants were seated in a sound-attenuated booth and conducted the production task presented on a computer screen placed in front of them. Participants were paid for their participation, and were informed before the interview that the aim of the research was the study of Dutch.

The production task was conducted using the ZEP experiment software (Veenker 2012) on a laptop operating with Linux and an AKG C420 head-mounted microphone. This equipment was designed for portability, while still providing excellent recordings. Since the same recording and computer equipment was used in the five regions, there were no apparent differences in the quality of the recorded speech signal (all 48 kHz sampling frequency, 24 bits quantisation). Participants conducted a word reading task: they were instructed to read aloud a list of 160 Dutch words. This task was originally designed for another study (see Pinget 2015 for more information). For the purpose of the current study, a subset of nineteen monosyllabic words containing the phoneme /s/ were selected (see Table 1). This subset contains two words (*schelp* 'shell' and *kous* 'stocking'), which were pronounced twice by all speakers. Both realisations of these words were included. The word *saus* ('sauce') contains both a word-initial and a word-final /s/. In this case also, both /s/ realisations were included, resulting in 22 realisations per speaker available for analysis. In Table 1, the nineteen monosyllabic words are classified per linguistic context (/s/ belongs to a cluster vs. no cluster, and /s/ is word-initial vs. word-final).

Table 1   The selection of nineteen monosyllabic words containing the phoneme /s/, split up per linguistic context

	cluster	no cluster
word-initial	*schaar, schelp (×2), slak, spuit, schijn* 'scissors', 'shell' (×2), 'snail', 'syringe', 'look'	*saus, soep* 'sauce', 'soup'
word-final	*feest, vuist* 'party', 'fist'	*gras, huis, mes, neus, vis, vos, fles, bus, saus, poes, kous (×2)* 'grass', 'house', 'knife', 'nose', 'fish', 'fox', 'bottle', 'bus', 'sauce', 'cat', 'stocking' (×2)

2.3 Phonetic analysis

2.3.1 Segmentation

All /s/ fricatives were segmented by assessing their spectral characteristics (Gordon et al. 2002; Jassem 1979; van Son & Pols 1996). Voiceless fricatives are characterised by the presence of noise in the higher frequency region together with the absence of low-frequency energy, which would indicate voicing. The [s] boundaries were set manually based on visual assessment of these spectral characteristics in PRAAT (Boersma & Weenink 2017).

2.3.2 Acoustic measurements

Based on earlier studies of voiceless fricatives (see Section 1.1), spectral centre of gravity, spectral maximum, and duration were measured for the current analysis. Using a script in PRAAT (Boersma & Weenink 2017), the spectral measures were determined for all realisations of [s] over the 1-8 kHz range, over the segment's full duration. Duration was determined from the manually set phoneme boundaries. The spectral maximum was highly correlated with the spectral centre of gravity (r = .73, p < .001), but did not meet modelling requirements. For this reason, this measure was left out of consideration in this paper.

3 Analysis and results

To analyse the effects of the fixed factors Region (5) and Gender (male, female) on the participants' [s]-productions we built linear mixed-effects models in R (R core team 2012) using the *lme4* package (Bates et al. 2012). As reference levels, *South Holland* was set for the factor Region, and *female* for the factor Gender. By doing so, the final model would most clearly reflect if the other regions differed from South Holland, and if female speakers may lead a change in the production of [s]. The latter would be reflected in a Region by Gender interaction. Additionally, potential effects of the linguistic context of [s] were explored, through the inclusion of the contextual factors Position (initial, final) and Cluster (yes, no), because Collins & Mees (2003) implied contextual differentiation of s-retraction in Dutch and because these contextual effects were also shown for English s-retraction (Baker et al. 2011; Stevens & Harrington 2016). Potential effects of the rounding of the preceding vowel were not included in this analysis.

We used model comparison to select the model most justified by the data. In the random part of the model both Speaker and Item were included,

and random structure was maximised (see Barr et al. 2013). In a model's random structure individual variation between speakers and items is modelled. Items may be pronounced differently by region and/or by gender, whereas speakers may vary in their pronunciation adaptations by linguistic context. We assume that model components with an absolute t-value larger than 2 indicate a significant difference (Hox 2010).

Before modelling, durations were log transformed (base = 10), and final models were validated through visual inspection of residual plots. If our linear models fit the data well, the residuals should show a normal distribution around zero. Figure 2 shows the untransformed results for each of the acoustic measures. Remember that s-retraction would be reflected by lower values for CoG, and possibly by a shorter duration.

3.1 Centre of gravity

The optimal model for the centre of gravity included a Region by Gender interaction.[2] Model comparison showed that the inclusion of the Region by Gender interaction was justified ($\chi^2(4)$ = 9.85, p = .043). Model details are given in Table 2, in which the β coefficients reflect the estimated mean CoG for the reference (intercept), i.e. female SH speakers, and deviations from that value for other speaker groups.

The CoG of speakers from South Holland (estimated CoG = 4849.7 Hz) was significantly lower than that of speakers from West Flanders (estimated CoG = 4849.7 + 1359.2 = 6208.9 Hz) and Flemish Brabant (estimated CoG = 4849.7 + 1109.5 = 5959.2 Hz). There were no differences between South Holland and the other regions in the Netherlands (Groningen and Limburg). Moreover, there were gender differences: female speakers (estimated CoG for Randstad female speakers = 4849.7 Hz) have a higher CoG than male speakers (estimated CoG for Randstad male speakers = 4849.7 − 443.0 = 4406.7 Hz). The factors gender and region also interacted: West-Flemish male speakers turned out to produce /s/ with a CoG that was even lower than the male speakers in other regions.

3.2 Duration

For duration, the optimal model included the contextual factors as an interaction next to the factors region and gender as main effects.[3] Model

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2 CoG ~ region * gender + (1 + region * gender | word) + (1 | participant).
3 log10dur ~ region + gender + position * cluster + (1 + gender | word)+(1 + position * cluster | participant).
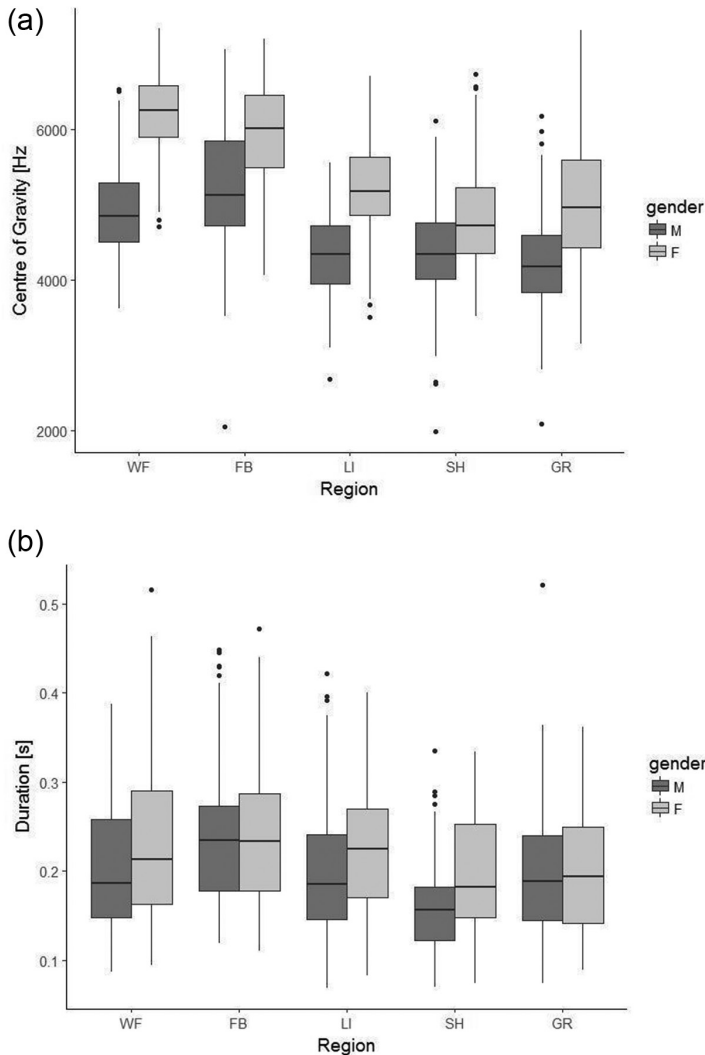
Figure 2   Boxplots for (a) centre of gravity and (b) duration. Results are given by re-gion (WF = West Flanders, FB = Flemish Brabant, LI = Limburg, SH = South Holland, GR = Groningen) and by gender (M = male, F = female).

comparison showed that the Position by Cluster interaction was justified ($\chi^2(1)$ = 11.011, p < .001). The model details are given in Table 3. Note that the coefficients in a linear model predicting a log-transformed dependent variable indicate a change factor: The intercept for SH female speakers is 219 ms [$10^{\wedge}(-0.65859)$], which is decreased by 3.6% if the speaker is an SH male, i.e. to 211 ms.

Table 2   The optimal linear mixed-effects model for the centre of gravity (CoG)

	β	Std. error	t-value
Intercept	4849.7	154.4	31.409
Region: WF	1359.2	205.3	6.621
Region: FB	1109.5	206.0	5.386
Region: LI	396.7	200.9	1.974
Region: GR	166.3	204.6	0.813
Gender: M	−443.0	202.2	−2.191
Region: WF * Gender: M	−832.1	287.8	−2.892
Region: FB * Gender: M	−243.7	285.5	−0.853
Region: LI * Gender: M	−460.1	285.5	−1.611
Region: GR * Gender: M	−334.3	285.5	−1.171

Table 3   The optimal linear mixed-effects model for duration

	β	Std. error	t-value
Intercept	−0.659	0.016	−40.78
Region: WF	0.075	0.017	4.41
Region: FB	0.138	0.017	8.04
Region: LI	0.080	0.017	4.70
Region: GR	0.036	0.017	2.08
Gender: M	−0.036	0.011	−3.22
Position: initial	−0.171	0.019	−8.82
Cluster: yes	−0.172	0.019	−8.84
Position: initial * Cluster: yes	0.102	0.026	3.90

The duration of [s] in South Holland (estimate mean = 219 ms) is significantly shorter than in the other regions. There is also a gender effect: male speakers produce shorter [s] than female speakers. Moreover, there are some effects of contextual factors. [s] is significantly shorter when it is in initial position and when it is in a cluster. These effects however are attenuated when they are combined, as shown by the interaction between position and cluster.

4   Discussion

Both measurements, CoG and duration, show regional variation in the pronunciation of /s/. However, as discussed earlier, a cross-linguistic study by Gordon et al. (2002) showed that spectral centre of gravity is a more reliable measurement for distinguishing fricatives than duration. When looking at the results of the former measurement first, there is mainly a difference between the Flemish regions (West Flanders and Flemish Brabant),

which have the highest centre of gravity, and the regions in the Netherlands (South Holland, Limburg and Groningen), which have the lowest centre of gravity. This means that the pronunciation of /s/ is more retracted in the Dutch regions than in the Flemish regions. These results are not fully in line with the hypothesis based on Collins and Mees' (2003) observations: South Holland was expected to show a more retracted [s] than the other regions. The difference between the Flemish and Dutch regions shows that s-retraction is found in an area larger than the Randstad, pointing towards a North-South pattern of variation (Belgian vs. Netherlandic Dutch). The regional variation patterns we found in this study in the pronunciation of /s/ thus seem to be in line with the patterns found for other variables as discussed in the introduction.

Apart from the regional differences there are gender differences in centre of gravity. Male speakers have a shorter [s], with a lower centre of gravity than female speakers. Therefore, male speakers seem to have a more retracted [s] than female speakers. It is unclear whether these differences are caused by biological or social factors. On the one hand, it is possible that the pronunciation of [s] by male speakers is always more retracted because of anatomical differences between males and females, where male acoustic filters (i.e. the distance between the sibilant's place of articulation and the lips) tend to be longer. There are studies which report differences in spectral centre of gravity and spectral maximum between male and female speakers. Koenig et al. (2013) and Munson et al. (2006) for example found that, for the English language, both measures taken from female speakers were higher than for [s] uttered by male speakers. Why the difference in spectral centre of gravity between males and females is not the same in every region is hard to explain if it is based solely on biological factors. On the other hand, the gender differences could (partially) be explained by social factors. In that case, s-retraction would appear to be led by male speakers of Dutch. It is however traditionally thought that women mostly lead sound change, especially in the case of changes 'from below the level of conscious awareness' (Labov 2001). The finding that male speakers have a more retracted [s] does seem similar to the results from the study by Stevens & Harrington (2016), which we discussed earlier. They found no differences in the production of retracted [s] between male and female speakers, but the perception of s-retraction was associated with male speakers. They suggested that 'insufficient compensation in perception for the inherent acoustic differences between male and female speech might play a role in the initiation of sound change and in /s/-retraction in particular' (Stevens & Harrington, 2016: 132). Even though their explanation is based on the

biological differences between male and female speakers, they also suggest that s-retraction as a sound change might originate from male speech. However, we cannot rule out that the differences in CoG are due to variation as a result of sampling, because the regional gender groups were not matched for biological similarities.

When looking at duration, the results are in line with the hypothesis that [s] pronunciation is shorter in South Holland than in other regions. Even though this result is consistent with s-retraction and the hypothesis formulated by Collins & Mees (2003), it is equally consistent with more general differences in tempo found in Dutch (Verhoeven, De Pauw & Kloots 2004; Quené 2008). Verhoeven et al. (2004) found that Belgian speakers of Dutch had a lower articulation rate than speakers from the Netherlands. In the Netherlands, the central region, i.e. Randstad, was especially fast. This result was confirmed by Quené (2008), but in that study the regional differences within each country were moderated. There also was a gender effect in our data with males producing [s] shorter than females. Similar tempo differences are more generally found between male and female speakers of Dutch in the studies just-mentioned. Finally, there were effects of the linguistic context of [s] on its duration. The stimuli were recorded as a list, one by one, and therefore each item forms its own phonological phrase. The longer final than initial [s] pronunciations may therefore partially be explained by final lengthening (see the results of Jongman 1998, Experiment 1, for a similar pattern), and the shorter durations in clusters by the shortening of speech sounds in more complex syllables (see Lehiste 1970: 40, or Nooteboom 1972, for similar patterns in Dutch). In these data, no effect of linguistic context on the Centre of Gravity was found, yielding no evidence that particular contexts elicited more s-retraction than others, as forwarded by Collins & Mees (2003). However, it will be important in further research to examine word-final contexts -rs (e.g., *laars* 'boot', *kaars* 'candle') which were not included in this study (due to the fact that the word list was originally designed for another purpose) and to control better for the rounding of the preceding vowels. When taking our measurements together, we are therefore inclined to interpret the effects found for duration as more general tempo differences between the speaker groups included in this study than as evidence for s-retraction. This is consistent with the acoustic studies on fricatives who mainly report durational differences between sibilants and non-sibilants, but not between /s/ and /ʃ/ (Behrens & Blumstein 1988; Jongman et al. 2000).

As explained in the introduction, the whole Dutch fricative system is undergoing change: voiced fricatives are increasingly devoicing (Kissine

et al. 2003, 2005; Pinget 2015; Van de Velde 1996; Van de Velde et al. 1996). This devoicing process shows different degrees of advancement depending on the region (i.e. roughly speaking the more Northern the region, the more devoiced) and the type of fricatives (labiodental, alveolar and velar/uvular) (Van Heuven & Van de Velde 2010). The devoicing of /z/ seemed to have originated from the Randstad area, and spread to a large part of the Dutch language area (Van de Velde & Van Hout 2001). The analogous regional variation patterns (for s-retraction and z-devoicing) do raise the question whether there might be a chain shift in alveolar fricatives: alveolar /z/ is more and more devoicing to /s/, and therefore /s/ may be retracting to the post-alveolar /ʃ/. Chain shifts are well-studied sociophonetic phenomena for vowel changes (e.g., the Northern Cities Vowel Shift, see Labov, Ash & Boberg 1997, 2006), but less well-known when it comes to consonantal changes. Further sociophonetic analyses (also at the individual level) are required to determine whether there might be a chain shift in the Dutch fricative system.

One last point of discussion is that this has been an explorative study. We have not compared realisations of both [s] and [ʃ] within individual speakers. Therefore, it was only possible to measure in which regions [s] is more retracted relative to other regions. It however could not be demonstrated that [s] of speakers from those regions that seemed to have a retracted [s], is actually similar to these same speakers' realisation of [ʃ]. This should be addressed in further research.

5 Conclusion

We hypothesized that there is regional variation in the pronunciation of /s/ within the Dutch language area. Based on the original observation of Collins & Mees (2003), we expected speakers from South Holland (Randstad) to show a more retracted [s] (i.e. a more [ʃ]-like pronunciation of /s/) than speakers from other regions, here West Flanders, Flemish Brabant, Netherlands Limburg, and Groningen. Spectral centre of gravity (CoG) and duration were used to measure the degree of s-retraction. Moreover, we expected a gender difference in spectral centre of gravity.

The analyses revealed that CoG values were significantly lower (consistent with more retraction) in the regions in the Netherlands (South Holland, Limburg and Groningen) than in the Flemish regions (West Flanders and Flemish Brabant). For duration, speakers from South Holland produced significantly shorter /s/ than the other speakers, and males had shorter

durations than females. Yet, these differences might solely be explained by general patterns in speech tempo. It is however difficult to distinguish whether the differences observed here are caused by biological or social factors, or both.

In conclusion, /s/ shows regional variation within the Dutch language area. These patterns of variation are not fully in line with the hypothesis formulated by Collins and Mees (2003). The difference between the Flemish and Dutch regions shows that s-retraction is found in an area larger than the Randstad, possibly pointing towards a North-South pattern of variation (Belgian vs. Netherlandic Dutch).

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