An acoustic-phonetic study of retraction of /s/ in Moroccan Dutch and endogenous Dutch

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Abstract

In Moroccan Dutch, /s/ has been claimed to be pronounced as retracted [s̠] (towards /ʃ/), in certain consonant clusters. Recently, retracted s-pronunciation has also been attested in endogenous Dutch. We tested empirically whether Moroccan Dutch [s] is indeed more retracted than endogenous Dutch [s] in relevant clusters. Additionally, we tested whether the inter-speaker variation of /s/ is smaller between Moroccan Dutch speakers than between endogenous Dutch speakers, as expected if retraction of /s/ would be used as identity marker in in-group conversations in Moroccan Dutch. The [s] realizations of 21 young, male Moroccan Dutch and 21 endogenous Dutch speakers were analyzed. Analyses of the spectral centre of gravity (CoG) show that both groups of speakers had more retracted pronunciations of [s] in typically retracting contexts than in typically non-retracting contexts. However, Moroccan Dutch speakers had higher CoG in both contexts than endogenous Dutch speakers, refuting the stronger retraction expected in Moroccan Dutch speakers. The inter-speaker variation was larger between Moroccan Dutch speakers than between endogenous-Dutch speakers, refuting the expected usage of /s/ retraction as a group identity marker.

Keywords: s-retraction, Moroccan Dutch, phonetic convergence, sociophonetics

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1. Introduction

The variety of Dutch spoken by second-generation speakers of Moroccan descent, generally referred to as 'Moroccan Dutch' (Dorleijn & Nortier 2006; Hinskens 2011; 2014; Muysken 2013; Van Meel 2016), is mainly used in informal in-group conversations (Nortier & Dorleijn 2008; Mourigh 2017). A characteristic feature of Moroccan Dutch is the phoneme /s/, which is often said to be pronounced as the phoneme /ʃ/ when occurring in consonant clusters: Dutch *school* ('school') would then be pronounced more similar to *sjchool*. At the same time, endogenous Dutch speakers vary in their pronunciation of /s/ (Ditewig, Pinget & Heeren 2019). For instance, speakers of endogenous Dutch in the Netherlands produce a more /ʃ/-like pronunciation of /s/ than those in Flanders (Ditewig et al. 2019). Here we use the term 'endogenous' to refer to the varieties of Dutch spoken in the Netherlands by speakers with a Dutch ethnic background. Hence, the current study aims to investigate the pronunciation of /s/ in Moroccan and endogenous Dutch, by means of acoustic-phonetic analysis.

In the literature, the phenomenon that /s/ is pronounced with a more backward place of articulation, more similar to /ʃ/, is termed *s-retraction* (cf. Baker, Archangeli & Mielke 2011; also the term *palatalization* is used to refer to this phenomenon, see e.g. Mourigh 2017). It is unclear whether s-retraction in varieties of Dutch is indicative of a phonemic shift from /s/ to /ʃ/, or whether it results in an allophone of /s/. In the latter case we should strictly be speaking of [s̠], i.e. a retracted variant of /s/.[1] The literature on s-retraction in Dutch seems to suggest a phonetically motivated sound change from [s] to its phonetic variant [s̠] (Ditewig et al. 2019). However, others have proposed the notion of *overgeneralization* of /ʃ/, that is a phonemic shift (Dorleijn & Nortier 2006; Nortier & Dorleijn 2008). Stevens & Harrington (2016) showed that, in English, the spectral centre of gravity was lower in /s/ before /t/ than /s/ before vowels and,

[1] Note that we adhere to the convention to use square brackets [ ] to represent a phonetic realization or variant of a phoneme, and slashes / / to represent an abstract phoneme.

using a synthetic /s-ʃ/ continuum, listener perception showed a bias towards /ʃ/ responses when the sibilant was followed by /t/ relative to when it was followed by a schwa. It was therefore suggested that there is a phonetic bias, and that s-retraction may be a listener-driven sound change from /st/ to /ʃt/. For Dutch, it has not yet been investigated whether typical s-retraction contexts create a phonetic bias in listeners. Therefore, to abstain from making claims about the phonemic status of retracted s-pronunciations that seem to occur in certain phonetic contexts, we will refer to /s/ and its retracted variant [s̠].

In Moroccan Dutch, s-retraction is said to occur primarily when /s/ is the first phoneme in an onset consonant cluster (cf. Nortier & Dorleijn 2008; Mourigh 2017). As far as we are aware, however, the claim that s-retraction in these contexts occurs more strongly in Moroccan Dutch than in endogenous Dutch has not been corroborated by acoustic-phonetic measurement. In fact, Moroccan Dutch /s/ has never been measured acoustically before in general. The first research question then is whether Moroccan Dutch /s/ can be differentiated acoustically from endogenous Dutch /s/; i.e. is Moroccan Dutch /s/ in onset consonant clusters more retracted than endogenous Dutch /s/?

The second question is related to the use of features of Moroccan Dutch as an identity marker (Dorleijn & Nortier 2006), i.e., a linguistic marker of social variation that speakers can deliberately choose to use in their speech (Labov 1972). Intra-speaker variation in the use of markers is often linked to the communicative situation, and for Moroccan Dutch, this means that the variety is mostly used in informal in-group situations (Dorleijn & Nortier 2006). Inter-speaker variation is related to the notion of phonetic convergence or accommodation. Conversational partners have been found to converge or accommodate towards each other phonetically, i.e. to reduce their inter-speaker variation, triggered by a mostly unconscious desire to emphasize similarity (e.g. Giles 1973; 2016; Coupland, Coupland & Giles 1991). Because Moroccan Dutch contains identity markers, used to express group identity and thus similarity (Dorleijn & Nortier 2006), speakers of this variety of Dutch may show phonetic accommodation for these markers when talking with each other. This follows from Trudgill's (1986: 11) idea that identity markers that are socially salient show phonetic accommodation. Since Moroccan Dutch speakers themselves report their s-retraction as a salient feature of this variety (Mourigh 2017), and since accommodation would result in more similar phonetic behavior among speakers in such a feature, we predict less variation between speakers of Moroccan Dutch in their pronunciation of /s/ as compared to endogenous Dutch speakers. It should be noted that previous research by Mourigh (2017) has found inter- and intraspeaker variation in the use of retracted [s], based on situational factors such as conversational topic. However, these data were collected in an interview setting focusing on metalinguistic comments, which might not have elicited convergence. The second research question then is whether the inter-speaker variability in the pronunciation of /s/ is smaller for Moroccan Dutch speakers than for endogenous Dutch speakers in in-group conversations.

The aim of this exploratory study is twofold. Firstly, it provides us with new insights in the acoustic-phonetic characteristics of Moroccan Dutch /s/ in different phonetic contexts relative to endogenous Dutch /s/. Secondly, we test whether /s/ retraction, a phonetic characteristic that has been claimed to be used as an identity marker for the Moroccan Dutch ethnolect, does affect the inter-speaker variation in pronunciation of /s/. In other words, we investigate whether s-retraction results in more similarity within a group of Moroccan Dutch speakers, relative to a group of endogenous Dutch speakers.

2. Background

2.1 Moroccan Dutch

Young second-generation speakers with a Moroccan ethnic background have adopted a variety of Dutch that is markedly different from other varieties of Dutch, mostly in its phonetic aspects

(Dorleijn & Nortier 2006; Nortier & Dorleijn 2008; Muysken 2013). The Moroccan Dutch variety is an ethnolect in the sense that it is a variety of a majority language that has emerged after a period of bilingualism and is associated with a specific ethnic group (e.g. Muysken 2013). Ethnolects can differ from the standard variety in multiple respects. In the case of Moroccan Dutch there are mainly differences in the phonetic domain (e.g. Nortier & Dorleijn 2008), but syntactic differences such as in grammatical gender have also been observed (Hinskens 2019; Hinskens, Van Hout, Muysken & Van Wijngaarden 2020). Many ethnolects, especially those spoken by young ethnic minorities, are used as a stylistic register (e.g. Hinskens 2011; Hinskens et al. 2020); the speakers are bilingual and also proficient in the respective standard variety of the area. They can easily switch between varieties depending on their communicative goals, and do so often (Hinskens 2019; Jaspers 2011). The reported use of features of Moroccan Dutch as an identity *marker* corresponds to such a function of ethnolects as a register in that speakers consciously choose to employ these features in specific situations (Dorleijn & Nortier 2006; Nortier & Dorleijn 2008). This is as opposed to an *indicator*, which refers to a characteristic speech style or element that speakers cannot consciously employ (Labov 1972).

Moroccan Dutch as spoken by second-generation speakers is based on the variety of the first-generation immigrant speakers, but it contains different aspects. First-generation immigrant speakers show an L1 influence of Berber and Arabic in their Dutch ethnolect, primarily in their pronunciation. Some reported features of this ethnolect are a gemination of Dutch uvular /x/, a more voiced pronunciation of /z/ (Hinskens 2011; Van Meel 2016), and the pronunciation of /sx/ as /ʃx/ (Nortier & Dorleijn 2008). The Moroccan Dutch of second-generation speakers mainly shows phonetic ‘exaggerations’ of the L2 Dutch speech of first-generation immigrant speakers (Nortier & Dorleijn 2008). Second-generation speakers’ pronunciation of /x/ shows even more gemination than that of first-generation immigrant speakers, and syllable-initial /z/ is even more voiced than in first generation immigrant speakers (Nortier & Dorleijn 2008).[2] Most important for the current research is the finding that the pronunciation of /sx/ as [s̠x] is overgeneralized: /s/ is pronounced as [s̠] when it occurs as the first consonant in certain consonant clusters (Nortier & Dorleijn 2008; Mourigh 2017).

The pronunciation of /s/ as [s̠] in consonant clusters has been reported in several studies in the speech of second-generation speakers with a Moroccan background in various Dutch cities (Mourigh 2017; Van Krieken 2004; Nortier & Dorleijn 2008). It seems to appear most in /sl/, /sn/, /sm/ or /sx/ onset clusters (Van Krieken 2004; Mourigh 2017).[3] In his study on speakers from Gouda, Mourigh (2017) reported that /s/ is pronounced as [s̠] in nouns, verbs and adverbs. It occurs in word-initial as well as in word-medial onset clusters, but the pronunciation of /s/ as [s̠] was not attested across word boundaries or in compounds.

The studies discussed above are based on observations by linguists and on introspection of participants, by asking them how their way of speaking is characterized and how it differs from endogenous Dutch. The finding that the pronunciation of /s/ as [s̠] is not only observed by linguists, but is also reported as a characteristic feature by speakers of Moroccan Dutch themselves, suggests that it is indeed a marker as defined above, and might even go towards being a stereotype, which is a variable speakers comment on amongst themselves (Labov 2001). The present study aims to test claims made in these previous studies using evidence from another domain, viz. acoustic-phonetic measurements of /s/'s produced by a representative sample of speakers of Moroccan Dutch and endogenous Dutch.

2.2 The acoustic characteristics of /s/ in the Dutch language area and s-retraction

[2] 'exaggerated' is the term used in literature on Moroccan Dutch. Such intensification of a sound change, especially when occurring in transfer to a young, next generation, has also been called 'incrementation' (Labov 2001).

[3] /sx/ is represented orthographically as <sch> in Dutch. However, orthographic <schr> is realized as [sr] in most (standard) western varieties of Dutch as spoken in the Netherlands. See for example Van Eerten (2007), who attested this pronunciation in the Corpus Spoken Dutch. In contrast, Mourigh (2017) found that in Moroccan Dutch as spoken in Gouda <schr> is pronounced [sxr].

The pronunciation of /s/ in Moroccan Dutch should be regarded within the context of the place of /s/ in the Dutch fricative system and the pronunciation of /s/ in the Dutch language area. The Dutch fricative system mainly consists of three voiced-voiceless pairs: labiodental /f/ and /v/, alveolar /s/ and /z/, and velar/uvular /x/ and /ɣ/. The voiced velar is only found in southern and eastern varieties (Goeman & Van de Velde 2001: 93). In addition to these pairs, there is also the glottal /h/. The voiceless postalveolar /ʃ/ and voiced palato-alveolar /ʒ/ are common, but primarily occur in loanwords (Booij 1999, e.g. *sjaal* 'scarf' /ʃaːl/, *sjouwen* 'to carry' /ˈʃɔuə/, *journaal* 'news' /ʒurˈnaːl/, and *garage* 'garage' /xaːˈraːʒə/). The phoneme /ʃ/ primarily occurs in initial position, but can also result from assimilation of /s/ with a following /j/, as in *neusje* (/nøːʃə/, 'small nose') (Booij 1999). Finally, the Dutch voiced fricatives show a devoicing trend, especially in The Netherlands (Van de Velde, Gerritsen & Van Hout 1996; Kissine, Van de Velde & Van Hout 2003). Whereas all fricatives in codas have neutralized the voicing contrast, this sound change is still ongoing in onsets. Standard and northern varieties of Dutch have neutralized the voicing contrast for /x – ɣ/ and in some regions, such as Amsterdam, there is no /s – z/ voicing contrast (Collins & Mees 2003: 190-191). Fricative devoicing seems to be more progressed in /f – v/ than in /s – z/ (Kissine et al. 2003).

Dutch /s/ is described as a laminal alveolar fricative, meaning that the alveolar constriction is not made with a tapered tongue tip as is typical in languages such as English (and also Moroccan Arabic and Berber, see Van Meel 2016: 32-33), but with the more posterior tongue front/blade (Collins & Mees 2003: 189-191 and 221). In addition, the alveolar constriction in Dutch is laxer and may be accompanied by lip-rounding. As a result, /s/ in Dutch has lower frequency friction and sounds less 'sharp' than in English (Collins & Mees 2003; Quené, Orr & Van Leeuwen 2017). The sharper-sounding apical articulation of /s/ in the heritage languages Moroccan Arabic and Berber (Van Meel 2016: 32-33) might have influenced the articulation of /s/ in speakers of Moroccan Dutch, who are reported to also have a 'sharper' sounding /s/ (Dorleijn & Nortier 2006). It is unclear how this sharper /s/ pronunciation may co-exist with the retracted realization of /s/ in the Moroccan Dutch variety.

There is also regional variation in the realization of /s/ in the Dutch language area (Collins & Mees 2003; Ditewig et al. 2019); the pronunciation of /s/ in The Netherlands is more retracted than in Flanders (Ditewig et al. 2019). S-retraction has also been observed in various varieties of English, German, and Italian (see Stevens & Harrington 2016). In many English varieties, /s/ is pronounced most retracted when it occurs as the first phoneme in consonant clusters, mostly in word-initial position (Lawrence 2000; Baker et al. 2011; Cruttenden 2014; Stevens & Harrington 2016). To be more specific, the experiments on the effect of the following phonetic context in English varieties have been restricted to /s/ followed by a vowel versus a stop consonant /p, t, k/, where the stops could also be followed by a rhotic. These studies show that /s/ is more retracted when followed by a stop consonant than a vowel, and even more retracted when the rhotic is part of the onset cluster (Baker et al. 2011; Stevens & Harrington 2016; Stuart-Smith et al. 2019). For the Moroccan Dutch variety, a contextual effect for s-retraction has also been reported (Van Krieken 2004; Mourigh 2017). The consonants eliciting retraction, however, are different from those in the English case. Mourigh (2017) differentiates between s-retraction in typical contexts, which he refers to as 'regular', and non-regular s-retraction in atypical contexts. Regular retraction occurs when /s/ is followed by /l, m, n, x/ and irregular retraction is sparse and occurs in various other contexts, including five cases of /st/ (out of 279 cases of s-retraction). The following consonants in the observed regular retraction contexts range in place of articulation from bilabial (/m/) to uvular (/x/), which indicates that it does not seem to be anticipatory place assimilation that drives s-retraction. It has as yet not been assessed *acoustically* whether there are contextual differences in s-retraction in varieties of Dutch, including Moroccan Dutch. In doing so, we follow the division into typical and atypical retraction contexts as proposed by Mourigh (2017) rather than the contexts proposed for English.

The postalveolar fricative /ʃ/ is produced with a more backward tongue position than /s/. This difference is reflected in various acoustic-phonetic measurements, as a more backward pronunciation yields a longer acoustic filter (downstream from the noise source at the constriction point), which in turn leads to lower resonance frequencies affecting the frication noise (see Stevens 1998: 398-405 for details). Thus a more backward pronunciation is usually reflected in a lower spectral centre of gravity (CoG) and lower spectral maximum. Gordon, Barthmeier & Sands (2002) compared /s/ and /ʃ/ in six languages, and found that indeed /ʃ/ had a lower CoG and spectral maximum than /s/. These differences have also been found for endogenous Dutch canonical realizations of these fricatives (Rietveld & Van Heuven 2013: 157-159). In an experimental study using a picture-prompted repetition task, Reidy (2016) furthermore found that the spectral characteristics of word-initial English /s/ and /ʃ/ differ over time. Fricative /s/ showed a steeper rise in peak frequency values from its onset to its midpoint than /ʃ/. In addition to averaged spectral measures, the development of spectral measures over time may thus reflect differences between retracted and non-retracted realizations.

2.3 Inter-speaker variation and phonetic convergence

Not only are there differences between varieties of Dutch in the pronunciation of /s/, but there are also differences between individual speakers within these varieties. These individual differences are caused in part by biological variation between speakers. The characteristics of fricatives are dependent on the place of constriction and the size of the oral cavity, as well as the size of the tongue (Stevens 1998). This leads to more general differences in the acoustic characteristics between groups of speakers, for example based on biological sex. Male speakers tend to have longer vocal tracts, and therefore tend to produce lower frequency components than female speakers do. Biological differences also lead to inter-speaker variability, as reflected in several studies on the pronunciation of /s/, for English (Quené et al. 2017; Jongman, Wayland & Wong 2000; Newman, Clouse & Burnham 2001), and also for Dutch (Quené et al. 2017).

However, not all inter-speaker variation is caused and restricted by inherent biological differences between speakers. Speakers have a degree of articulatory freedom and are known to show phonetic convergence or accommodation, a phenomenon rooted in the work of Giles (first proposed in 1973). The central idea and original cornerstone of his *communication accommodation theory* (CAT) is that “when interlocutors desire each other’s approval they will converge their speech patterns, whereas when they wish to differentiate from each other socially, they will diverge them” (Thakerar, Giles & Cheshire 1982: 205).[4] Convergence thus seems to result from an underlying belief that similarity leads to attraction (so-called ‘similarity attraction’, as first proposed by Byrne 1971). Next to divergence or convergence, speakers might also maintain their language use (e.g. Giles & Ogay 2007). Which strategy comes into play depends on the social categories the speakers are members of, and whether the conversation is between in-group or out-group members. Speakers are members of several social groups, some of which are more salient, also in a socio-historical context, such as culture, ethnicity and social status (e.g. Giles & Ogay 2007; Zhang & Giles 2018). According to communication accommodation theory, interactions between in-group members foster strategies that accentuate similarities between the speakers (e.g. Giles & Ogay 2007). A tendency towards similarity leads to convergence, which functions to generate positive feelings and reduce social distance between the members of a group the speakers associate themselves with (Coupland et al. 1991; Giles & Ogay 2007).

[4] CAT has been revised numerous times since its original conception, adding for example models of sociohistorical context and evaluation of interpersonal relations (e.g. Giles & Gasiorek 2013). Its application is increasingly extended to other aspects of (intercultural) communication. However, linguistics remains a core part and the notions of convergence and link to similarity and social category membership remain relevant (e.g. Giles & Ogay 2007; Zhang & Giles 2018).

Convergence is present in varying aspects of communicative behavior, reflected in a variety of linguistic levels. Examples of these are word choice (Bortfeld & Brennan 1997; Niederhoffer & Pennebaker 2002), syntactic structures (Gries 2005), and phonetic aspects such as speech rate (Schweitzer & Lewandowski 2013), utterance length (e.g. Matarazzo & Wiens 1973), and accent (e.g. Giles 1973; Bourhis & Giles 1977). Even nonverbal features in communication have been found to show convergence, such as smiles and expressions, gazing, and gestures (e.g. Jokinen, Harada, Nishida & Yamamoto 2010; Bruder, Dosmukhambetov, Nerb & Manstead 2012; Kimbara 2008).

Further evidence for extensive convergence on the phonetic level can for example be found in a study by Pardo, Gibbons, Suppes & Kraus (2012), who reported that college roommates converged in their pronunciation of vowels, and that the degree of convergence slowly increased over time. The degree of convergence was dependent on the reported closeness of the relation between the pairs of roommates. Some other relevant recent studies include Babel (2009; 2012), who found convergence in the production of certain vowels, and Evans and Iverson (2007), who found convergence in vowel production in the in-group population of university students. Following the literature discussed in this section, it may be expected that if s-retraction in Moroccan Dutch is used as a group identity marker, which is furthermore a salient feature (see our discussion in the introduction), then it is likely to occur in in-group conversations and to be subject to convergence. This may in turn influence the variation between speakers of Moroccan Dutch relative to that between speakers of endogenous Dutch.

3. Research questions and hypotheses

Regarding the pronunciation of /s/ in Moroccan Dutch, this research has two aims. We first investigate the acoustic characteristics of /s/ in spoken Moroccan Dutch, in comparison with endogenous Dutch. Using [s]-tokens sampled from informal in-group conversations, we take spectral measurements both averaged across the fricative duration, and dynamically at three time points within the fricative. We predict (1.a) that Moroccan Dutch /s/ will be retracted more strongly than endogenous Dutch /s/, based on the literature on Moroccan Dutch. An alternative finding, based on recent indications of a generally retracted pronunciation of /s/ in endogenous Dutch (Ditewig et al. 2019), would be that there is no difference between Moroccan Dutch and endogenous Dutch s-retraction.

Additionally, the phonetic context of /s/ has been proposed to influence the degree of retraction in Moroccan Dutch. We expect the possible difference between Moroccan Dutch speakers and endogenous Dutch speakers to be larger in consonant clusters where retraction typically occurs in Moroccan Dutch, i.e. /sx, sl, sn/ (henceforth typical retraction clusters), than in other consonant clusters, such as /st/ (henceforth atypical retraction clusters). Typical cluster /sm/ and frequent atypical cluster /sp/ were not included, because anticipatory lip rounding in these contexts may influence the fricative's acoustics, as has been found for Dutch /s/ (Smorenburg & Heeren 2020). Lip rounding lengthens the vocal tract, thus lowering its resonance frequencies. Based on the literature on Moroccan Dutch, we thus predict (1.b) an interaction between language variety and phonetic context.

Our second research question concerns the function of s-retraction as an identity marker in Moroccan Dutch. Do speakers of Moroccan Dutch vary less in their [s] realizations, thus showing evidence of inter-speaker convergence, than speakers of endogenous Dutch in in-group conversations? We predict (2) that between-speaker variation will be smaller between Moroccan Dutch speakers than between endogenous Dutch speakers.

4. Methodology

4.1 Materials

Speech materials from the NFI-FRIDA database were used (Van der Vloed, Bouten, Kelly & Alexander 2018). It contains speech from 249 speakers, 200 of which are aged between 18 and 35. All speakers are male and have low levels of education. 108 speakers have an endogenous Dutch background, 71 a Turkish background and 70 a Moroccan background. This information about ethnic background is included for every speaker in the database. All speakers have Dutch as their L1, live in the Amsterdam area, and the majority was also born and raised there (Van der Vloed, Kelly & Alexander 2020). The speech materials were collected over several sessions, on two days at least one week apart, and the materials consist of 5-minute in-group telephone conversations with one other speaker. From the recordings it can be inferred that most speaker pairs knew each other, because speakers discussed e.g. mutually known people and places.

The speech was recorded simultaneously on several devices, but the current study only included the high-quality recordings (48 kHz sampling frequency) of the sessions that were recorded indoor without background noise, using a Shure WH20 HQ headset. Twenty-one speakers with a Moroccan Dutch background and twenty-one speakers with an endogenous Dutch background were included. Speakers were selected based on the availability of at least 20 tokens of /s/ in onset clusters, at least 10 per phonetic context (see below). In total, 1,192 tokens were collected.

The selected /s/ tokens occurred in word-initial and word-medial onset consonant clusters. Phonetic contexts were chosen based on two factors related to retraction. First of all, three contexts named in the literature on s-retraction in Moroccan Dutch were considered: /sl/, /sx/ and /sn/.[5] These contexts are grouped together as *typical retraction contexts*. To test the contextual hypotheses (1.a, 1.b), three clusters that are not observed as typical retraction contexts were considered as well: /st/, /str/ and /sk/. These contexts are grouped together as

[5] Contrary to Gouda Moroccan Dutch, as investigated by Mourigh (2017), we cannot exclude the realization of orthographic <schr> as [sr] in our Amsterdam corpus. In total, 25 of our tokens contain <schr>, but these do not differ in acoustic measurements from the other /sx/ contexts.

atypical retraction contexts. The distribution of tokens in the materials over the respective contexts is shown in Table 1.

	Typical contexts			Atypical contexts		
Context	/sx/	/sl/	/sn/	/st/	/str/	/sk/
Absolute number	285	127	142	498	94	46
Percentage (of category)	51.4	22.9	25.6	78.1	14.7	7.2
Percentage (of total)	23.9	10.7	11.9	41.7	7.9	3.9

Table 1: Distribution of tokens over contexts in absolute numbers and percentages of the respective category and of the total number of tokens.

The NFI-FRIDA database contains orthographic transcriptions, and using these transcriptions, /s/ tokens were located in the speech signal and then manually segmented and annotated. The boundaries of each token were set manually based on visual assessment of their spectral characteristics. Generally, onset and offset boundaries were placed at the start and end of high-frequency aperiodic noise, characteristic for sibilant speech sounds. For fricatives preceded by plosives the onset was set after the initial release burst of the plosive. The offset of fricatives followed by plosives was marked by the onset of the silent interval that indicates the closure of the plosive. When /s/ was followed by /x/, the offset was placed visually before the start of lower-frequency bands typical of /x/.

4.2 Acoustic Analyses

Retraction was measured using a measurement that can reliably distinguish /s/ from /ʃ/ (see section 1.1.2): the spectral centre of gravity (CoG, see Gordon et al. 2002). CoG is a measure of spectral mean, the central tendency of a spectrum, and it is taken over a certain frequency range within the spectrum. CoG is typically higher in /s/ than /ʃ/ (Gordon et al. 2002), and would therefore be higher in non-retracted relative to retracted realizations of /s/ (example spectrograms for Dutch can be found in Rietveld & Van Heuven 2013:157-159). CoG is also highly correlated with the spectral maximum, which is the frequency component in the spectrum with the highest intensity.[6] The higher the spectral peak frequency of an [s], the sharper it sounds.

The CoG was measured for all tokens of [s] over the segment's full duration, using Praat (Boersma & Weenink 2017). From each [s] waveform a power spectrum was computed over the 2.0-8.0 kHz frequency range, capturing the power distribution of different frequency components in the signal. Next, the average frequency (CoG) over that frequency range was computed, with weighting by the power spectrum. Additionally, in order to track CoG over time during the consonant, the CoG measure was also taken at 25%, 50% and 75% of the segment's duration, using 10-ms windows for computation of the spectra. This allows us to also assess temporal variability within the realization of the fricative (cf. Reidy 2016).

4.3 Statistical analyses

The data were analyzed by means of linear mixed-effect models (LMMs) in R (R Core Team 2020). The so-called LMM technique allows us to simultaneously separate the random variations among speakers and among words from the fixed effects of interest, viz. ethnicity (Moroccan Dutch or endogenous Dutch, varying between speakers) and phonological context (typical or atypical for retraction, varying between words). Hence the latter (fixed) effects of interest are assessed only after separating them from the former (random) effects (Quené & Van den Bergh 2004). Moreover, contrary to most other techniques, LMM does not require assumptions of equal (co)variances (homoskedasticity, sphericity): more precisely, in answering our first question we allowed random variations among speakers to be different for the two phonological contexts, and allowed random variations among words to be different for the two speaker groups. Moreover, because LMM is a regression technique, it also allows for incomplete designs such as ours, where a particular speaker realizes a particular word either not

[6] For the current data, a correlation of $r = .81$ ($p < .001$) was found between CoG and spectral peak measurements.

once, or once, or more than once. In LMM, we start with building and fitting models containing all regression components of possible relevance, including interactions of fixed predictors, after which these LMMs are compared with simpler models from which terms were dropped, using likelihood ratio tests. Here we only present the optimal LMM resulting from this manual fitting procedure. LMMs were estimated and compared using the R package *lme4* (Bates, Maechler, Bolker & Walker 2015).

In order to answer the first research question, we performed two LMM analyses. The first LMM analysis assessed the effects of the fixed factors Ethnicity and Context on the average CoG over the entire [s] token. The second LMM analysis also assessed the effect of *time* (at 25%, 50%, or 75% of the [s] token, with 50% used as a baseline), on the CoG.

In order to answer the second research question, we performed a separate LMM analysis, again using the average CoG over the entire [s] token as the dependent measure. Ethnicity and Context were again included as fixed main effects of interest. In this latter LMM, the only random variation taken into account was that between speakers (Goldstein, Browne & Rasbash 2002). The resulting optimal LMM contains variance estimates, from which the so-called *intra-speaker correlations* were computed for both groups. A high intra-speaker correlation indicates that most *variance* is found between speakers, as opposed to within speakers; hence, the intra-speaker correlation reflects the relative ‘uniqueness’ of the speakers within both groups (Quené 2008). In order to obtain a more robust estimate of these intra-speaker correlations, with sampling variability, this second LMM analysis procedure was also repeated 200 times, for 200 so-called bootstrap samples of speakers (Efron & Tibshirami 1993), yielding 200 intra-speaker correlations for each group.

5. Results

5.1 Static CoG: Effects of ethnicity and phonetic context

The optimal model for average spectral CoG measured over the entire [s] segment included significant main effects of fixed predictors Ethnicity and Context. The output of this best-fitting LMM is given in Table 2. The interaction effect was not significant ($t < 1$), and an alternative model without this interaction term fit the data equally well according to a likelihood ratio test ($\chi^2(1) < 1$, p = .45). The random structure included intercepts for Speaker and Word, and random slopes for Speaker over Context ($\chi^2(2) = 17.0$, p=.0002) and Word over Ethnicity ($\chi^2(2) = 23.2$, p<.0001).

Fixed effects		*β*	*Std. error*	*t-value*	
Intercept		**4600**	**103**	**44.8**	
Ethn.MoroccanDutch		**691**	**145**	**4.8**	
Context.Typical		**−459**	**92**	**−5.0**	
interaction		97	128	0.8	
Random effects			*Variance*	*Std. dev.*	*Corr.*
Word	Intercept		128164	358	
	Ethn.MoroccanDutch		195435	442	−0.61
Speaker	Intercept		174244	417	
	Context.Typical		62228	249	−0.47
Residual			254963	505	

Table 2: The optimal linear mixed-effects model for CoG (in Hz). Significant fixed effects are printed in boldface.

The estimated CoG of Moroccan Dutch speakers is 691 Hz *higher* (rather than lower, as expected) than the estimate CoG for endogenous Dutch speakers. The CoG estimate for typical retraction contexts is 459 Hz lower than for atypical retraction contexts. Figure 1 shows the observed CoG measures, broken down by the two main effects of ethnicity and context.

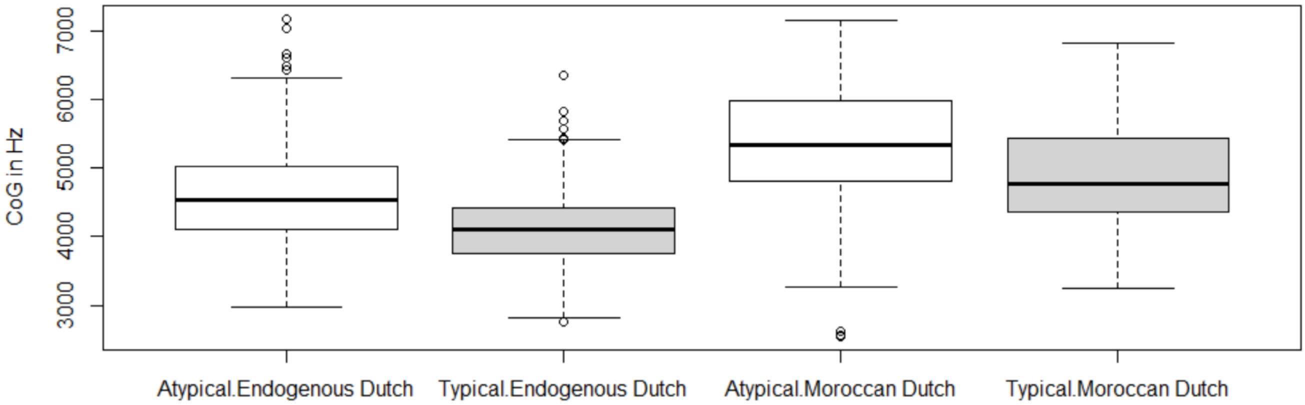

Figure 1: Boxplots of observed CoG results in Hz, broken down by Context (Atypical, Typical) and Ethnicity (Endogenous Dutch, Moroccan Dutch)

5.2 Dynamic CoG: Effects of ethnicity and phonetic context

The best fitting model for the dynamic CoG measure included a main effect of Ethnicity ($\chi^2(1) = 25.74$, $p < .001$) and a Time by Context interaction ($\chi^2(2) = 82.08$, $p < .001$). There was no interaction between Time and Ethnicity ($\chi^2(2) = 2.28$, $p = .319$). The random structure included intercepts for Speaker and Word, and a random slope for Speaker over Context ($\chi^2(2) = 111.25$, $p < .001$). The model output is given in Table 3.

Fixed effects	β	Std. error	t-value
Intercept	4625.72	98.6	46.9
Time.point1	**−185.2**	**32.8**	**−5.6**
Time.point3	**211.8**	**32.8**	**6.5**
Context.Typical	**−337.7**	**84.6**	**−4.0**
Ethn.MoroccanDutch	**709.9**	**122.0**	**5.8**
Time.point1: Context.Typical	−63.3	47.3	1.3
Time.point3: Context.Typical	**−338.1**	**47.3**	**−7.1**
Random effects		Variance	Std. dev.
Word	Intercept	242607	492.6
Speaker	Intercept	175572	419.0
	Context.Typical	125831	354.7
Residual		317214	563.2

Table 3: The optimal linear mixed-effects model for dynamic CoG. Significant fixed effects are printed in boldface.

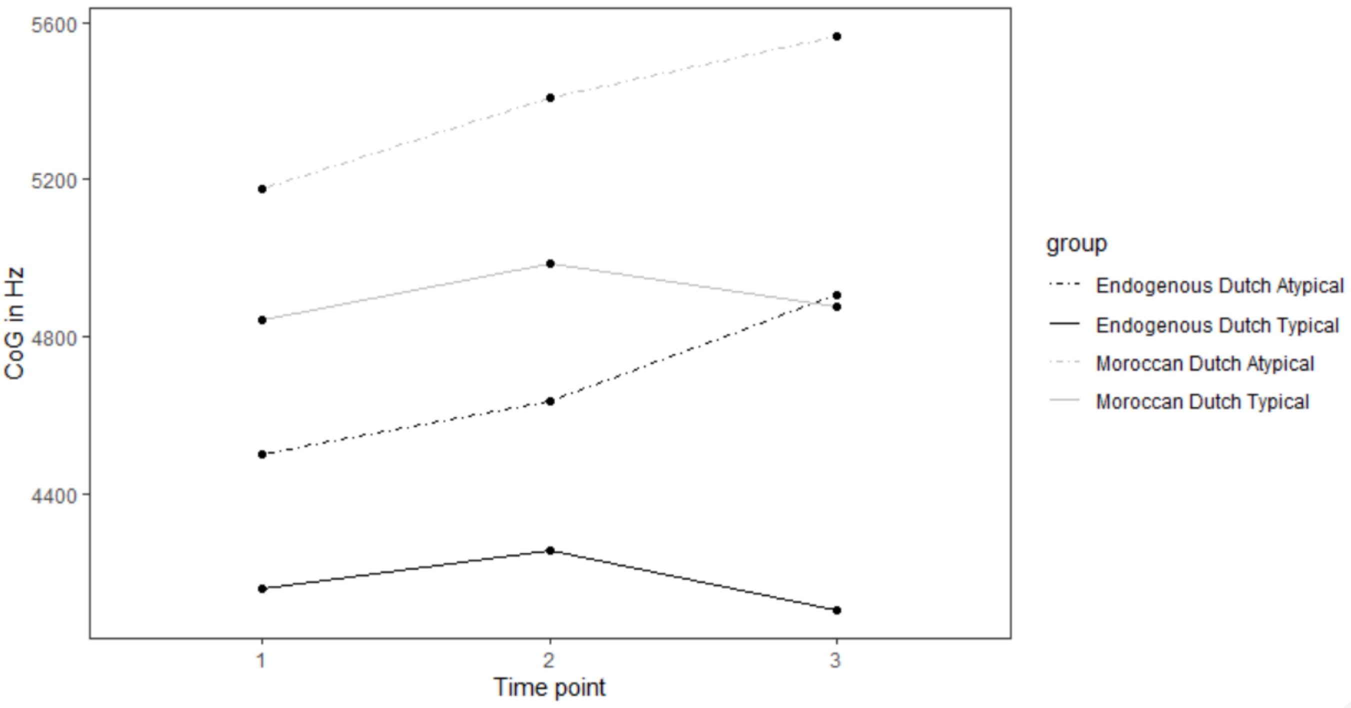

Figure 2: Mean CoG in Hz by Context and Group over time interval

The model output shows that there is an interaction between time and phonetic context, meaning that the change in CoG over time is dependent on phonetic context. As illustrated in Figure 2, for atypical contexts, CoG increases during the fricative segment from time 1 (25%) to 2 (50%) to 3 (75%). For typical contexts, CoG peaks at the middle of the segment, and then decreases at time 3.

5.3 Between-speaker variability and intra-speaker correlations

As described above, the intra-speaker correlations for each group were assessed over 200 bootstrap samples of speakers. The median intra-speaker correlation for the endogenous Dutch speakers was 0.20 (with bootstrapped 95% confidence interval [0.18, 0.23]; non-bootstrap value was 0.20), and the median intra-speaker correlation for Moroccan Dutch speakers was 0.33 (with bootstrapped 95% confidence interval [0.29, 0.37]; non-bootstrap value was 0.32). That the values are less than 0.5 indicates that within-speaker variance was larger than between-speaker variance for both groups, and these values also indicate that between-speaker variance was *larger* (rather than smaller) for the Moroccan Dutch than the endogenous Dutch speakers. Contrary to our expectation, the Moroccan Dutch speakers have a significantly higher individual uniqueness (as observed in all 200 bootstrap samples, $p < .0001$ in sign test).

6. Discussion

We had two research questions: (1) is Moroccan Dutch /s/ in consonant clusters more retracted than endogenous Dutch /s/, and (2) do speakers of Moroccan Dutch vary less in their [s] realizations in in-group conversations, thus showing evidence of inter-speaker convergence, than speakers of endogenous Dutch? We expected (1.a) that Moroccan Dutch speakers show more retraction (lower CoG) than endogenous Dutch speakers, (1.b) especially in the specific typical contexts /sx/, /sn/ and /sl/. This difference would be reflected in a lower CoG for Moroccan Dutch speakers and in a differential time course for [s] realizations between the speaker groups. Because of the use of s-retraction as an identity marker in Moroccan Dutch, less inter-speaker variability was expected within this group.

Our results show (1.a) that Moroccan Dutch speakers have a higher CoG than endogenous Dutch speakers, and (1.b) that CoG values are lower for both groups in typical retraction contexts than in atypical retraction contexts. These results do not indicate stronger s-retraction in Moroccan Dutch than endogenous Dutch speakers: the results do not support any interaction between context and ethnicity (interaction $\chi^2 < 1$). This means that the retracted pronunciation of [s] described as characteristic for Moroccan Dutch as compared to endogenous Dutch was not attested; this finding matches our own impression that when merely listening to the data, we did not perceive retracted /s/ as described in the literature. The expected interaction may have been absent in these data because the typical retraction contexts did not elicit strong retraction in the Moroccan Dutch speakers. Even though the data consist of in-group conversations, i.e. the specific conversational setting that is said to elicit retracted [s] (Mourigh

2017), the speech task might not have met all conditions for the use of retracted [s]; Mourigh (2017) found that the use of s-retraction was not only dependent on the interlocutor ('interpersonal stance'), but also on the topic of conversation (more retraction in an informal context) and the stance expressed by the speaker in his utterances ('epistemic stance'). Whereas the speech collection used in the present investigation contained samples of in-group conversations that were rather informal in nature, the epistemic but also interpersonal stance were in no way controlled.

Across retraction contexts, CoG values were not lower, but higher for Moroccan Dutch speakers than for endogenous Dutch speakers. Moroccan Dutch speakers thus seem to have a less retracted pronunciation of [s] than endogenous Dutch speakers, across both phonetic cluster contexts. A first explanation is that cultural and social factors have resulted in adjustments in the pronunciation of /s/ in Moroccan and endogenous speakers of Dutch. As mentioned in section 1.1.2, in comparison with many other languages – such as English or French in which the [s] has a higher CoG and thus a 'sharper' sound – standard Dutch [s] is already quite retracted, irrespective of its position in the utterance and irrespective of speaker size. In languages where [s] has a 'sharper' sound, the fricative is apical, i.e. a tighter constriction is formed by a pointed tongue tip. Moroccan Dutch has also been reported to have a 'sharper' sounding [s] (Dorleijn & Nortier 2006), a finding which is confirmed acoustically by the current results. The use of this 'sharper' fricative in Moroccan Dutch might be influenced by the apical articulation of [s] in the heritage languages of these speakers (Moroccan Arabic and Berber; Van Meel 2016: 32-33 refers to this as 'dentalization'). It is therefore conceivable that speakers of Moroccan Dutch use this feature from the heritage language as an expression of their connection to the heritage language.

Additionally, this finding of higher CoG in Moroccan than Endogenous Dutch might be partially explained by small physical differences between the speaker groups. There might be anatomical differences between the Moroccan Dutch male speakers and endogenous Dutch male speakers that correlate with the properties of the vocal tract, such as a small difference in average body height. Differences in CoG have for example been found between male and female speakers (Fox & Nissen 2005; Koenig, Shadle, Preston & Mooshammer 2013). In another speech collection, the speakers' mean fundamental frequency (F0) differed between these two ethnic groups, Moroccan and endogenous Dutch (Sternheim 2014); Moroccan Dutch speakers had a higher mean F0 than endogenous Dutch speakers. A direct link with physical differences cannot be made, however, because such data are not available for either speech collection, and because, as with F0 differences, sociocultural factors cannot be excluded. The difference observed here might therefore also be (partially) explained by mere sampling differences.

The context effect, with more retraction in typical contexts across groups, could in part be explained by anticipatory coarticulation effects. As shown in Table 1 about half of the tokens in the typical retraction contexts (/sn/, /sl/, /sx/) appeared in an /sx/-context and are thus followed by a velar consonant. The other half of the tokens are followed by an alveolar consonant. In contrast, the tokens in the atypical retraction contexts (/st/, /str/, /sk/) mainly appeared in an /st/ or /str/-context (93%) and are thus followed by an alveolar consonant. This relative difference in distribution of place of articulation across context types might be reflected in our results; the more backwards (velar) the following consonant is pronounced, the lower the resonance characteristics of [s]. Opposed to observations of contextual restrictions for s-retraction in some other languages, this would suggest that, for Dutch, s-retraction may result from anticipatory assimilation of place of articulation. In English, in contrast, it seems that place of articulation of the immediate phonetic context may not be the main factor explaining s-retraction (cf. Baker et al. 2011; Stuart-Smith et al. 2019). For example, there seems to be equal – or sometimes more – s-retraction in /str/ than in /skr/ or /spr/, although this varies by gender and dialect of English (Stuart-Smith et al. 2019). The anticipatory place assimilation hypothesis for s-retraction in Dutch could be tested by comparing CoG values of [s] realizations in typical contexts and atypical contexts with the same place of articulation to each other (e.g. comparing /st/ to /sn/ and /sk/ to /sx/). However, we were unable to make these comparisons because of the limited number of tokens in /sk/ and /sn/ contexts. The fact that, in typical contexts, s-retraction seems to occur mostly in the latter half of the fricative, i.e. in the part of the fricative that is most affected by the following context, further seems to indicate that s-retraction in Dutch may be phonetically motivated by anticipatory place assimilation.

With regard to our second research question, we hypothesized that Moroccan Dutch speakers would converge more in their pronunciation of [s] in in-group conversations, because Moroccan Dutch is used to express group identity under this circumstance. However, our intra-speaker correlations show that there is more (rather than less) variance in CoG of [s] between Moroccan Dutch speakers than between Endogenous Dutch speakers. This indicates that the between-speaker variance is relatively larger among Moroccan Dutch speakers than among endogenous Dutch speakers. These results could indicate that even in in-group conversations between acquaintances, the use of [s] might be restricted to certain topics and conversational situations, as suggested by Mourigh (2017). Alternatively, the function of a feature as an identity marker might not necessarily result in convergence in [s] pronunciations.

Further research could clarify our results by not only comparing [s] productions of Moroccan Dutch speakers to those of endogenous Dutch speakers, but by also considering realizations of intended /ʃ/ phonemes, in order to investigate whether [s] is pronounced closer to [s̱] in one variety than the other. Also, whereas the current study only included male speakers from Amsterdam, it would be interesting to consider speakers from other regions as well as female speakers in acoustic-phonetic analyses. Ethnolects are influenced by urban youth varieties (e.g., Van Meel 2016), and therefore Moroccan Dutch spoken in Amsterdam might differ from Moroccan Dutch spoken in other cities. Including female speakers is motivated by their role as leaders of socio-phonetic change (Labov 2001). Regarding our question on variation, production of [s] in in-group conversations across topics and conversational styles could be compared, to investigate the origin of the higher variability between Moroccan-Dutch speakers than between endogenous Dutch speakers.

7. Conclusion

We investigated s-retraction in Moroccan Dutch and in endogenous Dutch [s], as a function of consonantal context, and tested the hypothesis that s-retraction would show less inter-speaker variability when functioning as an identity marker. Results from in-group telephone conversations showed that *both* groups of speakers had a more retracted [s] in typically retracting than in typically non-retracting contexts. However, Moroccan Dutch speakers showed *less* retraction in both typical and atypical retraction contexts than endogenous Dutch speakers. Moroccan Dutch speakers furthermore showed *more* rather than less between-speaker variance in their CoG values, which provided no support for the expected relation between s-retraction being a group identity marker in Moroccan Dutch, and a higher degree of phonetic convergence. In conclusion, relative to endogenous Dutch, the retracted pronunciation of [s] does not seem to be a distinctive phonetic property of the Moroccan Dutch ethnolect.

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