THE NORWEGIAN RETROFLEX FRICATIVE

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ABSTRACT

In this paper, the Norwegian retroflex fricative /ʂ/ is investigated through the combined use of electropalatography (EPG) and electromagnetic articulography (EMA) based on four informants. Cross linguistic investigations of retroflex consonants have shown that there are three characteristics often present in their articulation: an apical articulation, a posterior place of articulation, and a bending up (retroflexion) of the tongue tip. Our investigation shows that for the Norwegian retroflex fricative, only one of these characteristics is always present, an apical articulation. The other two characteristics were found only in some contexts or in some individuals. Compared to the Norwegian retroflex plosives the same characteristics are found, including extensive variability. However, there is generally less retroflexion in the fricative than in the plosives.

Keywords: retroflex consonants, fricatives, articulation, EPG, EMA

1. INTRODUCTION

The variety of Norwegian studied in this investigation is that of Urban East Norwegian — the variety spoken in and around the larger cities in Eastern Norway [5]. In Urban East Norwegian there are three coronal fricatives, all voiceless, /s, ʂ, ɕ/. /s/ is alveolar and /ɕ/ is palatal. When it comes to /ʂ/, the descriptions in the literature vary. The place of articulation in the palate is given both as palato-alveolar [1, 8] and as alveolar [1]. Traditionally, /ʂ/ is included in the set of consonants referred to as retroflex, /ʈ, ɖ, ɳ, ʂ, ɭ, ɽ/. There is a distinctive opposition in Norwegian between the retroflex consonants and a set of consonants labelled alveolar, /t, d, n, s, l/. Notable exceptions to this type of labelling are Endresen and Kristoffersen [1, 2, 5], who argue that in Urban East Norwegian the important distinction is related to the active articulator, i.e., laminal vs. apical, from two different phonological sources. There is a set of retroflex phonemes and, in addition, there is a sandhi-process of retroflexion. This process, often referred to as the Retroflex Rule, see e.g. [5], merges clusters of the apical alveolar /r/ or the retroflex flap /ɽ/ plus the alveolar consonants /t, d, n, s, l/ into the corresponding retroflex consonants across morpheme and word boundaries.

The term retroflex is used both to refer to a particular tongue shape, the tip of the tongue curled up [6], and to consonants with a place of articulation between the (post)alveolar and palatal region, as indicated for instance by its placement in the IPA table of phonetic symbols. The phonetic classification of retroflex sounds is problematic since these sounds in general show large articulatory variation [3, 4], both between languages and between individuals.

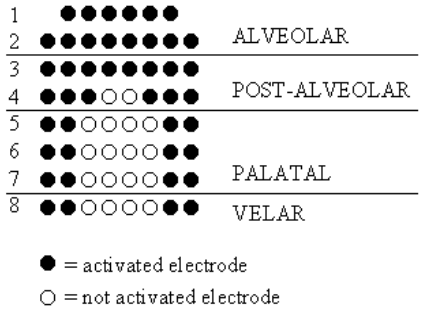
The aim of the present study is to see whether the Norwegian retroflex fricative is alveolar or post alveolar, whether it is apical or laminal, if the tongue tip is curled upwards, and to what extent there is individual variation in the articulation. A comparison with the Norwegian retroflex plosives is also made.

2. INSTRUMENTATION

We used electropalatography (EPG) and electromagnetic articulography (EMA) in our investigation.

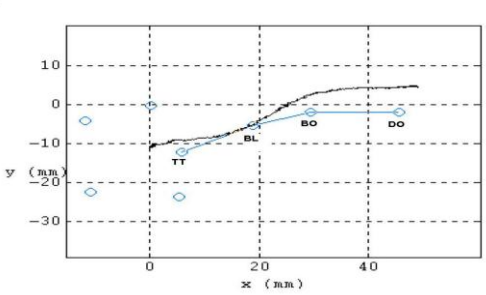
For EPG we used the Reading EPG system, with 62 electrodes arranged in 8 rows, the front row containing 6 electrodes and the rest 8 electrodes each.

Figure 1: The Reading EPG palate. Filled electrodes indicate contact between tongue and palate.



For EMA we used the Carstens Articulograph AG100 EMA system. For these particular recordings, four coils were glued to the tongue along the midsagittal line — on the tongue tip, the tongue blade, the tongue body, and the tongue dorsum, with an approximately equal space between the coils.

Figure 2: Example of EMA picture. The relevant coils are the tongue tip (TT), the tongue blade (BL), the tongue body (BO), and the tongue dorsum (DO).



The subjects were fitted with an EPG palate during the EMA recordings. The combination of these two techniques has clear advantages for accurate analysis of articulation. However, the combination of EPG and EMA may interfere with the EPG contact patterns. To control for this, we compared the EPG patterns obtained here with EPG patterns obtained without the use of EMA. No difference was indicated.

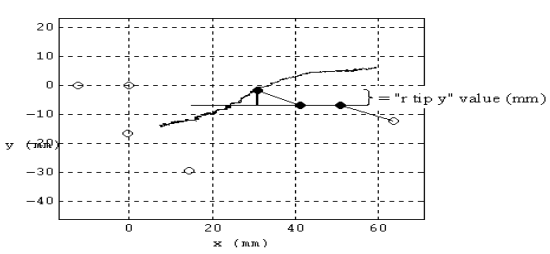
3. DATA

The data were collected from four Urban East Norwegian adult informants, HS (female, aged 54), IM (female, aged 60), RE, (male, aged 54), AN (male, aged 31). HS and IM are the two authors of this paper. The data are based on the following list of words read in a carrier phrase ten times in random order: /ʂiː/, /fɑˈkiːʂ/, /ɭɑːʂ/, /ʂɑːl/, /sɑː/, /rɑːs/, /riːs/, /siːg/.

4. DATA REDUCTION

The basis for establishing the place of articulation in the passive articulator was the articulation point marked by *the EPG frame of maximum lingual-palatal contact*. Since there was only contact along the sides of the EPG palate during the articulation, we have chosen not to use the COG index to quantify the contact area, see e.g. [7], an index used in other studies of retroflex consonants, and just look at general tendencies by comparing the EPG patterns. In order to see to what extent the tongue tip was bent backwards, i.e. retroflected, we used the so called 'r tip y' value [7]. This measurement is based on the configuration of the first three tongue coils. For each token, the line joining the tongue blade and the tongue body coils is used as a baseline, and the distance in mm of the tongue tip coil from this line is measured. This is illustrated in Figure 3 below. This measure yields a positive 'r tip y' value if the tongue is bent upwards (retroflected), a negative 'r tip y' value if the tongue tip is bent downwards, and a 'r tip y' value of 0 if the tongue tip is flat in relation to this tongue plane.

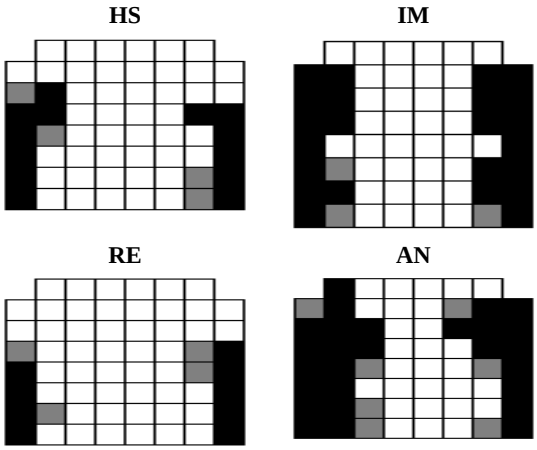
Figure 3: Quantification of 'r tip y' value.



5. RESULTS

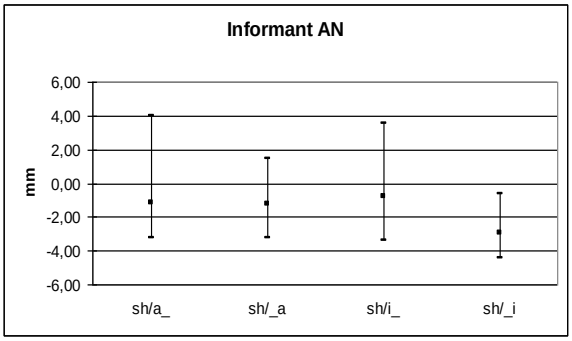
The EPG patterns show individual variation at the point of maximum contact. Two informants have an alveolar place of articulation and two a postalveolar one (see Figure 4).

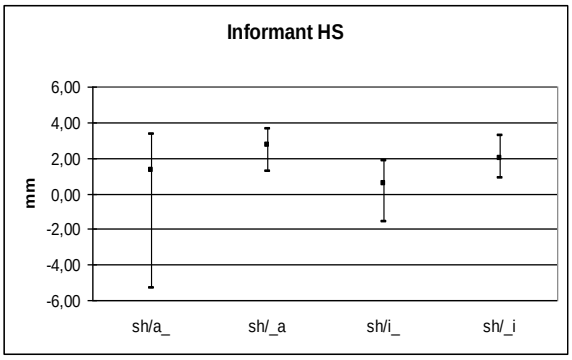
Figure 4: EPG patterns for /ʂ/ at point of maximum contact in all contexts for all four informants. Electrodes activated more than 67% of the tokens are black, 33-67% are grey, and 0-33% are white.

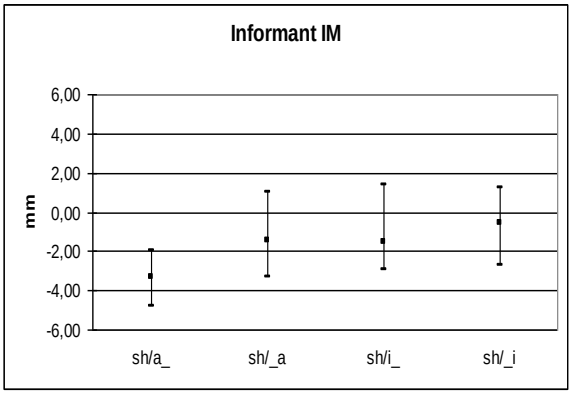


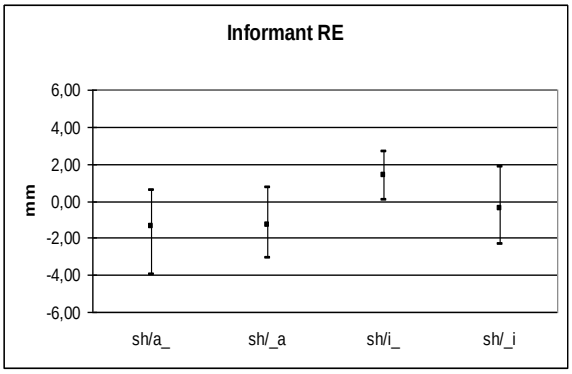
Our EMA data also show individual variation when it comes to a retroflex tongue configuration, as measured by a positive 'r tip y' value during the articulation, from onset to offset (see Figure 5). A negative value indicates no retroflexion during the articulation.

Figure 5: Maximum vertical tongue movement ('r tip y') for /ʂ/ for each informant in all phonological contexts from onset to offset. Values in millimetres.



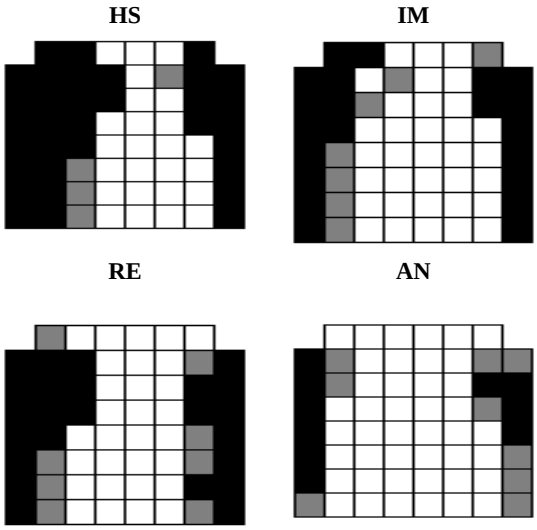






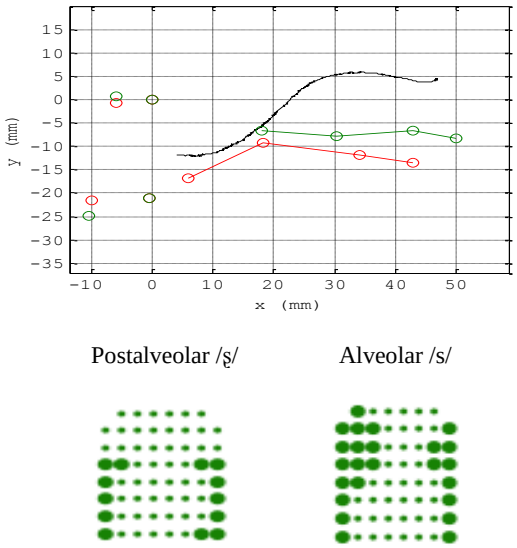
If we compare the EPG patterns for the alveolar fricative /s/ and the retroflex fricative /ʂ/, we see that there is individual variation at the point of maximum contact for /s/, just as for /ʂ/, but that for each individual informant the point of contact is more anterior for /s/ than for /ʂ/.

Figure 6: EPG patterns for /s/ at point of maximum contact in all contexts for all four informants. Electrodes activated more than 67% of the tokens are black, 33-67% are grey, and 0-33% are white. (One of the electrodes in the second row of IM's palate did not function properly during the recording.)



The EMA profiles of the tongue in the frame of maximum contact show a clear difference in the tongue configurations for /s/ compared to /ʂ/. For /ʂ/ the tongue tip coil is close to the passive articulator and the line between the tongue blade and the tongue body coils is (approximately) parallel to the x-axis, and the tongue dorsum coil is more retracted than the dorsum coil in the /s/ profile (see Figure 7). For /s/ the tongue blade coil is close to the alveolar ridge at the point of maximum contact, indicating a laminal articulation. The tip of the tongue is either close to the upper front teeth or pointing downwards in the direction of the lower front teeth. To sum up: /s/ and /ʂ/ differ both with regard to place of articulation in the palate and with regard to tongue configuration. /s/ is laminal whereas /ʂ/ is apical. /s/ is alveolar whereas /ʂ/ can be both alveolar and post-alveolar. For one and the same informant, /s/ is more anterior than /ʂ/. The tongue dorsum is more retracted for /ʂ/ than for /s/.

Figure 7: EMA profiles and EPG patterns of /ʂ/ (postalveolar, uppermost in EMA chart) and /s/ (alveolar, lowermost in EMA chart) at point of maximum contact (informant HS, /s/- *sa*, /ʂ/ - *sjal*).



6. DISCUSSION

For the present study it is of interest whether the Norwegian retroflex fricative is articulated at the same place and with the same tongue configurations as the Norwegian retroflex stops, /ʈ, ɖ/. A comparison with a previous study of Norwegian retroflex and alveolar stops [7] shows clear similarities between the stops and the fricative. A unifying characteristic for the retroflex stops, as for the retroflex fricative, is an apical articulation, a characteristic which distinguishes them from the corresponding alveolar stops and alveolar fricative which have a laminal articulation. There is considerable inter- and intra-individual variation with regard to retroflexion, the tongue tip being bent upwards, both for the plosives and for the fricative. There is, however, less retroflexion for the fricative than for the plosives. With regard to place of articulation, the EPG data show individual variation both for the plosives and the fricative. The place of articulation for both sets may be more anterior than post-alveolar. Thus, across speakers the passive articulator is not a reliable indicator for place of articulation either for the retroflex plosives or for the retroflex fricatives. However, for each individual speaker, the closure onset of /ʈ, ɖ/ is always more posterior than the closure onset of /t, d/, and the point of maximum contact is more posterior for /ʂ/ than for /s/, in accordance with the placement of alveolar and retroflex stops and fricatives in the IPA table of phonetic symbols. Two additional features which have been shown cross linguistically to be frequently present in retroflex consonants, a retracted tongue dorsum and a flat tongue middle [3], are also found in the articulation of the Norwegian retroflex plosives and the retroflex fricative. For reasons of space, we have not included these in our presentation, but these characteristics are illustrated in Figure 7.

7. REFERENCES

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