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Letter to the Editor

The articulation of Norwegian retroflexes

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ABSTRACT

In an articulatory study of Norwegian retroflexes, SMC [Simonsen, H. G., Moen, I., & Cowen, S. (2008). Norwegian retroflex stops in a cross linguistic perspective. *Journal of Phonetics 36*, 385–405] report that one speaker produced his retroflexes as alveolars. I argue here that the data presented in SMC show that all speakers produced their retroflexes as postalveolars, in agreement with earlier descriptions in the literature.

1. Introduction

In volume 36 of this journal, Simonsen, Moen, and Cowen (2008) (henceforth SMC) report their findings from a phonetic study on the articulation of the laminal alveolar /t d/ and apical postalveolar (retroflex) /ʈ ɖ/ in Urban East Norwegian (henceforth 'Norwegian'). SMC's hypothesis goes as follows:

> Norwegian has a small coronal inventory, only two sets of stops [. . .], and we would therefore expect Norwegian retroflex stops to have [. . .] [i]ndividual variation in [. . .] place of constriction in the passive articulator, and a place of constriction that can be more front than post-alveolar (p. 388).

SMC conclude that their hypothesis is confirmed by their data:

> [. . .] our EPG data show that there is individual variation in place of articulation and that the place of articulation may be more anterior than post-alveolar. Thus, across speakers the passive articulator is not a reliable indicator for place of articulation (p. 402).

SMC's conclusion has been cited by others in subsequent studies (cf. e.g. Tabain, 2009). The aim of this paper is to argue that SMC's conclusion is not warranted by the data they report in their paper.[1]

2. Generalizing to the population

Norwegian retroflexes are traditionally and typically reported to be apical postalveolar (see e.g. Endresen, 1991, 42). SMC report that three out of their four subjects produced their retroflexes as postalveolars (p. 393). I interpret this finding as confirmation that the previous literature was accurate in the descriptions of Norwegian retroflexes. The fact that one out of four speakers – speaker AN – in SMC's study behaved differently is not sufficient basis to conclude that there is a marked variation in the articulation of retroflexes in the population. More importantly, however, the data presented by SMC cast doubt on the conclusion that speaker AN did not produce his retroflexes as postalveolars. This will be discussed below.

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[1] I should report that I have a vested interest in the topic of Norwegian retroflexes, having myself published on this very topic (Johnsen, 2011; Stausland Johnsen, in press, 2012a,b,c). Based on the criticism raised in this letter, I have silently not accepted SMC's conclusion in my work. It is only fair, then, that I put my reasoning in writing.

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3. Determining the passive articulator from EPG frames

The subjects in SMC's study wore artificial palates fitted with electrodes (EPG), which are activated when the tongue touches the palate. A sequence of temporal snapshots, or frames, are collected during a subject's articulation. Fig. 1, taken from SMC, illustrates one such frame.

In order to measure the contact point for the stops in this experiment, SMC first selected the frame with the highest number of activated electrodes for each token (p. 390). SMC then used two different measures to locate the primary point of articulation in these frames: the 'center of gravity index' (COG) and 'place of constriction' (PC). The COG is simply the mean number of activated electrodes per row, but with a higher weighting for more anterior rows (SMC looked only at the first six rows). Thus the higher the COG, the more anterior the point of articulation. One problem with the COG is that it treats all columns of electrodes equally. SMC recognize this as a 'methodological problem', because the COG will include irrelevant information about contact along the sides of the palate. They could, as they note, have reduced the problem of irrelevant side contact if they had restricted their measure of the COG to the mid four columns, a procedure they chose not to implement (pp. 390–391). To illustrate this problem, imagine two very simple EPG frames. Articulation (a) has full contact in the second (alveolar) row, whereas articulation (b) has full contact in the third (postalveolar) row. Both articulations have otherwise two columns of activated electrodes on both sides of the palate (as in Fig. 1). Since articulation (a) is more anterior, it will have a higher COG value than articulation (b). By taking the a/b ratio, we can get an estimate of how similar (a) is to (b). The closer the ratio is to 1, the more similar the two articulations are. In this case, the COG a/b ratio is 1.19. If we restrict the measure to the mid four columns, on the other hand, neither of the two articulations would have any side contact towards the back. In this case, the COG a/b ratio would increase to 1.25, even though there has not been any change in the anteriority/posteriority of the two articulations. What this simple illustration shows is that the more side contact a speaker has during the articulation of the stops, the less accurately the COG value will reflect the differences between anterior and posterior articulations. This is important, because the only speaker in SMC's study for which there is no significant difference in the COG values between anterior /t d/ and posterior /ʈ ɖ/ (p. 394) is also that speaker whom SMC emphasize ''has a lot of side contact all the way toward the back'' (p. 393), and this speaker is speaker AN.

This speaker is in other words the same one whom SMC conclude has an alveolar articulation of /ʈ ɖ/, a claim based both on the COG value and on their second measure of the primary point of articulation, the 'place of constriction' (PC). The PC is defined as ''the frontmost row [. . .] displaying a minimum of free electrodes'' (p. 391). As we will see, this definition is crucial for the conclusion that AN produces his retroflexes as alveolars. The reason for this is that the definition has built into it a bias in favor of anterior articulations. That is, if there is a tie between two rows in terms of having 'a minimum of free electrodes', then the PC will always choose the more anterior row. This bias plays a central role in SMC's study, because their hypothesis is that they ''expect [. . .] a place of constriction that can be more front than post-alveolar''. As will be seen in the following, however, the PC will also choose a more anterior row even when a posterior row has more activated electrodes.

Fig. 2 is speaker AN's EPG frame for the retroflex /ʈ ɖ/ tokens (p. 393). As mentioned above, SMC selected the frame with the highest number of activated electrodes for each token, and the EPG frame in Fig. 2 represents the accumulation of all these frames. Electrodes activated in more than 67% of the tokens are black, 33–67% are grey, and 0–33% are white (p. 392). SMC do not report what the PC is measured from, nor how 'free electrodes' are defined. Given that they refer to the accumulated EPG frames as in Fig. 2 when they discuss the PC (pp. 392–393), I assume that the PC is measured from these accumulated frames, and that 'free electrodes' refer to the white electrodes in these frames. The row with the most activated electrodes in Fig. 2 is the postalveolar row 3. It has seven out of eight electrodes activated in more than 67% of the tokens. As SMC acknowledge, the curious 'free electrode' in the middle of this row is the result of there being a coil glued onto the speaker's tongue (p. 392). In all

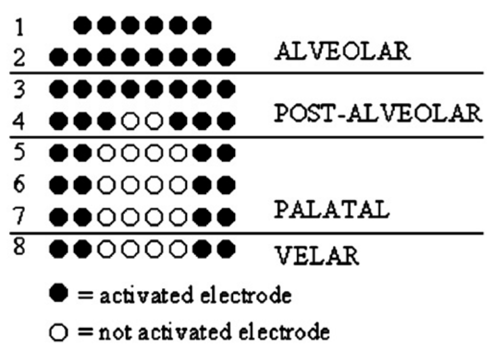

Fig. 1. An EPG frame.

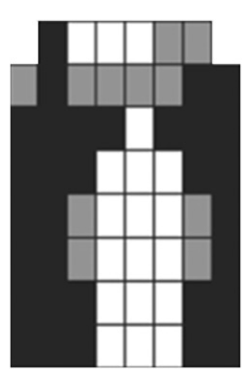

Fig. 2. AN /ʈ ɖ/.

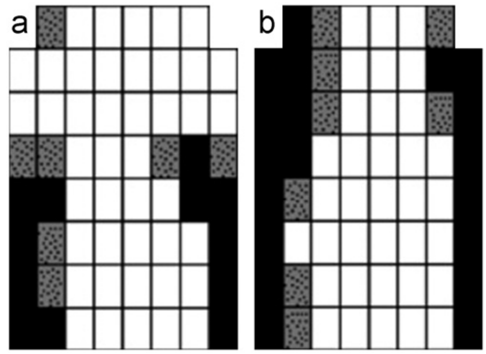

Fig. 3. Onset frames for AN. (a) /ʈ ɖ/ and (b) /t d/.

likelihood, then, all eight electrodes of this row would normally be activated for this speaker. But, because of the way the PC is defined, the conclusion must be that "the PC for AN is alveolar" (p. 393), even though only *three* of the eight electrodes in the alveolar row 2 are activated in >67% of the tokens. The reason for this is twofold. The first reason, as mentioned above, is that the PC by definition favors more anterior articulations in the case of a tie. But as just mentioned, the postalveolar row 3 has more activated electrodes than the alveolar row 2, so there is not really any tie between these two rows. The definition of the PC still chooses the alveolar row 2 instead of the postalveolar row 3 because the selection of which row is the place of constriction is not based on which row has the most activated electrodes, but rather on which row has the lowest number of 'free' electrodes. The fact that the electrodes in the second row are activated less often than the electrodes in the third row is irrelevant by this definition, but I would argue that it is not irrelevant for determining what the most typical articulation is for this speaker. Since it is the postalveolar row 3 which has the most activated electrodes, I conclude that speaker AN produces his retroflexes as postalveolars.

4. The onset of retroflexes

As is well known, retroflex stops are best cued in postvocalic position. As a result, languages rarely contrast retroflex with alveolar stops in prevocalic position (see Steriade, 2001 for a discussion). This typological generalization holds also for Norwegian: The contrast between /t d/ and /ʈ ɖ/ exists only postvocalically. The most important articulatory properties of retroflex stops are therefore those that exist in the transition phase from the previous vowel into the stop closure, or in other words the onset of the retroflexes. Admirably, SMC both collect and present these data in their paper.

According to SMC, the COG and PC measures of the stops produced by speaker AN indicate that he produces both /t d/ and /ʈ ɖ/ as alveolars, with no significant difference in the point of articulation between these two categories (a conclusion I contested in Section 3 above). If this were the case, we would expect speaker AN to show no significant difference in the stop onset phase between these two categories either. The EPG frames for the onsets in speaker AN's articulation clearly show that this is not the case.

In Fig. 3 (taken from Figure 5 in SMC), the onset for retroflex /ʈ ɖ/ is shown on the left (3a), and the onset for alveolar /t d/ on the right (3b), both categories in postvocalic position. As this figure shows, speaker AN makes a very clear contrast in the place of articulation between these two categories, and we see that his retroflex /ʈ ɖ/ are articulated in the postalveolar region. SMC reach the same conclusion: "The EPG frames of /ʈ, ɖ/ show that the PCON [=place of constriction in the onset frame] is post-alveolar or palatal for all speakers in all phonological contexts" (p. 394).

5. Conclusion

Speaker AN comes from the county of Østfold in Norway. Previous articulatory descriptions of retroflexes in the Østfold dialects all agree that they are postalveolar (Hoff, 1946, 13f., Myhre, 1952, 16, Thorbjørnsen, 1973, 33f.). I am myself from Østfold, and my retroflexes are also postalveolar, as has been seen in an informal ultrasound demonstration. SMC have determined that AN's retroflexes are alveolar. I have argued in this paper that this conclusion is a consequence of how the measures they used to determine the place of articulation were defined. Once we inspect the EPG frames revealing the point of contact between the tongue and the palate, we clearly see that speaker AN produces his retroflexes as postalveolars, in concordance with previous descriptions in the literature.

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