A Note on Laryngeal Activity in the Danish "stød"

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The Danish "stød" is a sort of accent connected with a definite syllable in the word (historically it is related to accent I in Swedish and Norwegian and in Southern Danish dialects). The stronger forms are characterized by creaky voice, which is found either at the end of a long vowel ("stød in the vowel") or at the beginning of a voiced consonant following a short vowel ("stød in the consonant"). Syllables ending in a short vowel or in a short vowel plus voiceless consonants cannot have stød. The stød is generally indicated in phonetic transcriptions by the sign for glottal stop (?) after the vowel or consonant in question, but in normal standard Danish there is no closure except in very emphatic speech. The occurrence of the stød is to a large extent predictable, but there are some minimal pairs distinguished by the presence or absence of stød, e.g., [le:se] 'reader' vs [le:sw] 'reads,'[man] 'one, you,' (indefinite pronoun) vs [man?] 'man.'

The most thorough phonetic investigation of the stød was undertaken by Svend Smith (1944) on the basis of kymograms, oscillograms, pitch curves, and electromyograms of the respiratory muscles. He describes the stød as "a stress accent, a special marking movement made by a thrust-like emphasizing of sounds" (Summary, p. 6), primarily consisting in a brief and intense, rather suddenly reduced innervation of the respiratory muscles, a sort of ballistic movement, combined with a more tense articulation of the whole word, which is visible in the initial consonant. The sudden cessation of innervation of the respiratory muscles results in a reduction of subglottal pressure causing a decrease in intensity and pitch, sometimes ending in irregular oscillations. He does not find any consistent difference in the pitch movement in the beginning of the word.

Smith's acoustic description has been confirmed by later studies by Margaret Lauritsen (1968) and Pia Riber Petersen (1973). Petersen examined pitch and intensity curves based on tape recordings of six subjects. She found a very great variability in the phonetic manifestation of the stød, but a general tendency to a more extensive fall in pitch and intensity in syllables with stød sometimes ending in irregular vibrations. This latter phase of the stød (which Smith calls the second phase) is found at approximately the same distance from the beginning of the vowel, corresponding to the end of a long vowel or the beginning of a consonant after a short vowel. The stød is thus a syllabic phenomenon.

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However, nobody has yet tried to verify Smith's physiological description. He was not able to synchronize the electromyographic recordings with the audio signal, and it is therefore not quite certain that the activity in the respiratory muscles precedes the glottal modifications; nor is it known whether there is an active innervation of the glottis, and in the positive case, whether the activity is triggered by the respiratory activity or independent of it.

In connection with the investigation of Danish stop consonants reported in the preceding report of this volume (Fischer-Jørgensen and Hirose, 1974) some EMG recordings (using hooked-wire electrodes) were made of the activity of laryngeal muscles in Danish words with and without stød. For details of the technique applied, see the preceding report. No comparison with the respiratory muscles was made. The purpose was only to see whether there was a positive innervation of the laryngeal muscles in the stød. The subjects, PM, PH, TB, and EFJ, all have a clear stød. PM, TB, and PH are from Copenhagen; EFJ grew up in Southern Funen, where the dialect lacks stød, but she has never spoken Funish dialect. For EFJ a longer list containing words with and without stød was used, but recordings were made only of the interarytenoid muscle (INT) and the posterior cricothyroid muscle (PCA), and they did not show any difference for words with and without stød. There is a peak in PCA at the end of the word [man?] which may, however, be due to a more vigorous opening of the glottis at the end of the word.

The other subjects read the word pairs [lɔ:sw, lɛːʔsw], [pʰi:bw, pʰiːʔbw] and [man, man?] in the frame [han sa:] "he said," placed in a randomized list of words used for the investigation of stop consonants. Each word appeared 16 times.

For subject PH a recording made of the vocalis muscle (VOC) did not show any differences depending on the stød. This recording, however, was not very good. In the case of subject TB a difference was found in the activity of VOC in words with and without stød (see Figure 1). The words with stød showed a higher degree of activity. It should be mentioned, however, that TB's pronunciation of the stød was somewhat exaggerated. The words with stød were pronounced with higher intensity and with higher pitch in the stressed syllable than the words without stød (this is particularly true of the pair [pʰiːbə/pʰiːʔbə]), and the higher activity of the VOC may be due to the rise in pitch. TB shows no difference between the words [pʰuˈrist] and [pʰaˈɡai?], belonging to the consonant list, but a somewhat lower activity in [buˈdist].

The curves of subject PM's recordings are more reliable. The recordings comprise the vocalis muscle (VOC) and the lateral cricothyroid (LCA). The subject pronounced all words with a rising pitch at the end. This explains the general rise of the curves (see Figure 2) but apart from this, the words with stød show a sudden, very clear peak in the beginning of the vowel in all three pairs. Moreover, there is a definite peak in the second syllable of the words [pʰaˈɡai?], [baˈkʰan?t], [betʰaːʔle], [pʰeˈdaːʔli], but hardly any peak in [pʰuˈrist] and [buˈdist]. LCA also shows a slightly higher activity, but this is not very clear. The initial consonant p shows no difference, either in the inferior orbicularis oris muscle (O01), or in the superior orbicularis oris muscle (OOS) for words with and without stød. Initial m has a slightly higher average peak in OOS in the words with stød but the difference is hardly significant.
Figure 2
Thus, for one subject, whose curves are particularly reliable, a difference in innervation of the vocalis muscle has been found. The investigations are being continued at the Institute of Phonetics in Copenhagen.

REFERENCES


Smith, S. (1944) Bidrag til løsning af problemer vedrørende stødet i dansk rigssprog [with an English summary: Contributions to the solution of problems concerning the Danish stød (Copenhagen)].