

PHONETIC ANALYSIS OF DANISH STOP CONSONANTS.

Eli Fischer-Jørgensen

In the beginning of the fifties the author started an analysis of Danish stop consonants. Some of the preliminary results of the acoustic analysis were summarized in an article in 1954. (1). In the following years the study was concentrated on the difference between the two stop series ptk and bdg, which was examined from articulatory, acoustic and auditory points of view. Material from other languages as well was included for comparison. - In 1958 a rather extensive bulk of material had been collected, and I had planned to work all this material together in a monograph on the fortis-lenis problem with special reference to Danish. This plan was, however, interrupted for several years due to illness, and some of the methods and results are now more or less out of date. - It is my intention now to take up single aspects of this problem in a series of shorter reports and articles. For the moment I only want to give a very brief summary of the main results of the earlier investigations.

In Danish the two series of stops ptk and bdg are distinguished only under very restricted conditions. The exact definition of these conditions raises various problems, but in a brief formula (which presupposes the delimitation of structural syllables) it can be stated that they are only distinguished initially in a syllable. In this position ptk are aspirated (and t is affricated), bdg unaspirated, and both series are voiceless. Finally before a pause aspiration is optional and non-distinctive, and the stops are normally voiceless, at any rate at the end. When occurring medially they are unaspirated, and voicing depends on the preceding sound. After voiced sounds they are often fully (but generally not very strongly) voiced, the extension and degree depending on the tempo of speech and on individual factors. According to the most common phonemic interpretation the dental and labial stops in medial and final positions are considered as members of the phonemes /t/ and /k/, whereas the fricatives [ð] and [ɣ], which do not occur initially are considered as manifestations of /d/ and /g/. -- We are here mainly concerned with

the stops in initial position.

In articulatory terms the difference between ptk and bdg can be characterized as follows: ptk seem to be produced with wide open glottis during both closure and aspiration, whereas bdg are produced with a closed or only slightly open glottis (this assertion is based on preliminary endoscopic investigations). The intra-oral air pressure during the closure is slightly higher for ptk than for bdg, but the difference is only about 4-8 per cent, and most of this difference is due to a certain rise of the air pressure during the closure of ptk; but the air stream from the mouth after the explosion (measured by means of an aerometer) is clearly stronger in ptk than in bdg. - The lip pressure on the other hand (measured by means of a rubber bulb) is generally higher for b than for p, and the tongue pressure seems higher for d than for t; the subjective sensation of organic pressure is in agreement with these findings. The duration of the closure is longer in bdg than in ptk, the difference being slight, but significant. It is particularly clear for d compared to t, t having a shorter closure and a longer aspiration than p and k.

As for the acoustic intensity it is quite clear that the aspiration and affrication noise of ptk is stronger than the slight aspiration that may be found in bdg, but no clear difference has been found between the intensity of the explosions, which on the whole have a wide range of variation. It is, however, evident that t has a weak and short explosion (weaker than that of d) followed by a strong fricative phase, which is clearly distinguishable from the explosion by the frequency of the noise. - Formant transitions to a following vowel are longer after bdg than after ptk. This may simply be due to the fact that most of the transition after ptk takes place during the aspiration.

Thus in regard to duration of closure and intensity of organic pressure bdg seem to behave like fortis compared to ptk, but in regard to duration of the open phase, speed of air stream and intensity of aspiration noise ptk are stronger than bdg. Only if aspiration is considered as part of the fortis-lenis opposition, not as a separate opposition, can ptk be considered as fortis in Danish.

From the auditory point of view the decisive difference

between ptk and bdg lies in the aspiration. Tape cutting and splicing experiments have shown that an exchange of the explosion phases of p/b t/d k/g has no effect on the perception, and that a pause between explosion and vowel is not sufficient for the perception of ptk, there must be aspiration noise present.

Tests with identification of foreign stop consonants in meaningless monosyllables cut out of words show that Danish listeners normally identify unaspirated voiceless stops (in Dutch, French, Hindi) as bdg, whereas voiced aspirated stops (Hindi) are normally identified as ptk. -

In later reports and articles a number of these points will be treated in more detail with documentation and references.

References:

1. Eli Fischer-Jørgensen: "Acoustic Analysis of Stop Consonants" ; Miscellanea Phonetica II (1954), pp. 42-59.