

THE DANISH "STØD"
THE PROBLEM OF PHONETIC REALIZATION AND PERCEPTION

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ABSTRACT

The present investigation of the Danish *stød* is based on recordings by 13 Danish speakers. Duration, F_0 , intensity, formant frequencies of the *stød*-vowels has been compared with those of the *stødless* vowels. The *stød*-vowels are distinguished from the *stødless* vowels first of all by F_0 pattern, than by quality and intensity changes. It has been found out how the *stød*-vowels are perceived by the groups of subjects with different level of Danish knowledge.

A specific feature of the Danish prosodic system is that unlike closely related Swedish and Norwegian, there exists *stød* in Danish, which is a dynamic syllabic accent resulting in a brief vocal folds compression or a complete closure with an additional distinctive value.

The *stød* may occur in a long vowel, in a diphthong, almost in all sonorant consonants, in / δ / and only in a stressed position. By many phonologists the *stød* in Danish is considered to be phonemically distinguishing element. O. Jespersen represented 400 minimal pairs distinguished only by presence or absence of the *stød*. The *stød* is commonly found in monosyllables, but the majority of oppositions *stød*-word/*stødless*-word are disyllabic words: (jeg) læser [$l\acute{e}^?s\acute{e}r$] - (I) read, læser [$l\acute{e}:s\acute{e}r$] - reader. The *stød*, however, here is not an independent distinctive element, it plays only a secondary part in the system of expressive means of the language, because the differences in these minimal pairs are obvious from word order in the sentence. Danish linguist A. Hansen pointed out that the *stød* is not absolutely necessary for un-

derstanding Danish /1/.

Historically, the *stød* is correlated with pitch accents of other Scandinavian languages. While comparing Norwegian, Swedish and some Southern Danish dialects, one finds some similarity in opposition of *stød* presence and absence in Danish words and that of presence and absence of pitch accents in the words of Scandinavian origin. For instance, a simple pitch accent in modern Swedish is manifested in a falling tone and a complex one in a falling-rising tone. These accents were replaced in the 13-14 centuries by the opposition *stød*-word/*stødless*-word, the *stød* corresponding to the accent 1, the absence of *stød* respectively to the accent 2.

The Danish *stød* has always been in the centre of word prosody studies. The problems of its origin and realization were interpreted in the works of R. Rask, K. Verner, L. Hjelmslev, A. Martinet, O. Jespersen and other linguists, but still the Danish *stød* evokes a lively discussion.

Formerly, the *stød* was considered to be a complete closure, hence it was called "a glottal stop". S. Smith found that a complete closure is as a rule rare, a brief and intense innervation of the expiratory muscles takes place. It abruptly initiates and briefly terminates /2/. Two or three *stød* phases may be observed: the 1st phase - regular oscillations, the 2nd phase - oscillations weaken or disappear (in a case of complete closure) and the 3rd phase is possible when new oscillations appear.

Recent phonetic investigations have shown, that there is great variability in the phonetic manifestation of the *stød*, produced by different speakers or the same speaker in different words /3/. The difference may be manifested in duration, pitch, intensity. There are several ways of *stød* realization and the question arises, whether there are any common characteristics of *stød* and what helps us to perceive these different acoustic signals as *stød*.

This paper is concerned with the study of stød, occurring in vowels. 800 Danish words and 96 sentences were chosen for the study. Most words presented pairs (with a long vowel and a stød-vowel) or three words with a long, short and stød-vowel, so that the consonants, surrounding vowel under study were the same. Some words were put into phrase constructions of different length. Others were single words, containing stød-vowels. 13 speakers, students and staff members from the universities of Denmark were recorded. The instrumental and audio analysis were taken up.

To study the perception of the Danish stød the combinations, consisting of a consonant and a long vowel, a stød vowel or a short vowel, were cut out of 45 words, performed by two speakers. These combinations were then presented to 3 groups of subjects with different level of Danish knowledge.

The curves of single words and phrases with stød vowel make it possible to distinguish different types of stød pronunciation: from the complete closure to the curve with no changes.

Out of many stød types 3 main types seem to be pointed out according to 3 phases. Two-phased stød vowels prevails in this material (69% for the isolated words and 96% for the statements), while there are 27% of three-phased stød-vowels in the isolated words and only 2% in the statements. The 2nd phase is likely to be the stød itself, so it is produced in the end of a vowel and seldom in the middle (in a case of 3 phases). One-phased stød-vowels, i.e. vowels with no change in the oscillatory pattern (4% for the isolated words, 2% for the sentences), will be regarded further.

In our investigation the length differences between long and stød-vowels are not significant in almost all cases (All the exceptions are single words). The duration of the stød-vowel comprises 93% of the long vowel in statements, 84% in single words.

The phase duration in the stød-vowel follows next sequences: phase 1 takes 2/3 of the whole stød-vowel (in a case of 2-phased stød-vowel); this length stretches in from the 1st to the 3rd phase (in a case of 3-phased stød-vowel), the first one being the most long (50% or so). With this in mind, the stød takes 1/3 of the whole vowel length.

Average Fo in the stød-vowel is likely to be higher than that of the stødless vowel, the range of Fo changes being wider in the stød-vowel.

Stød-vowel can also change the fundamental frequency of the statement due to its frequency characteristics. At the end of a statement amplified Fo may be observed instead of subdued Fo because

of the stød in the last word. This kind of amplification occurs, when a speaker reinforces his vocal folds while producing stød.

The intensity in the stød-vowel undergoes various changes because such vowel has 2 or 3 phases. Besides these changes, the intensity may be marked in comparison with stødless vowels. The higher intensity in the 1st phase of a stød-vowel can influence the dynamic changes in the statement.

F1 and F2 comparison in stød and stødless vowels revealed some quality differences, though not very significant ones. The stød-vowel may be described as more open, front stød-vowels are a little more retracted, back stød-vowels are a little more advanced.

The prime importance in the research is attached to the stød-vowels with no visible changes in the curve. Though the group is small, its investigation is very important, because a weak stød could be heard during the listening-test in spite of stød absence in the curve. These types of stød-vowels have a higher Fo level in comparison with the stødless vowels, whereas the average intensity, duration, F1 and F2 do not differ.

Therefore, the main characteristic feature of the stød-vowel is the Fo change, as the stød-vowel in all cases is accompanied with higher Fo and a wider range of changes than the stødless vowel has. Nevertheless there are some difficulties in outlining the peculiarities of Fo changes in the stød-vowel. Fo can be falling and rising, more complicated changes can be observed. Evidently, the determining factor is the change itself and the average higher Fo of the stød-vowel, than that of the stødless one. The quality and intensity changes are of minor importance as they don't always take place.

The research of the Danish stød perception by those informants whose native language has different segmental and suprasegmental features is believed to be of use in the definition of specific and universal perception abilities and in picking the most effective methods of training.

Russian students come across great difficulties in learning Danish vowel system both on articulation and perception levels. A student may hear no variations in native and foreign sound patterns, here the sensory abilities of a speaker are misleading. When the articulatory basis of the native language dominates, the motor mistakes may take place. A distinct boundary of these mistakes is the way for their improvement.

The perception in its turn depends either on the universal abilities of a person (for example, an ability to orga-

nize a word, to oppose vowel/consonant, coarticulation) or an individual abilities characteristic of the system of the native language and formed under the influence of this language phonological system (for example, oppositions of long and short vowels, stød).

To study the mechanisms of the stød perception in Russian class, to define the perception connection with the level of language knowledge, to outline the acoustic features, stimuli, containing combinations of consonant and long, short or stød-vowel were suggested for 3 groups of subjects: 1) the 3rd and the 5th year students of Danish department of Leningrad State University; 2) students unfamiliar with Danish; 3) staff members of the Department of Phonetics, unfamiliar with Danish.

The listening-test in the 1st group has shown that stød-vowels are identified only in half of all cases by the 3rd year and 5-th year students (54% and 53% respectively), "pure" long vowels are identified better (71% and 84%). Thus, the stød is identified rather badly, though the students can pronounce it. At the same time they have difficulties, connected with the normal realization of the stød-vowels in a coherent text.

The most "favourable" for identification are vowels: [u?] - 6%, [æ?] - 6%, [a?] - 12%, [ø?] - 12% of errors.

Stød-vowels are often identified as short ones, evidently, because of the fact, that stød-vowels in the coherent text seem to be shorter than corresponding long vowels. The duration of the first vowel phase (2/3 of the total stød-vowel length) is that part which is heard by the Russian subjects, when they identify these vowels as short ones.

Broadening of the phonetic context has improved the audibility of the stød (only 22% of errors). The subjects in this case were asked to identify words, containing investigated stimuli.

Thus the opportunity to appraise the type of the vowel contact with the following consonant influenced stød audibility. A pause, an interval in the vowel, additional noise or a kind of creaky voice - all this can be the indication of the stød for the Russian subjects. Particular characteristics of the stød-vowels (Fo, intensity, quality) evidently don't play the leading role for these subjects.

It was noticed at the same time that in some stimuli, containing the short vowel, but cut out of the words, where this short vowel is followed by the stød-consonant, the short vowel was identified with a stød-vowel in 76% of all cases. These errors can be explained in such a way: the short vowel, followed by the stød consonant in the words of the type hyl [hy'l?] - elder, mild [mil?] -

soft has usually the same average pitch level and in many cases also intensity level, than the stød vowel in words of the type hyl [hy'l?] howl, mil [mil?] mile. Thus also Fo and intensity are of certain importance for subjects, who knows Danish.

The results of the perception tests in the 2nd and 3rd groups shows that subjects, who don't know Danish, but were only given some information about stød, identify stød-vowels badly (64% of errors in the 2nd group and 62% - in the 3rd).

The stød audibility is not always high in the case when Danish subjects are asked to identify the stød. In the investigation of P. Riber Petersen the listening-test gave from 8 to 50% of errors /4/.

The received facts should be taken into consideration, when Danish is taught. Though the most essential stød characteristic is Fo, important are also intensity changes, phase distribution, quality differences. As an additional cue for the stød in the vowel the type of contact with the following consonant must be also taken into account.

References

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