ACOUSTIC FEATURES OF SYLLABICITY IN DANISH

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It is generally considered to be characteristic of the Danish language that it is not very distinctly articulated. This is undoubtedly true of unstressed syllables. The shwa vowel[1] of these syllables often fuses with surrounding voiced segments, and frictionless continuants often go together with an adjacent vowel to form long vowellike sequences. Typical instances are forms like [*hɒ:ʁə*], [*y:ðə*], and even trisyllabic forms like [*hɒ:ʁəʁə*], [*y:ðəðə*]. When adjacent to a nasal or [*l*] the shwa segment is frequently dropped, especially medially, as in [*fal*(*ə*)*nə*], [*bon*(*ə*)*nə*], although such trisyllabic forms remain—at least in some kinds of Danish—distinct from dissyllabic forms like [*falnə*], [*bonnə*]. It is generally said that an adjacent consonant becomes syllabic when shwa is dropped (or fused) in such forms as those just quoted. However, it is not altogether clear how the distinction of syllable number actually manifests itself.

The concept of "syllabicity" being a crux in Danish phonetics it seems worthwhile to present the problem in its acoustic aspects. The findings surveyed in this paper are based on analyses of mingograph and spectrograph records.[2]

The core of the material used for this study is a series of 11 word pairs with an alleged difference of syllable number. The words were read aloud with sentence main stress in a standardized type of context in which they were not influenced by utterance-final intonation (the manifestations in other contexts often deviate quite much but are not dealt with here). Individual, meaningful sentences ([*ʁo:ðə*], [*ʁo:əðə*] in *jeg vil rode grundigt*; *og han roede dårligt*, etc.) as well as inclusion of the words in a standard carrier phrase has been used, the former more extensively.

For consideration of space, numerical data (in all cases average values) will be given only to exemplify the phenomena dealt with (a fuller treatment with documentation will be given elsewhere).

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[1] No distinction is made here between "vowel, consonant" and "vocoid, contoid".

[2] The speech of six subjects speaking a Standard Danish typical of Eastern Denmark has been analysed. The following statements are essentially based on data from four of these, the remaining two being too deviating in speed of utterance and other features to be directly comparable to the rest.

An obvious characteristic of consonants taking over the syllabicity function of shwa is that they are longer than nonsyllabic consonants. This has been pointed out by Otto Jespersen[3] and more recently by Poul Andersen.[4] According to my data the difference in duration is clear (and statistically significant) in some word types at least; however it is sometimes difficult to determine what part of the word is longer. For example, intervocalic [*ln*] in [*fal*[ə)*nə*] is longer than is [*ln*] in [*falnə*], the increment being typically of the order of 40—50 ms, but this extra length does not seem to be consistently associated with either [*l*] or [*n*] (although with two subjects at least it is rather in the first consonant). In fused sequences involving [*ð, ʁ*] it is difficult to give a realistic measure of segment duration, but the duration of the whole voiced portion (including the stressed vowel) has been measured. Trisyllabic forms are generally somewhat longer than corresponding dissyllabic ones,[5] but the variation is considerable, and the overall duration can hardly be the only essential difference between them (with some words it is not even clearly significant).

Eli Fischer-Jørgensen[6] has suggested that there is in [*bon*(ə)*nə*] (which she transcribes [*bonn̩nə*]), an increase and decrease of intensity or "strength", and that this—possibly together with longer duration—accounts for the impression of an extra syllable peak. In my material trisyllabic forms sometimes do exhibit a steep intensity peak more or less coincident with a peak in the fundamental frequency contour. The intensity peak may, however, be a feature of very distinct pronunciation;[7] it does not seem to occur very constantly (in fused sequences particularly with [*ð*] there is no such distinction at all in the majority of cases). The distribution of this feature in respect to subjects and word types remains to be studied in detail.

Leaving aside differences of segment quality (which do occur, although they need not be there)[8] we may turn to pitch as a possible cue to syllabicity. In the type of material examined stressed words generally have a somewhat rising pitch with a short (normally quite short) fall at the end of the word.[9] Thus the peak of the pitch is generally close to the end of the word. However, trisyllabic words seem to differ from dissyllabic ones by having the peak normally much earlier, so that typically about two thirds of the word (excluding initial consonants) are occupied by the rise, and the last third by the fall. Typical examples of the difference are: [*hɒ:ʁə*] with 5,2 per cent of the duration taken up by the fall versus [*hɒ:ʁəʁə*] (fused) with 30,2 per cent, or [*ʁo:ðə*] with 9,6 per cent versus [*ʁo:əðə*] with 29,3 per cent (data from two different subjects, all average values). In such cases the difference is clearly significant. In a case like [*bonnə*] versus [*bon*(ə)*nə*] the same difference can be found, but sequences like these involving [*n*] or [*l*] present special problems which cannot be approached in the present paper.[10]

Fundamental frequency curves of Danish words have been recorded earlier by Ekblom, Sv. Smith and others, but the role of pitch in the distinction of syllable number has not been in the focus of attention.

A number of different cues seem to be present to a different degree under different conditions. In order to see if pitch inflection can at all serve as a useful cue to word structure I made a brief experiment. A small series of synthesized stimuli consisting of [*h*] plus [*ɒ*:] and differing only in pitch contour (roughly imitating contours typical of [*hɒ:ʁə*] and [*hɒ:ʁəʁə*]) were listened to by some of my colleagues and myself, and each was identified as either an imitation of [*hɒ:ʁə*] or of [*hɒ:ʁəʁə*]. Responses were unanimous and as expected, i.e. pitch seems to somehow enter into the signalling of syllabicity in Danish, or rather in the variety of Danish dealt with here.

DISCUSSION

Fischer — Jörgensen:

As I was quoted for having said (in my Textbook of Phonetics) that syllabicity in the cases mentioned should be due to intensity, I just want to emphasize that this was not based on instrumental research and that I find Mrs. Rischel's results very convincing.

Witting:

My question is whether it would not be more relevant linguistically to speak about morphemes and morpheme boundaries (some sort of internal juncture) rather than syllables (syllabicity) and syllable boundaries when dealing with cases such as Danish *faldne* versus *faldende*.

Smith:

In case your description of a typical intonation curve in your examples holds true, we may foresee a development of our Danish language into a tone language. This development would then be parallel to the development of the Stød in Old Danish, developing as a dynamic accent under similar conditions.

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[3] Modersmålets Fonetik (3rd ed. 1934), p. 115.

[4] Dansk Fonetik (in: Nordisk Lærebog for Talepædagoger, 1954), p. 323.

[5] An extra complication is the distinction of forms like [*sy:əðə*] vs. [*sy:ðəðə*], which is not accounted for in this paper.

[6] Almen Fonetik (3rd ed. 1962), p. 94.

[7] Cp. the distinction mentioned in note 5 above.

[8] Also cp. note 5.

[9] Some speakers of Danish do not seem to have this rise-fall but either a pure rise (this applies to one subject not included here) or a fall. For these, of course, there can be no difference of timing of the pitch peak. The general shape of the word contour is an important feature of regional pronunciations of Danish.

[10] With some subjects there are very pronounced ups and downs of the fundamental frequency contour at segment boundaries, so that it is not always possible to use timing of the peak as a parameter. With one subject I got a clear difference in words with [*n*] and [*l*], the percentages being comparable to those for other word types (with [*ð*], [*ʁ*]), but with some of the others the curves are quite puzzling.

Frøkjaer—Jensen:

Would you please tell me what is the smallest difference in fundamental frequency in the synthetic words between the two intonation levels required to distinguish the minimal pairs?

Rischel:

Ad Frøkjaer—Jensen: I have not made perception tests aiming at the determination of discrimination thresholds. Such tests should obviously be carried out both for pitch, duration and possibly intensity. The informal test I mentioned only showed that fundamental frequency contours imitating those found in real speech (in cases that are clearly different), i.e. with a considerable fall phase for trisyllabic but not for dissyllabic words, *can* provoke a listener to identify the stimulus as different words [in this case *hårde* 'hard' (pl.) versus *hårdere* 'harder'].

Ad Jørgensen, H. P.: I am studying the realization of the word types in connected speech, but the data are complicated to deal with. The difference of pitch timing tends to disappear in positions after the word carrying the main sentence stress. Other factors as well influence the pitch contour quite considerably, such as: following unstressed syllables or absolutely final position. Duration may be more important in such cases.

Ad Witting: My paper was concerned with the problem of what the phenomenon which we commonly refer to as syllabicity of consonants in Danish looks like from the acoustic point of view. However, I entirely agree that there is in the word pairs I have examined a difference of morphemic structure, and that the signalling function of pitch and duration is associated with this structural distinction.