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Two-phased stød vowels – a cognitive reality?

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This is the final one in a series of laboratory phonology experiments which address a complicated issue in Danish phonetics and phonology: the relationship between stød, length and morae. We wished to establish whether vowels with stød can be said to consist of two parts cognitively, a first half with modal voice (no stød) and a second half with stød. In a visual analogue scaling experiment, 81 subjects were asked to fix the point in time in the vowel where stød begins. They could not.

1. Introduction

The pertinent facts, leading up to this latest experiment, about acoustic and perceptual properties of Danish stød have been reported and discussed in Grønnum & Basbøll (2001a, 2001b, 2002a, 2002b). Here is the briefest possible summary: Consonants with stød are not systematically longer than consonants without stød, and they may be shorter as well. Vowels with stød are as long as long vowels without stød, and both are 50-70% longer than short vowels. Stød vowels are also found to equal long vowels perceptually, though this similarity may be overshadowed by the similarity between syllables with stød, irrespective of vowel length.

2. Stød onset timing and cognitive reality

Variability in the onset (when it can be determined at all) of the laryngealization which is the stød, measured from vowel onset, is very considerable, with time lags ranging between 10 and 130ms. It averages around 60ms, cf. Grønnum & Basbøll (2001a). We need now to know whether and how this onset is perceived. Whether there is any support for a claim that stød vowels have two distinct phases, a first half without and a second half with stød. That in its turn would give cognitive reality to his new account of the principles at work in stød distribution.

2.1. Stimuli

From the sentences recorded for Grønnum & Basbøll (2001a), we excised 20 disyllabic words with stød, four from each of five speakers. They are instances of [ˈd̥iːˀsən ˈsb̥iːˀsʌ ˈviːˀsʌ ˈpʰiːˀb̥ʌ ˈg̊yːˀsʌ ˈlɛːˀsʌ ˈlɛːˀnʌ] *disen (2), spiser (3), viser (1), piber (1); gyser (3); læser (8), læner (2)* 'the fog, eats, shows, whines, shudders, reads, leans'. Two words with high vowels ([iːˀ] or [yːˀ]) and two words with [ɛːˀ] were selected from each speaker. Stød was

unmistakably audible in all but two items where it was faint. Stød does not have to be audibly faint, however, to be hard to detect in speech waves or spectrograms. So we attempted a further bi-partition of stimuli: two items by each speaker had visibly irregular vibrations and two did not. The words were randomized. Two of them doubled as initial and final dummies, i.e. there was a total of 22 words to be responded to, but the first and the last were disregarded in the subsequent statistical analysis. Each word was presented three times with one second intervals between repetitions and five second pauses between new words. The test totalled just under 4 minutes. The task was a visual analogue scaling where listeners had to mark, on 22 individual sheets of paper, on a 10cm long line, where they thought the stød began. The test was performed in class rooms, over professional quality loudspeakers, with first year students of linguistics, audiologopedics and English, respectively, and in a group of graduate students. That way we obtained valid data from 81 listeners who all have stød in their own speech and who provided us with a comfortable safety in numbers.

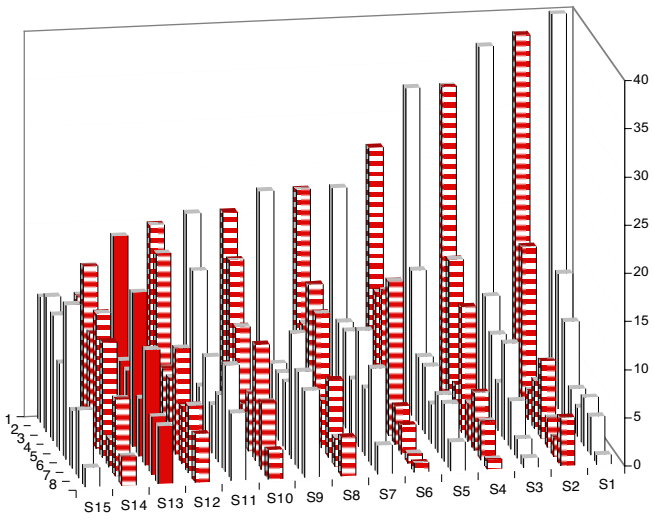

Figure 1. 1210 responses in 8 categories to 15 stimuli.

3. Results

Listeners spontaneously reported, after completion of the test, that they had found it very difficult and were not really sure what they were doing, which is telling in itself. Nevertheless, there is a trend in their responses, only—as we shall see—it has nothing to do with anything that we can associate with stød as we usually identify it.

Marks on the line were converted to numerical values: within the leftmost 2cm they rate "1", within the next six 1cm intervals they rate from "2" through "7", and marks within the rightmost 2cm of the line rate "8". In five words responses were not significantly different from chance (at $p < .05$ or better). 1210 responses to the remaining fifteen are depicted in Fig. 1. There is a pronounced overall tendency towards perceived stød onset at the very beginning of the vowel, and certainly no indication of two phases in the vowel, a first half without stød and a second half with stød, which would have made responses hump in the middle, around "4" and "5".

The detailed documentation will not find room here, but we can summarize the outcome of the analysis. Some stimuli had a more pronounced tendency towards early judgements than others, cf. Fig. 1 (and five had evenly distributed responses). Can acoustic properties in the twenty words be made responsible for these differences? They are best quantified in terms of response distribution medians which range from 3 to 6 on the 8-point scale.

In eleven stimuli it is not evident in either spectrogram, F_0 tracing, microphone signal or harmonicity-to-noise ratio (HNR; reflects aperiodicity, cf. http://www. praat.org) that there is any creaky voice at all, even though only two of them sounded faint (those two and two more of these eleven produced chance responses). Fig. 2, top left, is an example. Fig. 2, top right, shows the corresponding stødless word by the same speaker. Nine stimuli do have visibly irregular vibrations, cf. the example in Fig. 2, lower left. But among those nine there are only two where we can point, with any confidence, to a clear transition between modal and creaky voice (and, surprisingly perhaps, one of those also received chance responses), cf. Fig. 2, lower right.

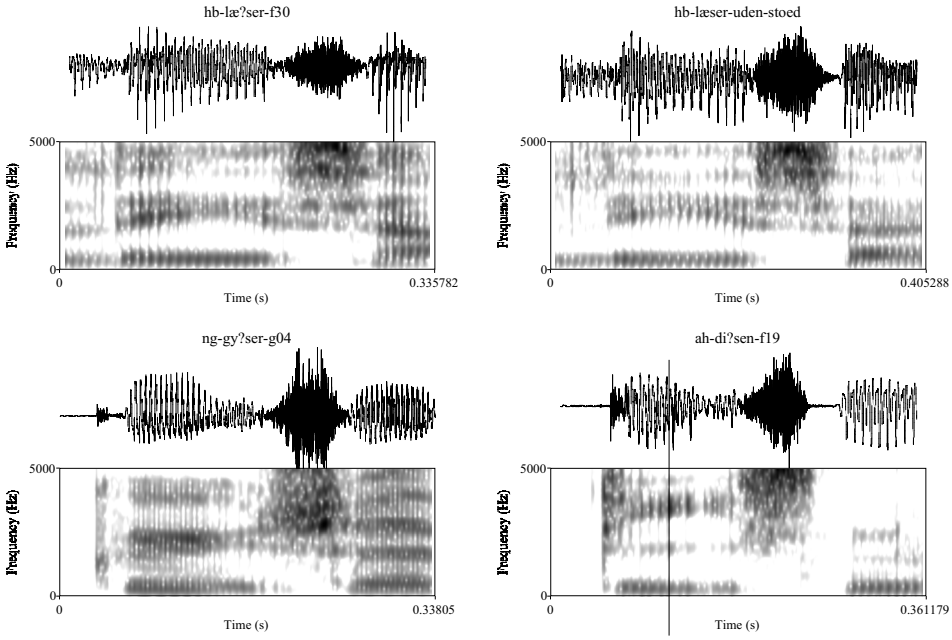

Figure 2. Three words with and one without stød; see further the text.

What did listeners actually respond to, in order to produce the trend depicted in Fig. 1? We extracted a number of acoustic parameters from the comprehensive selection available in praat: HNR average across the vowel, HNR maximum, distance of HNR maximum from vowel onset; average F_0 through the vowel, F_0 maximum, F_0 minimum, F_0 range; and vowel duration. The only factor which comes out with a (modest) correlation with the median of listeners' responses is vowel duration (r=.75). And that of course is directly related to the high [iː^{ʔ} yː^{ʔ}] versus lower [ɛː^{ʔ}] distinction in the words. We take this to mean that our listeners, at a loss to do what was actually asked of them, searched for something else in the stimuli to differentiate them and found only vowel quality. Inadvertently, they bear testimony to the fact that intrinsic differences in vowel duration do not entirely bypass perception, or else why did not words with [ɛː^{ʔ}] provoke *earlier* stød judgements than words with [iː^{ʔ}] and [yː^{ʔ}]?

4. Discussion

Our production results are from modern standard Copenhagen Danish. Chronological, geographical and social variation could not be taken into account, and there is little doubt that the details of stød and length are highly variable in time and space. This must be borne in mind when we discuss general issues about Danish stød, and not least when our results are compared to previous findings.

We have not found any justification for considering stød consonants to be systematically long in normal running speech. Nor did anyone ever suggest that stød consonants be long cognitively. At this point in our research we have no reason to believe that to be remotely likely either.

Vowels with stød are indeed as long as long stødless vowels and may also safely be considered cognitively long. But the latest experiment in the series proved without a doubt that listeners do not partition stød vowels into two halves.

Accordingly, everything considered, we found neither acoustic nor perceptual support for positing two phases in vowels with stød (as opposed to vowels without stød). With current knowledge and available methods, we can think of no other way to obtain empirical support for such a stance. Acoustically and cognitively, stød may therefore be considered a property of the syllable rhyme, rather than specifically of its second mora. Note also that morae play no role in poetic metre in Danish.

However, at more abstract levels of description, where no close affinity with phonetic surface manifestations and no explicit claim about psychological reality are postulated, a mora account of stød and its distribution may be entirely justifiable. This is indeed the analysis in Basbøll (2003). It embodies the claim that modern Danish has grammaticalized (phonologized) syllable weight, resulting in a linguistically relevant distinction between two classes of stressed syllables: light and heavy (containing one and two morae, respectively). Syllables with vowel length and/or stød are always bi-moraic, but no claim about two distinct phases should be made at this level of abstraction. The description in terms of morae would be relevant for historical analysis and typological comparisons.

5. References

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