

ACOUSTICAL AND PERCEPTUAL PROPERTIES OF THE DANISH STØD

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In the preceding volume of ARIPUC (vol. 7, 1973) Pia Riber Petersen published a report on the acoustical characteristics of the Danish stød. However, a couple of problems were left unsolved. In particular, it was intriguing that one of her subjects showed little or no visible difference between stød and stød-less vowels in neither spectrograms nor in the oscillogram and intensity curves, whereas there was a clear difference in the pitch contour, and, rather surprisingly, his stød-words were identified better in a listening test than those of another subject, whose stød was clearly visible in the spectrograms, oscillogram, and intensity tracings.

If one could make (trained) listeners pin down a point in a stød-vowel where they felt the stød-phase to set in, we would know where to look, if not what to look for, since there has got to be something in the acoustical signal that distinguishes a stød vowel from a stød-less one. It might be, of course, that pitch is the only cue with some speakers, but more research is needed before we can establish this as a fact.

A pilot experiment was performed using the author as a subject.¹ The following two word pairs were recorded on tape: [ble:sʌ - ble:ʔsʌ] and [vi:sʌ - vi:ʔsʌ] ('(a) blower - (he) blows' and '(a) hand (on a clock, meter, etc.) - (he) shows') which differ only in respect to the stød, the vowel qualities in each pair being identical. The words were consciously produced on the same pitch contour. - By means of a segmentator

1) I speak a form of advanced standard Copenhagen Danish and have a clearly identifiable stød.

(Thorvaldsen, 1970) the words were cut into pieces of varying duration. The first consonant was always included; the shortest stimulus had a vowel duration corresponding to a rather short vowel (8-10 cs), and the longest stimulus included the beginning of the following [s]; there were 20 stimuli for each word, the difference in duration between neighbouring stimuli being 1 cs. - It is possible to adjust the (rise-time and) fall-time on the segmentator in steps from 5 to 60 ms. A fall-time of 20 ms was chosen since shorter fall-times gave a slight impression of a stop consonant or glottal stop! following the vowel.

The stimuli were randomized and arranged in two separate listening tests, one containing 40 segments of [blɛ:sʌ - blɛ:ʔsʌ], the other 40 segments of [vi:sʌ - vi:ʔsʌ].

5 trained phoneticians (including the author) were supplied with answering sheets and asked to decide whether or not they heard a stød in the mutilated words. They all took the test 3 times. (An untrained listener also took the test, but his answers were completely inconsistent, and it may be that naive listeners cannot perform a task like this, but it is, of course, premature to say anything definite about this - more subjects will have to be tried. However, it is a common observation among teachers in the general phonetics classes attended by students in their first year of university that these students cannot easily identify a stød word when they hear one; i.e. they are not aware of the difference between stød and stød-less words.)

The results were, from the author's point of view, surprisingly good. First of all, nobody gave "stød-answers" to stimuli that did not originally have the stød - which is important, since the cutting technique cannot then be made responsible for the perception of stød in any of the stimuli. Secondly, there was next to universal agreement on the point in the sequence short-to-long (stød)stimuli where the stød was

perceived; that is, the 9 ([vi:ʔsʌ]) and 5 ([blɛ:ʔsʌ]) shortest stimuli (having vowel durations of 18 and 14 cs, respectively) were heard as having no stød, and all the remaining (longer) stimuli were judged as having stød. Now, this point coincides very nicely with the point in the tracings (marked with an arrow at the top) where an obvious change takes place (see fig. 1,a+b - only tracings of [blɛ:sʌ - blɛ:ʔsʌ] have been shown): the higher formants drop out, oscillations decrease in amplitude and are highly irregular, intensity decreases sharply and shows sharp peaks.

From PRP's recordings two words spoken (in a carrier sentence) by the aforementioned subject were chosen: [lɛ:sʌ - lɛ:ʔsʌ] ('(a) reader - (he) reads'). A listening test was constructed in the same way as before, but even before it was run, the results were suspected to be different from those reported above. - (It was very clear that the stød-word was produced on a higher pitch contour than the stød-less word (see fig. 2) and, furthermore, there seems to be a difference in voice quality in the two words (not visible in the tracings). This is true not only of this word pair, but of all the words in PRP's recordings of this subject.)

True enough, even the shortest mutilated stød-word was identified as having stød by the author and the only other phonetician who has taken the test so far, although we tried, purposely to disregard the pitch difference. This is in itself a dubious affair, particularly since the two words were recorded (and played back to the listeners) immediately before the test was run. Thus it may well be that the two words really have been identified as high-tone/low-tone words, and not as stød/stød-less words. It is interesting to note, though, that the pitch contour in the "stød-words", as spoken by this subject, is rising, whereas the general tendency with the other subjects in PRP's material is to produce stød-words on a falling contour. Also, as mentioned before, the "stød-words" seemed

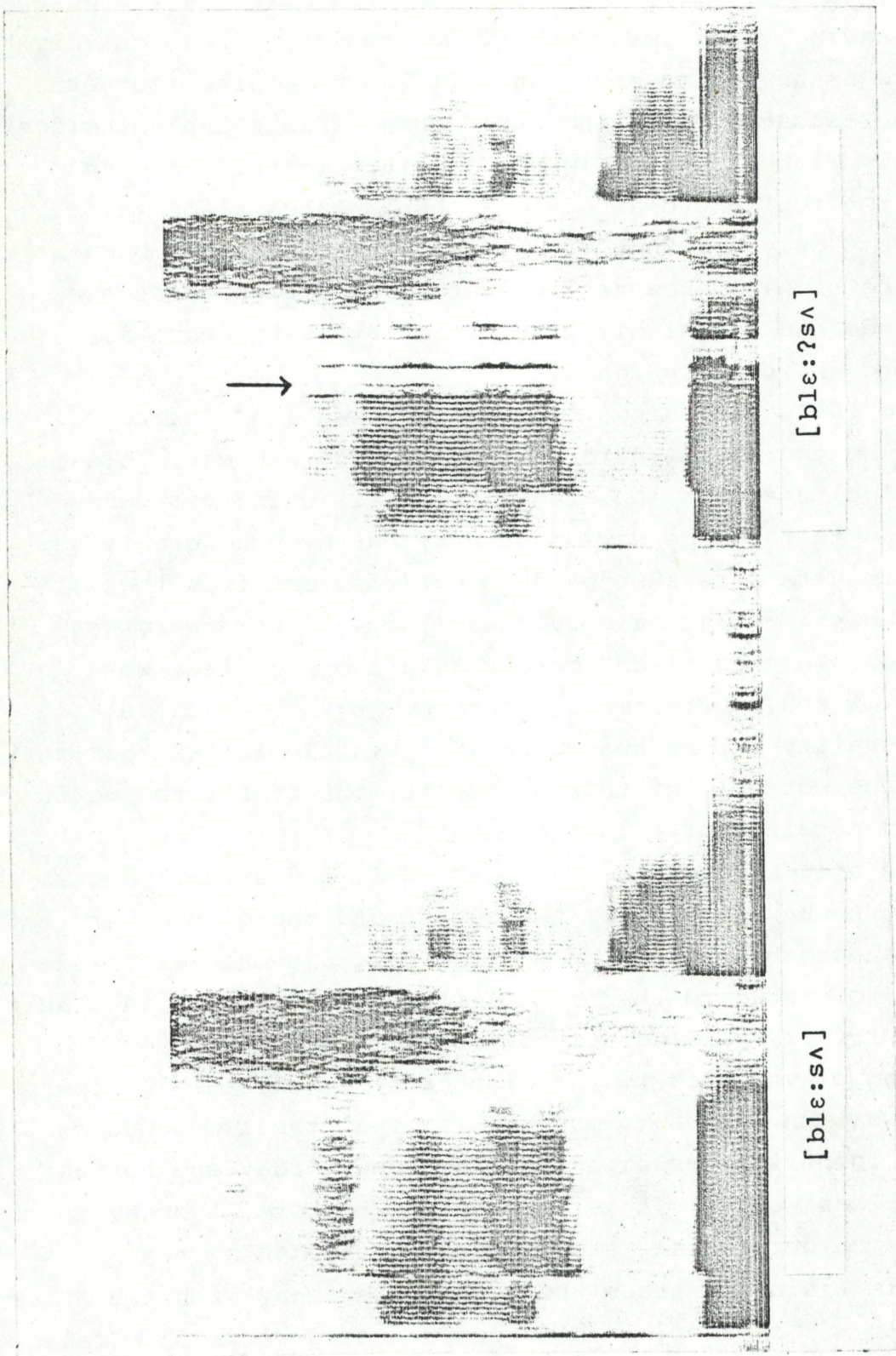


Figure 1a

Spectrogram of the author's pronunciation of [ble:s^ - ble:s^s^]

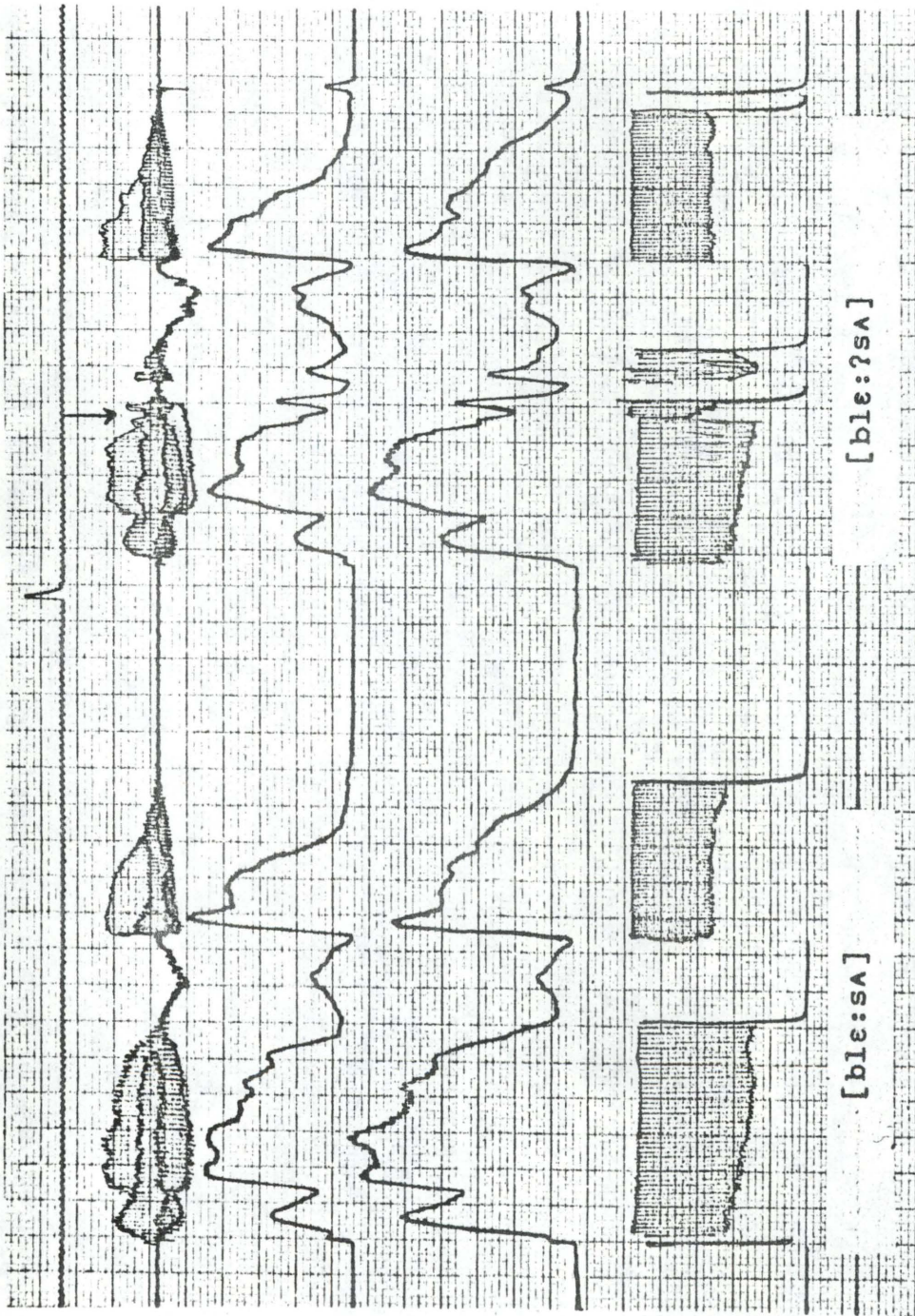


Figure 1b

Mingogram of the author's pronunciation of [ble:sa - ble:?sa]. The traces are, from top to bottom: duplex oscillogram, high-pass filtered (500 Hz) intensity (linear display), full frequency range intensity (linear display), and pitch.

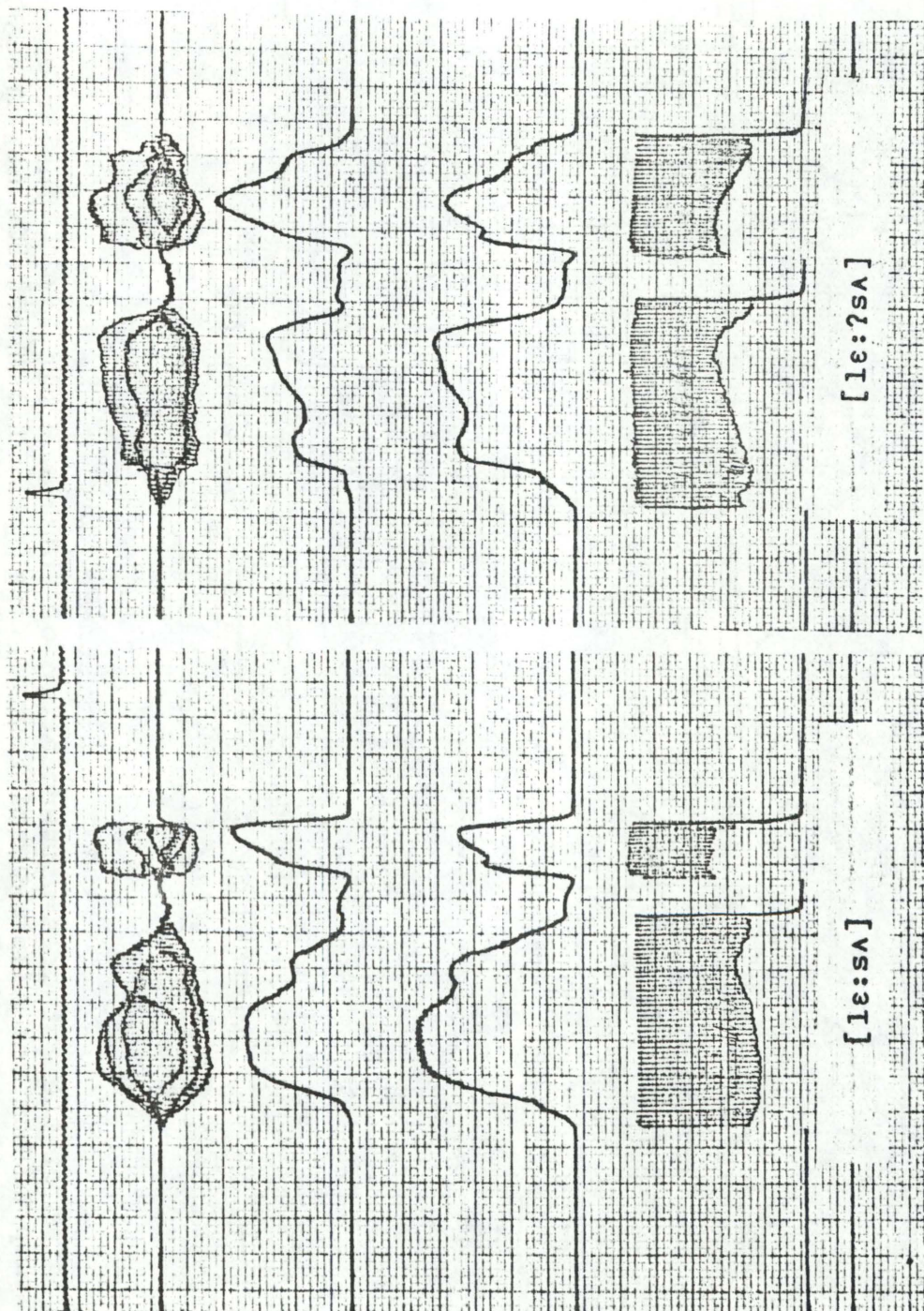


Figure 2

Mingograms of PRP's subject's pronunciation of [ɛ:sa - ɛ:ʔsa].
For an account of the traces, see fig. 1 b.

to have a different voice quality (slightly strained-sounding or compressed) - but whether this last factor is decisive as a cue for stød apart from pitch contour can only be determined when more experiments have been made.

It is evident, especially of course from PRP's investigations, that there are more ways than one to produce the stød and the task for the future will be to try to determine just how many different "stød"s are there, and is there a common denominator underlying them all? If there is not (and it is hardly to be expected), then how do we characterize these different acoustic signals, that are all perceived under the heading "stød"?

References

- Petersen, P.R. 1973: "An instrumental investigation of the Danish "stød"", ARIPUC 7, p. 195-234
- Thorvaldsen, P. 1970: "Construction of a segmentator", ARIPUC 4/1969, p. 8-15