

A NOTE ON VOWEL TRIANGLES AND QUADRANGLES -  
AN ANSWER TO HANS BASBØLL

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In his paper printed above Basbøll argues for regarding [a] as a vowel which in the general distinctive feature system is neutral as far as the difference front-back is concerned, and which can thus be considered a common starting point for a front raising and a back raising line.

(1) I agree, of course, with Basbøll that it seems to be a general fact that front vowels get more retracted the lower they are. This also appears in a gradually lower F2, and it seems to be due to the structure of our vocal tract. Thus the difference front-back is smaller for low vowels. This is generally implied when we talk of front and back vowels, but it may be relevant for the explanation of some developments.

(2) I also agree with Basbøll in his interpretation of *r*-colouring in Advanced Standard Copenhagen Danish (ASC-Danish). It is certainly simpler to consider the modern Danish vowel system as triangular with /a/ as the most open vowel. It gives a simple formulation of the *r*-colouring rule, and it is also in agreement with the phonetic manifestation. It is even possible to adduce some more phonetic evidence for this interpretation: The measurement of jaw opening for two ASC speakers (8-12 examples of the nonsense words /dæ:də/ and /dɑ:də/ in a frame sentence) showed a larger jaw opening for /ɑ:/ than for /æ:/ (for one speaker the difference is statistically significant at the 1% level, for the other at the 5% level). Moreover, /ɑ/ behaves as a very low vowel with respect to intrinsic duration and F<sub>0</sub>. Figures 1 and 2 give a graphic display of intrinsic duration and F<sub>0</sub> for ASC speakers based on measurements by Bundgaard (1980) and by Reinholt Petersen (1976).

Since we are discussing articulatory features (with rounding as a separate dimension) I should, however, find a three-dimensional graph more adequate. Basbøll here follows the tradition from Daniel Jones, which has also given difficulties for the use of the cardinal vowel chart. In Basbøll's figure the common point for /ɑ/ and /ɒ/ seems to indicate that /ɒ/ is also neutral in the back-front dimension. But is that really in-

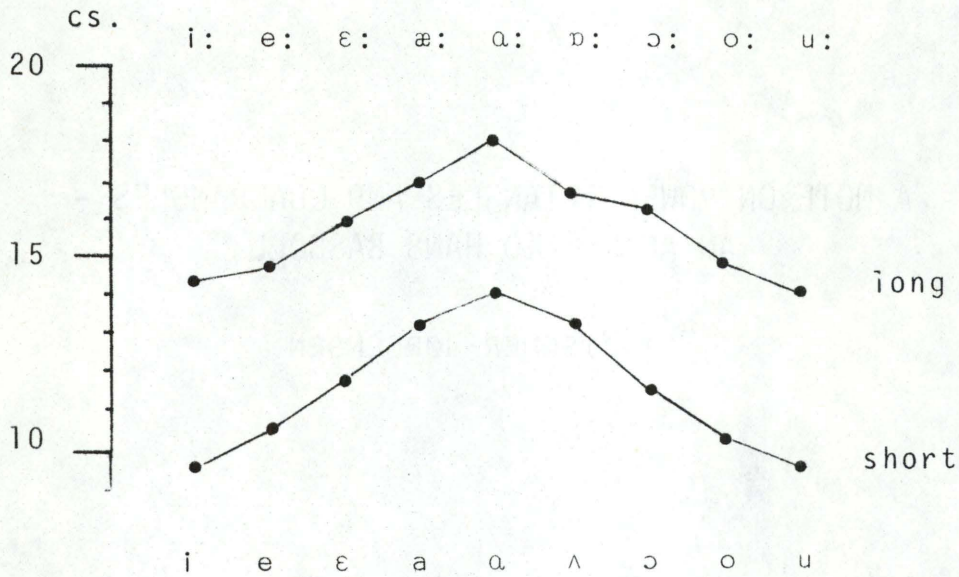


Figure 1

*Intrinsic duration of Danish front unrounded vowels and back vowels (based on Bundgaard 1980, 5 subjects)*

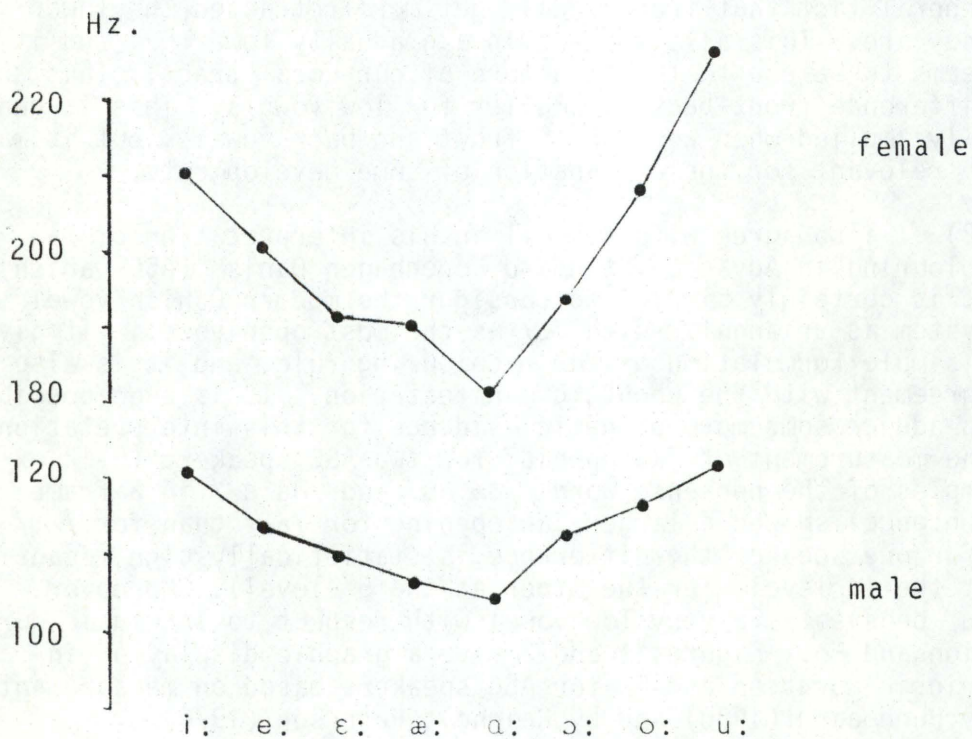


Figure 2

*Intrinsic F0 of Danish front unrounded vowels and back vowels (based on Reinholt Petersen 1976, 5 subjects)*

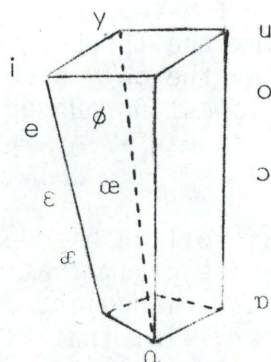


Figure 3

A three-dimensional vowel graph (| high-low, — front-back, / unrounded-rounded), with ASC Danish long vowels.

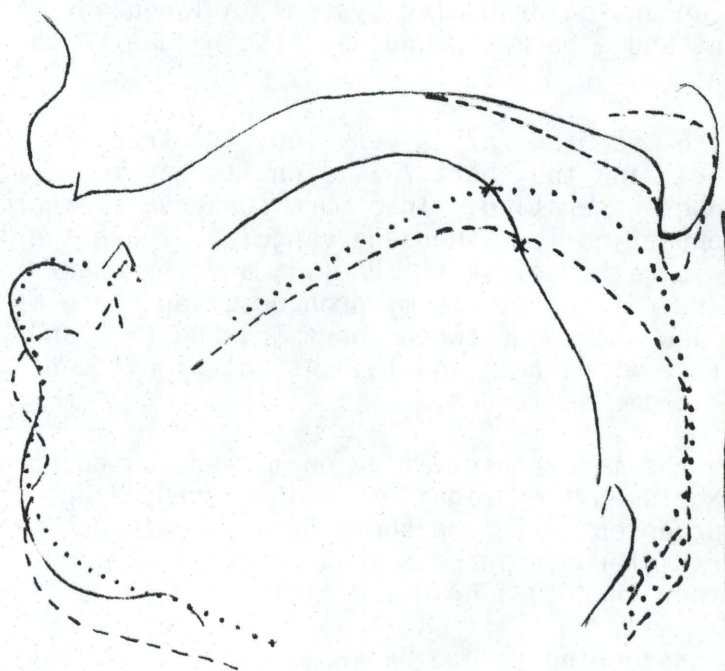


Figure 4

Tracings from X-ray photos of Danish [æ:] —, [ɑ:] ---, and [ɶ] ... (subject EFJ); xx : approximate placement of pellets.

tended? A three-dimensional version of Basbøll's graph might perhaps look like Figure 3. I have placed the long Danish vowels in the graph. I think the three-dimensional figure shows more clearly why /ɑ/ as the only back unrounded vowel can simply function as the lowest unrounded vowel and thus get in the same relation to /i e ε æ/ as /ɒ/ to the back rounded vowels.

(3) Whereas I agree with Basbøll in his description of ASC Danish, I do not agree with his claim that the general feature system should be specified as triangular. I do not find the argument against the a-corner, viz. that [i] [u] [ɑ] but not [a] are close to consonants, very compelling. In the first place, [ɑ] is close to a consonant not because the tongue is low but because it is retracted, and in the second place [u] does not represent a clear corner either in this sense, since all vowels which are close to the palate or the uvula or the pharynx wall are close to consonants.

As for the relation between the sounds normally labelled [a] and [ɑ], Basbøll says himself that the main phonetic difference is front-back, and that an individual language may have an [ɑ] that is higher than cardinal No. 5 and may thus get a quadrangular system. I agree, but the differences between phonetically triangular and quadrangular systems in languages which have both a front and a back a-sound may also be due to the height of the front [a].

In ASC Danish the back /ɑ/ is very low; the front /a:/ is in fact IPA [ɛ:], and the short /a/ is on its way from [æ] to [ɛ] in the younger generation. In a more conservative norm the system is phonetically rather quadrangular. Here the long front /a:/ is rather close to IPA [æ], and the short /a/ is close to cardinal No. 4. In my pronunciation there is no difference in jaw opening between short [a] and [ɑ], and the difference between long [æ:] and [ɑ:] is not significant when said in words in frame sentences.

Further, in the more conservative norm there is no consistent difference between the height of F1 in short [a] and back [ɑ:] (Fischer-Jørgensen 1972, the short back [ɑ] was not measured), but a clear difference in F2. This points to a front back difference rather than to a height difference.

Moreover, considering [ɑ] to be kept low by preservative assimilation to [ɒ] is not a quite convincing formulation. In my pronunciation, at least, [ɒ] is higher than [ɑ]. Figure 4 shows tracings after X-ray photos of my vowels [æ:] and [ɑ:] pronounced in isolation, and of [ɒ] pronounced in slow speech in the sequence [ɑɒɑ]. It is obvious that when pronounced in isolation [ɑ] is both lower and more retracted than [æ], the lowering being due mainly to a wider jaw opening (there is not much difference in tongue height seen in relation to the jaw). The difference between [ɒ] and [ɑ] is almost exclusively one of height (cf. that [ɒ] has a lower F1 than [ɑ] (Heger 1975)), whereas the difference between [ɒ] and [æ] is mainly one of

fronting or backing of the whole tongue body. The jaw opening is the same and there is not much difference between the height of the raised parts of the tongue. Thus a preservative assimilation of [a] to [ɜ] would keep [a] back (with a concomitant narrowing of the pharynx), but there is no reason why it should be kept particularly low. In accordance with these X-ray pictures, a pellet tracking recording of the sequence [aɜa] undertaken in Tokyo 1976 showed the back of my tongue to go simply vertically up from [a] to [ɜ] and down again from [ɜ] to [a]. (The pellets were placed approximately at the place of the crosses in Figure 4 - unfortunately there was no pellet on the tongue root.) - Pellet tracking recordings of the sequences [eɜe, ɛɜɛ, øɜø, œɜœ] showed a movement obliquely back and up and down again with a slightly rolling movement, but opposite the one described by Delattre (1971). He found a movement down-back-up-front  $\overset{v}{\curvearrowright}^{\text{B}}$ , whereas in my case it was  $\overset{v}{\curvearrowleft}^{\text{B}}$ . The slight lowering before the fronting after /ɜ/ may perhaps contribute to explain the rising-falling movement in F1 found by Heger (1975) after [ɜ].

I suppose that in theory a front [a] may be just as low as the lowest back [a] (you can in fact open the mouth more in the front). Even in Daniel Jones' own pronunciation of the cardinal vowels, where he tried to make No. 5 as low as possible but did not make any such effort for No. 4, the difference in tongue height is very small (Jones 1947) (F1 is even consistently lower in cardinal No. 5 than in No. 4 (Ladefoged 1967), but this may be due to a certain rounding).

In the phonological systems of individual languages the distinctive function and the behaviour in phonological rules must be taken into consideration. Trubetzkoy (1939) presented good arguments for considering some languages to have triangular and some to have quadrangular vowel systems. In my paper I mentioned that in Turkish and Finnish the facts of vowel harmony can be formulated most simply in terms of front-back, and here /a/ functions as a back vowel.

Finnish	i	y	u		Turkish	i	y	ɯ	u
	e	ø	o			ɛ	œ	a	ɔ
	æ		ɑ						

In the conservative Danish norm [ɜ] may be pronounced after a back [a] and [ɒ]. Thus, for instance, although my own pronunciation has been influenced by the ASC norm in various respects in later years, there may still be an [ɜ] in distinct speech medially before [i], e.g. *varig*, *Karry*, and I normally pronounce an [ɜ] in final voiceless clusters after short [ɒ] and [a] (e.g. *kort*, *barsk*). In such a norm front and back a-sounds are variants of one phoneme, and phonologically the system is triangular with a very variable lowest phoneme, which is front in most positions, but back in some. In most triangular vowel systems, however, there is only one a-sound which may be more or less central.

It is possible that the Nordic *i*-Umlaut may support the assumption of a triangular system in Old Nordic. But in German the situation is not quite the same. In Old German /e/ may become /i/ both before /i/ and /u/, so that this should rather be regarded as raising before high vowels. The umlaut may then be described as a fronting of /u/ and /o/ and a fronting and raising of /a/. This is not more complicated than Basbøll's formulation, and the common treatment of /u o a/ speaks for the description of /a/ as a back vowel.

I do not think there is much disagreement between Basbøll and me about all these different possibilities in different languages. But I deviate from him by drawing the conclusion that it would be very unpractical to set up a general system of distinctive features which was specified as either triangular or quadrangular. In my opinion the general system should be a system of independent dimensions, which do not meet, and a system of dimensions only, not of discrete steps. Thus neither the number nor the placement of the steps should be specified, although for purely practical reasons it is useful to agree on the transcription of some commonly used sounds. In this transcription [ɑ] is commonly used for a back vowel and [a] for a more fronted vowel. In some individual phonological systems [ɑ] may be the most open vowel, phonetically or phonologically or both, in other languages, with only one a-sound, front or central /a/ may be the most open vowel, and in so-called quadrangular systems there may be more than one vowel in the most open row. - But I consider these specifications as belonging entirely to the individual languages.

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