

Dept. for Speech, Music and Hearing  
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**Formant bandwidth data**

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## I. SPEECH ANALYSIS

### A. FORMANT BANDWIDTH DATA

The formant bandwidth versus frequency data that was presented in a summary article by G. Fant at the IIIrd International Congress on Acoustics in Stuttgart 1959 <sup>(1)</sup> has been compared with data from other investigators. Our data refer to the sine wave response of the vocal tract driven with a throat microphone as sound source applied externally to the throat. The sound was picked up at the lips by a condenser microphone. During measurements the subject held his glottis closed. Stationary response curves of the vocal tract produced by this simple method are shown in Fig. I-1 which also contains a summarizing graph of resonance bandwidths versus frequency. These values agree well with Dunn's data <sup>(2)</sup> up to resonance frequencies of 2000 c/s. In the 3000 c/s range our bandwidth data are on the average lower. This is presumably due to phonetic differences, the Swedish language possessing a relative greater amount of lip-rounded vowels.

The main difference between the formant bandwidths of real speech and these resonance bandwidths lies in the absence of the dissipation of vibratory energy through the glottis in real speech. According to House and Stevens <sup>(3)</sup> the expected differences in formant bandwidth would be of the order of 20 c/s at low frequencies and negligible at higher frequencies. However, the finite speed of frequency variation in our sweep-frequency measurements on the vocal tract in connections with instabilities of the subject might cause some resonance peak broadening which would go in the same direction as additional glottis losses. A comparison of our sine wave response data with House and Stevens <sup>(3)</sup> transient decay measurements, both investigations referring to closed glottis conditions and in addition the Dunn data are brought out in the following tabulation (Table I.A-1).

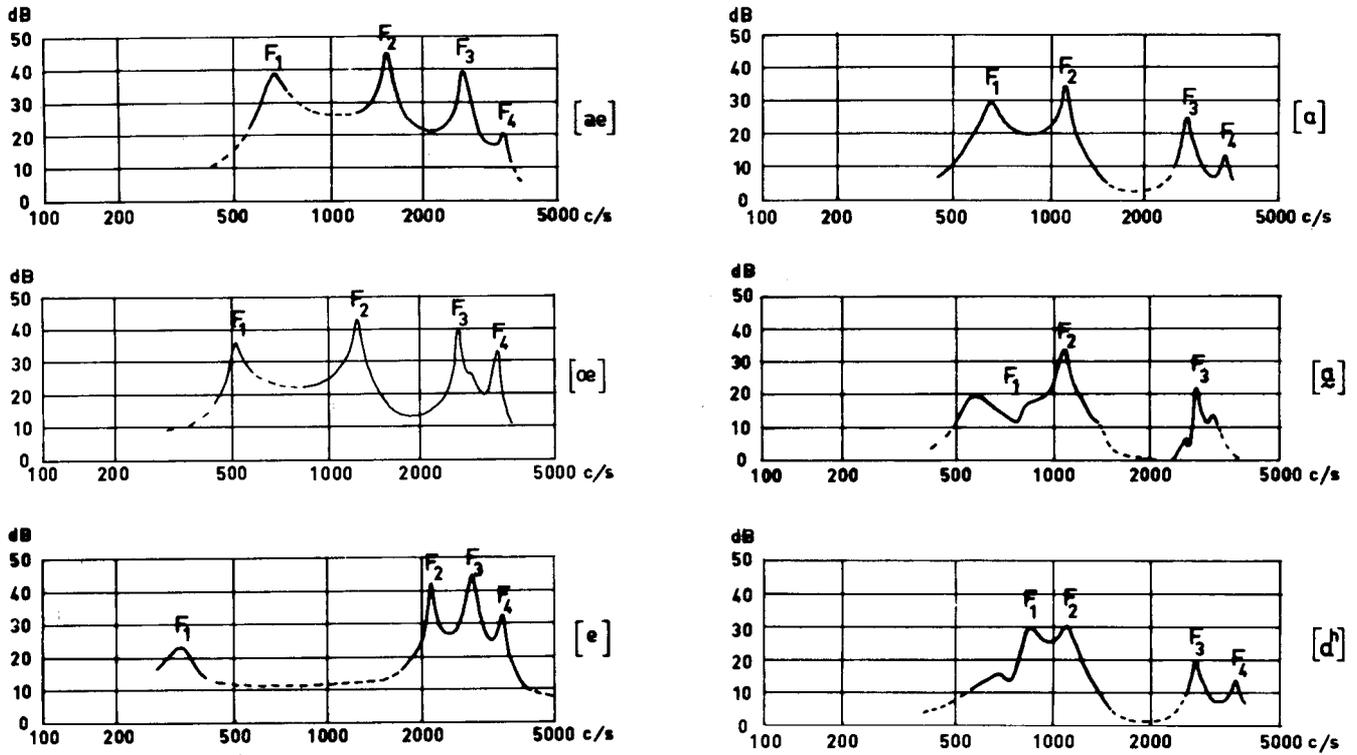


Fig. I-1.a Sine-waves response curves of the vocal tract driven externally from the pharynx and measured 2 cm in front of the lips. The effect of lowering the soft palate as in a nasalized vowel and of opening the vocal cords as in h-sounds is illustrated for the vowel [a].

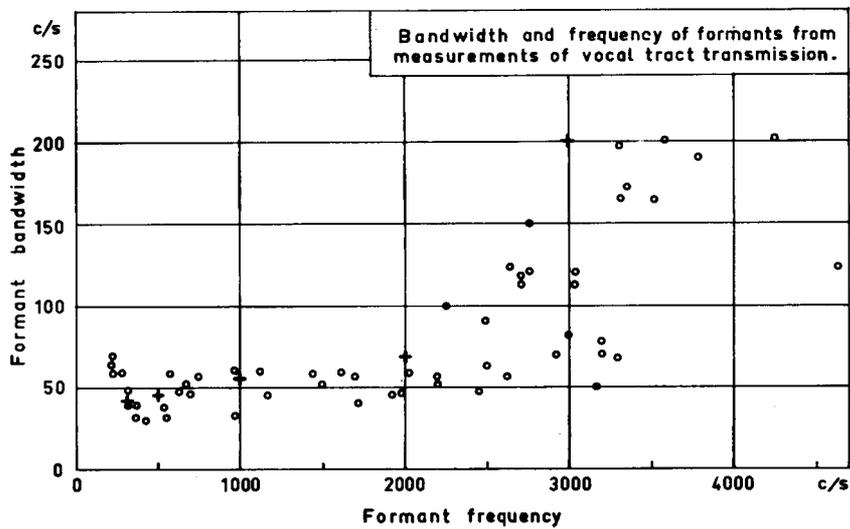


Fig. I-1.b Frequency dependency of the bandwidth of vocal resonances under conditions of closed glottis. Crosses refer to average data reported by H.K.Dunn.

TABLE I.A-1.

Approximate vowel quality			First formant bandwidth			Second formant bandwidth			Third formant bandwidth		
Am	Swe	n	F	HS	D	F	HS	D	F	HS	D
i	i	4	70		38	45		66	170		171
I	e	4	50	66	42	60	75	71	120	76	142
ε	ε	1	35	67	42	40	96	72	90	88	126
æ	æ	5	50	73	65	60	92	90	120	103	156
ɑ	ɑ	10	50	53	60	60	60	50	110	66	102
ɔ	o	3	40	41	47	50	40	50	60	46	98
u	u	5	60	39	50	50	39	58		47	107
U	ø	2	30	39	51	35	37	61	50	47	90
Λ	a	4	60	40	56	60	47	63	(100)	64	102
ɝ	œ	7	30	55	46	45	70	59	65	69	58

Am = American      Swe = Swedish      n = number of measurements on the Swedish subject (G.Fant)

F = Fant      HS = House and Stevens      D = Dunn

The overall agreement is especially apparent in the case of open and half-open backvowels.

The order of magnitude 50 c/s of the bandwidths of the first and second vowel formants is the same as measured by van den Berg with similar techniques applied to a laryngectomized subject <sup>(4)</sup>, the vocal tract of which he drove from a loudspeaker inserted at the laryngeal end of the vocal cavities. However, with our technique it is possible to make measurements on any normal subject and instrumental set up is very simple.

G. Fant

- (1) Fant, G.: "The acoustics of speech", Proc. of the Third International Congress on Acoustics Stuttgart 1959, Ed., L.Cremer, Elsevier Publ.Co. Amsterdam 1961, pp. 188-201.
- (2) Dunn, H.K.: "Methods of measuring vowel formant bandwidths", J. Acoust.Soc.Am. 33 (1961) pp. 1737-1746.
- (3) House, A.S. and Stevens, K.N.: "Estimation of formant band widths from measurements of transient response of the vocal tract", J. of Speech and Hearing Research 1 (1958) pp. 309-315.
- (4) van don Berg, Jw.: "Calculations on a model of the vocal tract for vowel /i/ (Meat) and on the larynx", J.Acoust.Soc.Am. 27 (1955) pp. 332-338.