Hoole, Physiologie

Relationships between respiratory activity and phonation

(Some conversion factors: 1 kPascal = 10.2 cm H_2O; 1 atmosphere = 760mm Hg = 1033.4 cm H_2O)

1. Subglottal pressure vs. fundamental frequency

Approx. 2-5Hz / cm H_2O.
Not enough to account for F0 variation on stressed syllables

See discussion in J. Ohala (1990) *"Respiratory activity in speech"*; W. Hardcastle & A. Marchal (eds.), Speech production and speech modelling, pp. 23-53.

But may account for **declination**

2. Subglottal pressure vs. intensity

Glottal source power increases 6dB for every doubling of excess pressure over phonation threshold pressure. (Threshold pressure is 3-4 cm H_2O; cf. Titze, 1994, p.229)

Ladefoged's investigation (figure from "Three areas of experimental phonetics", 1967) shows that for the same subglottal pressure an /a/ has about 6dB more intensity than an /i/. If subjects have to compare the loudness of an /a/ and an /i/ then they are considered equally loud if they were produced with the same subglottal pressure, *not* if they have the same sound pressure level.

➜ "Motor theory of speech perception" (Liberman et al., Haskins Labs)

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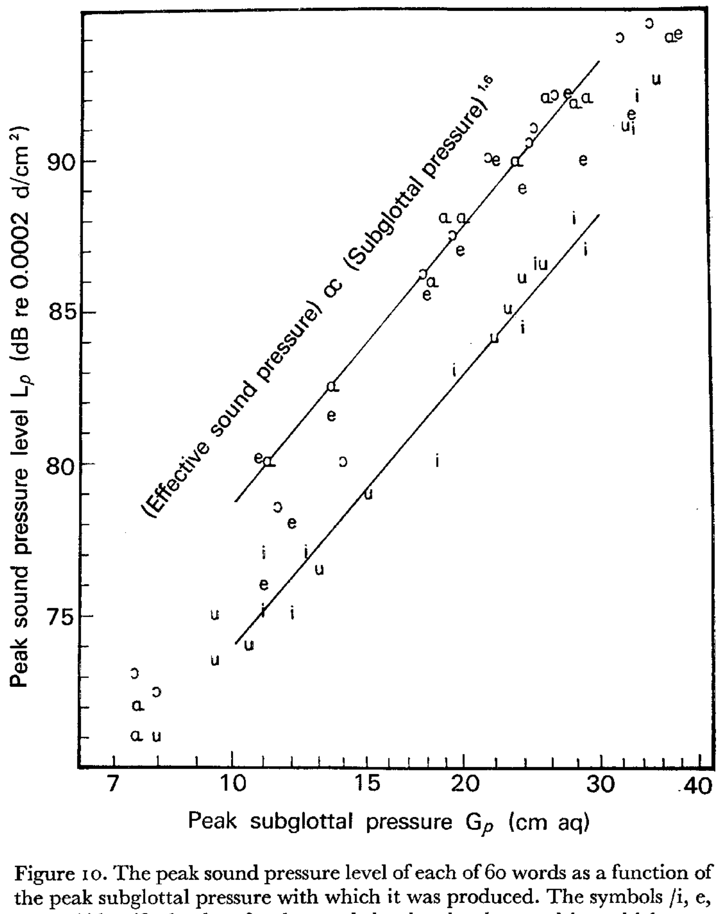

Figure 10. The peak sound pressure level of each of 60 words as a function of the peak subglottal pressure with which it was produced. The symbols /i, e, ɑ, ɔ, u/ identify the data for the words *bee, bay, bar, bore,* and *boo,* which were pronounced by a British speaker. Least-squares straight-line fits to the data for /ɑ/ and for /i, u/ are shown.

3. Vocal efficiency = Ratio of radiated acoustic power to aerodynamic power

Aerodynamic power = Subglottal pressure x mean airflow (cf. volt x amp)
Maximum aerodynamic power for phonation is about 1 Watt.
Maximum efficiency is about 1%.

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