Hoole, Physiologie

Relationships between respiratory activity and phonation

(Some conversion factors: 1 kPascal = 10.2 cm H₂O; 1 atmosphere = 760mm Hg = 1033.4 cm H₂O)

1. **Subglottal pressure vs. fundamental frequency**

Approx. 2-5Hz / cm H₂O.

Not enough to account for F₀ variation on stressed syllables


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 H₂O; 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)

![Graph showing relationships between subglottal pressure and sound intensity.](image)

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, a, u/ identify the data for the words bee, boy, bare, and boe, which were pronounced by a British speaker. Least-squares straight-line fits to the data for /a/ 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%.