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Vocology and Audiology: Natural Partners for Exploring the Voice

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When I took my first courses in communication sciences and disorders in the late '60s, sound production and sound reception (and perception) by humans were always taught in the same series of lectures. It was rare that range of frequency and acoustic power produced by the larynx were not immediately related to range of frequency and power received by the auditory system. I studied the classic books of Fletcher (1953) and Flanagan (1965), both of which drew strong parallelism between voicing and hearing.[1]

Consider first the anatomic and physiologic similarities. Neural signals activate the posturing muscles of the larynx to set up a glottal configuration. Airflow is produced to vibrate the vocal folds. This tissue vibration is converted to acoustic waves in the *larynx canal* (the epilarynx tube). These acoustic waves further propagate through the vocal tract and radiate from the mouth. On the reception side, the radiated sound is received by the outer ear (the equivalent of the vocal tract), elevated in pressure by the ear canal (the equivalent of the larynx canal, or epilarynx tube), and applied to the ear drum (the equivalent of the vocal folds). Cochlear fluid mechanics, the equivalent of glottal airflow mechanics in vocalization, excites the hair cells to transmit electrical signals to the brain via the auditory nerve. The receptor neurophysiology parallels the motor neurophysiology in the laryngeal muscles.

Over the years, the partnership between voice science and hearing science has waned a bit. Speech largely absorbed voice and aligned itself more with language. In Europe, this alliance is demonstrated by the title of the journal *Logopedics, Phoniatrics, and Vocology*. Interestingly, however, the older alliance still exists. For example, some academic departments in France use the term *Audio-phonologie* to describe their disciplinary emphasis.

We might pose the question: What's more important for a singing teacher, to have a good ear or to have a good larynx? A large debate could ensue on this issue. Certainly the terminology we use to describe voice production in the studio is more related to hearing science than voice science. We tell students to change pitch, loudness, timbre (or voice quality), roughness, and ring. All of these are perceptual terms. Even tremor, vibrato, and register are first defined perceptually before they are cast into production terminology like amplitude modulation, frequency modulation, or spectral tilt. We talk about loudness, but never use sones to quantify it; we talk about roughness, but rarely frame it in terms of critical band theory; we talk about pitch, but rarely recognize that it depends on timbre; we talk about vocal fry, but don't relate it to periodicity detection in the auditory system.

The concept of impedance, the ratio of a stimulus to a response, is finally creeping into the language of vocology. Impedance is a ubiquitous concept that exists in many fields of science. When impedance is high, there is little response to a stimulus; when impedance is low, there is much response to the stimulus. In audiology, impedance measurements have been made on solid-like materials (tissue), liquids (cochlear fluids), and gases (air ducts). In vocology, we are now calculating and measuring impedances of the vocal tract, which are subdivided into resistances and reactances. Inertive (positive) reactance has become an important variable for quantifying the interaction between the source and the filter in speech and singing.

In summary, our March/April focus on exploring the voice might include a little attention paid to the discoveries of our friends in the hearing world. Problems associated with excessive exposure to sound (or silence) are not independent from problems associated with excessive (or insufficient) sound production. The larynx and the ear evolved as a pair of organs. Let's not artificially divide them.

NOTE

1. Harvey Fletcher, *Speech and Hearing in Communication* (Princeton, NJ: Van Nostrand, 1953); James L. Flanagan, *Speech Analysis, Synthesis, and Perception* (New York: Springer Verlag, 1965).