Ingo Titze, Associate Editor

Introducing A Music Notation Scheme For Pitch-Vowel Interaction

Ingo R. Titze

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PITCH-VOWEL INTERACTION INVOLVES relations between harmonics and formants. A formant is an acoustic resonance of the vocal tract. It is a wave phenomenon in which forward and backward travelling sound waves between the glottis and the lips reinforce each other. Resonance occurs only at specific sound frequencies known as formant frequencies. In a neutral vowel like /ə/ or /ʌ/, these formant frequencies occur around 500, 1500, 2500, 3500, 4500 Hz, all are about 1000 Hz apart from each other. The separation is different for every vowel, however.

Most vowels are distinguished by the first two formant frequencies, labeled F1 and F2. Compared to the neutral vowels, the vowel /ɑ/ has a high first formant (around 700 Hz) and low second formant (around 1100 Hz), the vowel /i/ has a low first formant (around 300 Hz) and a high second formant (around 2100 Hz), and the vowel /u/ has both formants low (about 300 Hz and 800 Hz).

It is important to keep clear that the vocal tract does not *produce* these frequencies; it only resonates them. They must be produced by a source of sound, such as the glottal airflow between the vocal folds during vibration. The source generally produces many sound frequencies, simultaneously. If the sound is continuous, steady, and not noisy, the frequencies are harmonically related. There is a fundamental F0, a second harmonic 2F0, a third harmonic 3F0, and so on. Individually, each harmonic can be considered a tone, a pure whistle-like sound to which we would assign a pitch if it were heard in isolation. We can also assign a tone and pitch to a formant, with the understanding that it exists only as a tone location, a place in tonal space where a harmonic can be resonated (or boosted).

If we use traditional clefs for musical notation, harmonics and formants can be shown to coexist. The notation can be quite confusing and cluttered, however, unless a clear symbolic notation is used. To date, I have not found such a symbolic notation, but will propose one for discussion. Let the second harmonic of any note be written as a small diamond (◇) and the third harmonic as a small rectangle (□). Higher harmonics could be given additional symbols, but let that be a future discussion. With regard to formants, let the first formant F1 be a single symbol (Example 1) and the second formant F2 a double version of the symbol (Example 2).

Example 1 | Example 2

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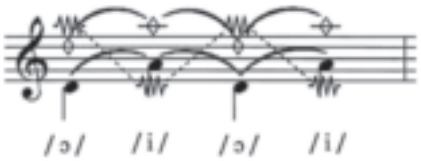

Example 3

Most of the interesting interactions occur between the first two harmonics (F0 and 2F0) and the first formant (F1). Example 3 shows a vowel sequence /ɔ–i–ɔ–i / to be sung on the pitch intervals D_4–A_4–D_4–A_4. Here we see that the fundamental (normal quarter note notation, ♩) and the second harmonic (◇) alternate in both, being below F1 for D_4 and both being above F1 for A_4. A simple representation such as this can give much insight into the way pitch-vowel interaction can be managed pedagogically. For example, on the note D_4 the second harmonic is closed to F1 (just below it). This location will strengthen the second harmonic more than the fundamental, giving rise to a chest (or modal) registration in voice quality. On the note A_4, the fundamental is closest to F1 (just above it), giving rise to a falsetto-like registration if no vowel modification takes place. Of course, singers can prevent this stark registration contrast by changing the vowels.

The important visual feature in Example 3 is the crossing of the formant trajectory (dashed line) with the harmonic trajectories (solid lines). Whenever such a crossing occurs, voice instabilities can arise in pitch, loudness, and voice quality. Thus, a clear and compact notation would be helpful.

I solicit some discussion among *Journal of Singing* readers on this topic. Many of you have already formulated ideas, perhaps much better than these presented here. A NATS conference discussion would then be appropriate.

Ingo R. Titze is Distinguished Professor of Speech Science and Voice at the University of Iowa and Executive Director of the National Center for Voice and Speech at the University of Utah. His formal education is in physics and electrical engineering, but he has devoted much of his studies to vocal music and speech. Dr. Titze has published more than 400 articles in scientific and educational journals, coedited two books titled *Vocal Fold Physiology*, and now has three books in print: *Principles of Voice Production*, *The Myoelastic Aerodynamic Theory of Phonotion*, and *Fascinations with the Human Voice.* He has lectured throughout the world and has appeared on such educational television series as *Innovation*, *Quantum*, and *Beyond 2000*. He is a recipient of the William and Harriott Gould Award for laryngeal physiology, the Jacob Javits Neuroscience Investigation Award, the Claude Pepper Award, the Quintana Award, and the American Laryngological Association Award. He is a Fellow and a Silver Medalist of the Acoustical Society of America, and a Fellow of the American Speech-Language-Hearing Association. Dr. Titze has served on a number of national advisory boards and scientific review groups, including the Scientific Advisory Board of the Voice Foundation and the Division of Research Grants of the National Institutes of Health. In addition to his scientific endeavors, Dr. Titze continues to be active as a singer. He is married to Kathy Titze and has four children and eight grandchildren. Mail should be addressed to Ingo R. Titze, National Center for Voice and Speech, 330 WJSHC, Iowa City, IA 52242. Telephone (319) 335-6600.