THE VOWEL FORMANT AND WHAT IT MEANS IN SPEECH AND VOCAL MUSIC

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The vowel formant is merely the frequency region where each individual vowel has an unusual amount of energy, regardless of the pitch (or overtones) at which a vowel is sung. Each vowel has its own distinct formant. No two vowels are alike, although two vowels do have frequency regions in common. Each vowel has two or more frequency regions. The vowel *oo*, as in pool, has one frequency region approximately at G (392 d.v.), and another at G (784 d.v.). If this particular vowel is sung on either of these pitches, the singer will find it very easy to intone.

The ease with which a vowel may be intoned depends upon the relationship of the pitch at which it is sung (or the resulting overtones), and the formant or frequency region of the particular vowel. If the overtones of the given complex tone (pitch) fall on the formant, the vowel may be sung with ease, and the order of ease in singing vowels (at a given pitch) will be determined by the number of the overtone, that is, fundamental, first, second, third, etc., overtones, in order, will be most easily sung.

For example, if the vowel in question is *oo* (pool), with the formant of G (392 d.v.), the order of ease of singing should be G (392) as fundamental; next, G (196) since G (392) is the formant or first overtone of the complex tone on this pitch; and for others, the formant G (392) will be as follows; second overtone, C (130 d.v.); third overtone, G (98); fourth overtone, E-flat (78), etc.

The formants of the various vowels have been determined definitely by physicists, including D. C. Miller, Harvey Fletcher, and I. B. Crandall.

These formants vary with the different vowel sounds, and they are entirely different for male and female voices, even when the fundamental pitch is the same. The author has constructed a complete table of all pitches within the ranges of both men's and women's voices, showing the easiest, next easiest vowel, and so on, to the most difficult vowel to intone on each particular pitch. Thus it is possible to select appropriate vowels for vocal exercises, as well as songs. However, when songs are transposed to other keys, this relationship is lost.

D. C. Miller suggested that certain songs which are especially effective, owe their quality to the proper relation of vowel sounds to pitches. Also that the "Hallelujah Chorus" from Handel's *Messiah* has been cited as such a selection. The first statement is true, however, the author found, on analyzing the "Hallelujah Chorus" selection that with the exception of the "ah" vowel, in the word "Hallelujah", which vowel has three formants, the song does not comply with formant requirements nearly as well as many other songs which have been analyzed.

Dr. G. W. Stewart has invented an acoustic filter in which the frequencies above 3000 d.v. are eliminated for any complex sound which passes through this filter. In other words, the upper overtones are eliminated. It so happens that the vowels *ee* (see) and *oo* (pool) have the same lower formants, but *ee* has also a very much higher frequency region or formant which *oo* does not have. In singing or speaking the vowel *ee* into this filter, the listener will hear the vowel *oo*. Humorous and distorted meanings can be obtained. For instance the words lease, glee, he, and three, become loose, glue, who, and through, respectively.

Time will be needed to determine the practical use of the vowel formant in speech. At present, only theoretical suggestions have been given. Since the vowel formant does influence the quality and clarity of the vowel, according to pitch, it may be possible to make some application to speech training. The average person has a pitch range of one octave in his speech, and perhaps if stress is given to certain words which include vowels on a definite pitch, more effective speech interpretation will result. However, speech is not like vocal music where definite vowels can be sung on particular pitches, although speech does utilize pitch, dynamics, and quality for certain expression. Perhaps it will be possible to find more practical application for the formant, in the future, somewhat like the practical use of dynamics in speech radio training.

Since the physicists are quite agreed on the vowel formants, so far as their pitches are concerned, the important question is: How do these formants actually apply or agree with vocal production? Therefore experimentation has been carried on in singing of vowels on the various pitches. It was found that this is quite a subjective procedure, and that three influencing factors enter into vocal production, namely: prejudice, suggestion, and fatigue. Prejudice and suggestion might influence both the performer and the listener as to the vowel sung with greatest clarity on a given pitch, and naturally fatigue greatly influence the ease of singing, regardless of vowel or pitch. If these three factors could be kept constant, or be eliminated, the experiment could be made very objective.

Although the experimentation is by no means complete, there are some deductions which can be made on what has been done up to the present time.

1. *Quality* of a vowel is definitely influenced by the formant. There may be a psychological factor involved so far as quality is concerned, since the thinking of "clear" vowel prior to production, regardless of pitch, has a marked influence on the clarity and quality of the vowel. However, the author has written two sets of words to the melody "Sweet and Low", one being the most easily sung vowels, according to the formant requirements, and the other, containing the most difficult vowels also according to these requirements. A pronounced difference in quality of vowels can be observed in the two performances by the same singer, due, no doubt, to the formant differences of the two.

Quality changes, it was found, were less apt to occur when intensity was varied, if formant requirements were followed. Likewise, the same conditions were found when changes were made in duration; that is, a tone of long duration was less apt to show changes in quality, if formant requirements were observed, than if no attention was paid to the formant relationship to pitch.

2. *Intensity* is likewise influenced greatly by the formant also. Although the vowel *oo* is the most difficult of all vowels to sing with great intensity, if it is sung on the proper pitches, a great difference could be observed. An average singer can usually sing with clarity when singing "moderately loud", but when extremely loud or soft singing is required, greater difficulty was observable, even for the professional singer, when the formant requirements were not followed.

3. *Duration* of a vowel sound was found to be influenced by the formant in exactly the same manner as has been mentioned for quality and intensity, although the attributes of intensity and pitch had had a more pronounced influence on duration than did quality.

4. *Pitch* is considered of utmost importance in vowel performance. In fact, the proper pitch for each vowel determines the perfection of performance, so far as quality, intensity and duration are concerned. Although it was believed that if the proper pitch were given to each vowel, there would be no danger of flatting or sharping. The very difficult pitch is not a half-tone above or below the tone which is easiest to perform for a definite vowel, but perhaps a third or fourth interval from this pitch. If a vowel is sung on a pitch a half tone below the "best pitch", that particular complex tone has a great deal of energy in the overtone nearest the vowel frequency region or formant, and it is fairly easy to intone.

5. *Harmony* which is so closely related to pitch and quality is naturally influenced by the formant in the same manner as these two factors. Sometimes two vowels do not seem to blend on certain pitches, yet this is not observed on other pitches for these same vowels. This may be due to the relation of the pitches to the formants. In the future the choral symphonies may become popular in music performances, and if so, consideration of the vowel formants will be of great importance in determining vowels for humming or singing the various parts.

The experimentation in the performance of vowels on various pitches, so far as the quality, intensity, and duration are concerned, will be continued and, it is hoped, some practical contributions to vocal performance will be forthcoming.