OPTIMUM FREQUENCY AND PITCH RANGE

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'Most of the therapies of voice disorders are based on the belief that a person has an optimum pitch at which the voice will be of good quality and will have a maximum intensity with the least expense of energy and they concern themselves mainly with altering the habitual pitch level or making the case to use his optimum pitch' (N. P. Nataraj 1972).

It is often hypothesized that by making the case to use his optimum pitch different types of voice disorders can be treated. (Y. S. Shantha 1973).

Dorothy and Sherman (1962) in treating hypernasal cases found that, when optimum pitch was below the habitual pitch and when the case was made to use his optimum pitch, nasality decreased.

Wilson (1968) while discussing the treatment of hyperfunctional voice disorders says that a considerable improvement may be achieved by lowering the habitual pitch towards optimum.

Fischer (1966) while treating pitch problems states that optimum pitch is the best pitch for speaking.

Williamson (1944) in his study of hoarse Voice concluded that the principal cause of the trouble was tension resulting from speaking at a level far below optimum pitch.

Lewis (1936) and Appleman (1953) found that a change in the pitch towards optimum is associated with optimal adjustment in the resonator thereby changing the quality.

Thus a review of literature on voice therapy shows that there is a great need, for finding the optimum frequency as it is so frequently used in treating voice problems. (Y: S. Shantha 1973)

Even if we take this as an overstatement it is still true that finding the optimum frequency is the crux of most therapies. We now have objective methods of locating optimum frequency. However this involves sophisticated equipment and therefore many practising clinicians are still stuck with less objective means.

In an attempt to objectify as far as possible, many therapists have used the pitch range and have prescribed an arithmetical relationship between the pitch range'and optimum frequency.

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There are several methods recommended for locating optimum frequency using the total pitch range. Usually the lowest and the highest note the person can produce are determined and taken as the pitch range. Some consider optimum pitch as a frequency one fourth above the lower limit of the pitch range (Pronovast 1942; Fisher—1942; Fairbanks—1960 and Berry and Eisenson—1962).

Pronovast (1942) located median pitch levels in six superior male speakers and observed they approximated with a level that was about one fourth of the total pitch range.

Brownstein and Jacoby (1967) consider the optimum pitch as one fifth from the lower limit of the pitch range.

Linke (1953) found that median pitch levels comprised one-fifth of the total range in case of female voices.

Johnson *et al* (1967) consider this method given by Fairbanks (1959) as the most satisfactory method yet devised for estimating a person's natural pitch level. They suggest modifications to cope up for the limitations of this method, which still remain confusing.

This paper is a report on the bi-product observations made during another study, 'A comparative study of vocal parameters of trained and untrained singers' (1974).

Thirty trained and thirty untrained singers constituted the two groups studied, and they were matched for age, sex, height and weight.

As a part of the study the optimum frequency and the pitch range were determined in both the groups.

$$\text{Optimum frequency} = \frac{\text{Natural frequency of the vocal tract}}{\text{Relationship}}$$

Optimum frequency was determined by feeding a tone of variable frequency ranging from 100 Hz to 5000 Hz having a constant intensity generated by the beat frequency oscillator into the vocal tract which was maintained in the vowel/a/ position by means of a probe speaker.

The response of the vocal tract was picked up by a condenser microphone and the output was graphically represented on the calibrated paper of a level recorder. The maximum peak was taken as the natural frequency of the Vocal tract and this was divided by the relationship factor i.e., 5 in females and eight in males, for obtaining the optimum frequency. (This method was used and validated by N. P. Nataraj in 1972).

In the present study trained singers used their optimum frequency while speaking unlike the untrained singers.

Next the pitch range was determined by instructing the subject to phonate the lowest possible and the highest possible pitch and the reading was directly obtained from the tacho unit of the stroboscope.

Pitch range was defined as the measure of the musical interval between the highest possible and the lowest possible pitch the subject phonated. As the subjects were singers, trained and untrained it was assumed that they correctly identified the lowest and highest points [To check what arithmetic relationship (J, *i*, or I) should be used]. The relationship between the optimum frequency and the pitch range determined in the present study are worked out and are presented in Table 1 for trained singers and in Table 2 for untrained singers.

Position of optimum frequency in relation to pitch range
(Expressed as % above the lowest frequency)

$$= \frac{\text{Highest frequency} - \text{lowest frequency}}{\text{Optimum frequency} - \text{lowest frequency}} \times 100$$

TABLE 1. Trained Singers

Optimum frequency (in cjs)	*Pitch range*		*Position of O.F. in relation to the P.R. expressed as* X % *above the lowest pitch*
	Lowest frequency	*Highest frequency*	
225	150	650	15%
145	50	360	31%
120	105	600	3%
245	200	800	7.5%
200	120	450	24%
180	100	550	18%
150	60	400	26%
255	75	1000	19%
145	100	750	7%
190	50	500	31%
290	50	500	53.3%
235	150	690	15.7%
160	60	300	41.6%
245	120	450	37.8%
140	75	500	15.5%
260	170	600	21%
240	200	2400	1.8%
245	150	650	19%
260	210	660	11%
225	150	600	19%
220	150	750	11.6%
255	150	750	17.5%
240	150	1200	9%
250	140	1300	9.4%
235	110	1100	21.6%
205	100	1200	9.6%
250	160	600	20.5%
155	60	350	32.7%
255	90	1750	9.3%
255	160	850	13.7%

TABLE 2. Untrained Singers

245	110	350	56.25%
180	100	260	50%
125	110	310	7.5%
230	200	550	8.6%
250	170	325	51.6%
245	200	500	15%
335	200	.550	90%
260	176	450	30.6%
130	90	500	10%
240	220	550	6.1%
255	150	900	21%
265	210	950	7.4%
110	90	260	11.7%
235	100	260	85.5%
120	100	90	4.2%
265	110	350	62.9%
260	210	510	16.6%
225	180	420	19.7%
240	240	550	0.3%
225	150	600	16.6%
235	200	350	23.3%
265	190	550	28.8%
260	200	425	26.6%
280	200	425	39%
320	110	450	68%
260	110	550	36.8%
250	200	510	16.1%
120	110	210	10%
225	120	350	46%
255	240	900	2.3%

TABLE 3. Summary Table

	Trained	Untrained
0—10	8	9
11—20	10	5
21—30	6	7
31—40	5	1
41—50	—	4
51—60	1	—
61—70	—	2
71—80	—	1
81—90	—	1
91—100	—	

it is noticed that there is no consistent relationship between the two features (P. R. and O. F.) in either the trained group or the untrained group.

Therefore the pitch range cannot be used to locate the optimum pitch arithmetically.

A comparison of the pitch ranges between the trained and untrained singers reveals that the trained singers have greater pitch range than untrained singers (Sheela Kumar 1974). This is in keeping with the review of literature.

Luchsinger (1965) studied the voice of a female singer and found the range as 41/2 octaves. Greene M. (1972) states that pitch covers one to one and a half octaves in untrained voices and 2 to 21/2 octaves in trained voices. Wolfsohn reported to have trained his pupils to break away from convention and recover a range of 6 octaves.

Luchsinger and Dubois (1965) analysed the singing voice of singers whose singing range was found to be from 64 c/s—2960c/s.

In his examination of 600 trained singers Priessler encountered differences in vocal ranges ranging from 24-54 semitones, (i.e. 2-41/2 octaves)

These findings reported in the literature and the observations made during the present study reveals that the pitch range is a variable and can be extended by vocal training.

Optimum frequency by definition is related to the vocal tract and is therefore more constant. Therefore the optimum frequency apparently cannot be related to the variable pitch range.

Perhaps the best resource for a therapist without the sophisticated equipment is still the subjective esthetic evaluation.

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