A STUDY OF FREQUENCY RANGE IN COLLEGE-AGED AND MIDDLE-AGED FEMALES

By

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Bachelor of Science in Arts and Sciences

Oklahoma State University

Stillwater, Oklahoma

1986

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF ARTS
July, 1991

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AND MIDDLE AGED FEMALES

Thesis Approved:

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PREFACE

The following investigation focuses on the effects of aging on vocal pitch characteristics in 20-26 year olds and 40-50 year olds.

I wish to convey sincere thanks and appreciation to my major advisor, Dr. Arthur Pentz, for his encouragement, support, and expertise which were invaluable in this project. I would also like to thank the other committee members, Dr. Cheryl Scott, and Mr. Gary Beeby, for their support and advisement in the development of this study.

I also wish to express gratitude to Amy Schwartz, Janet Brightmire, and the entire speech pathology department at Kaiser Rehabilitation Center for their cooperation and support during the preparation of this manuscript.

Finally, I would like to thank my husband, Scott, my daughter, Ellyn Royall, and our parents, Kermit, Burks, and Bettie, for their undying love, patience, and support throughout my graduate program.

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CHAPTER I

INTRODUCTION

The human body undergoes a multitude of changes as it ages. Cells change and cause less efficient functioning in all systems. Hair becomes gray, skin loses tone and color, senses become less acute, muscles lose their strength and flexibility, and overall performance becomes decreased. The entire speech mechanism is equally vulnerable to these changes. Cellular changes affect the structural and functional aspects of other organ systems.

Degeneration in the respiratory system causes a reduction of elastic recoil capacity of the lungs, a reduction of color and luster of the pleurae, (McKeown, 1965) and poorly lubricated pleural membranes (Comroe, 1965). Progressive thinning and degeneration of the vertebral discs often results in exaggerated curvature of the spine and changes the shape and size of the thoracic cavity (McKeown, 1965). Decreased muscle strength in the thoracic cavity (Dhar, Shastri, & Lenora, 1976), calcification and ossification of its joints (Grant, 1972) also contribute to decreased respiratory efficiency as age increases.

Atrophy of mucous membranes and drying of tissues lining the surface of the vocal folds and the entire vocal tract result in aberrant vibrational patterns which cause increased noise within the glottal spectrum (Hirano, 1974). Vocal pitch and resonance

changes are also affected by decreased elasticity and strength of laryngeal musculature and by changes occurring in the mucous membranes and tissues in the laryngeal, pharyngeal, oral and nasal areas (Hodkinson, 1982).

Other structural and functional properties of the laryngeal mechanism also changes with age. Degenerative changes including muscle atrophy (Hirano, Kurita, & Nakashima, 1983), cartilage calcification (Segre, 1971), ligament deterioration (Kahane, 1983), nerve atrophy (Segre 1971), and neurotransmission function degeneration (Wagman & Lesse, 1953), all impact the aging laryngeal function.

CHAPTER II

REVIEW OF LITERATURE

A number of studies have evidenced the direct effects of the aging process on the dimensions of phonation. Luchsinger and Arnold (1965) reported that the vocal range became smaller, vocal intensity was reduced, and vocal quality varied depending on organic changes within the larynx. Those differences were sufficient so that unfamiliar listeners seem to be able to differentiate between younger and older speakers simply by listening to conversational speech samples from members of each group. Ptacek and Sander (1966), reported that ten graduate students were able to differentiate the voices of young adults (male and female) under 65 years of age from older adults (male and female) over 65 years of age and indicated that the two primary dimensions used to make those judgements included pitch and intensity fluctuation. However, vocal quality change patterns do not seem to be similar for both sexes.

Pitch Changes in Males

Curry (1940), investigated the pitch characteristics of the male voice during pre-adolescence, adolescence, and post-adolescence and noted the pitch "breaks" that occurred as a result of adolescence. Three groups of males, one of ten-year-olds, one of

fourteen-year-olds, and one of eighteen-year-olds were studied. Six subjects were in each group. Individual groups contained members of similar physical size, chronological age, reading comprehension, speaking ability, and intelligence. Oral readings of the Rainbow Passage were recorded phonographically, and pitch curves were plotted from frequency measurements. Then, pitch measurements were computed, and the voice "breaks" were analyzed separately by individual wave-to-wave measurements. Results revealed that there was a progressive lowering of median pitch levels from age 10 years to 18 years of age with the greatest difference, approximately one octave, being between 14 years and 18 years of age.

Mysak (1959), conducted a study of two groups of elderly males, one between the ages of 65 to 70 years and one 80 years and older, and a third group comprised of the older subjects' sons. Each subject was asked to read the first paragraph of the Rainbow Passage which had been previously practiced. Then each provided a sample of impromptu speech using the topic, "What I Like To Do Most In the Summer Time." Fundamental frequency analysis and phonation/time ratio were determined using a Comparator-Counter Attachment for a Fundamental Frequency Recorder. Results indicated that the older group of males demonstrated a significantly higher average pitch level and greater pitch variability than those between the ages of 65 and 70 years of age.

Hollien and Shipp (1972) investigated fundamental frequency in a group of males between the ages of 20 and 89 years of age. One hundred seventy-five, normal, healthy male subjects were

recorded while reading the first paragraph of the Rainbow Passage. There were 25 speakers in each decade. Mean fundamental frequency measures were obtained using the Fundamental Frequency Indicator (FFI), a digital readout fundamental frequency tracking device, (Hollien & Paul, 1969). The FFI continuously extracts the fundamental period from complex speech waves. Periodic values are then processed digitally to yield the geometric mean frequency level and standard deviation of the frequency distribution. Results revealed a progressive lowering of average voice frequency in males from preadolescent up to 40 to 50 years and then a steadily rising trend until older age.

It would appear from these studies, that in the male population, pitch level from infancy throughout middle age tended to lower, only to rise again, slightly, in the elder years (See Table 1).

Pitch Changes in Females

Less abundant information exists regarding pitch characteristics in the female population. Studies of seven and eight year old females by Fairbanks, Herbert, and Hammond (1949), 11-year old, pre- and post- menarcheal 13-year old and 15-year old females by Duffy (1958), 15-, 16-, and 17-year-old females by Michel (1966), and adult females by Cowan (1936), Snidecor (1951), and Linke (1953), indicated that there is a steady lowering of mean speaking frequency from childhood through young adulthood, which appeared similar to the progression of mean speaking frequency for

Table 1

Summary of Pitch Studies in Males

Study	Age	Mean Pitch
Curry (1940)	10 yrs.	269.7
	14 yrs.	241.5
	18 yrs.	137.1
Hollien and Shipp (1972)	20-29 yrs.	119.5
	30-39 yrs.	112.2
	40-49 yrs.	107.1
	50-59 yrs.	118.4
	60-69 yrs.	112.7
	70-79 yrs.	132.1
	80-89 yrs.	146.3
Mysak (1959)	65-70 yrs.	110.3
	80 yrs. and older	142.6

the male population. McGlone and Hollien, (1963) conducted a study of pitch characteristics of women between the ages of 65-79 years and 80-94 years of age. Each subject was asked to read the first paragraph of the Rainbow Passage. Tape recordings were transferred to high quality discs and converted to a measurable trace by means of a phonellegraph. Results indicated that, unlike the males studied by Mysak (1959), which showed a steady increase in speaking frequency in advanced age, speaking frequency in females levels off from young adulthood through advanced age.

Saxman and Burke (1967) reported data on mean fundamental frequency and frequency variation for a group of women between the ages of 30 and 50 years of age. Nine of the women were between the ages of 30 and 40 years, with a median age of 33.5 years, and nine were between 40 and 50 years, with a median age of 44.5 years. The subjects were asked to read the first paragraph from Fairbanks' Rainbow Passage. The reading samples were recorded on magnetic tape while the speaker was seated in a sound treated chamber. Recordings were analyzed for mean fundamental frequency and standard deviation of fundamental frequency by means of the Fundamental Frequency Indicator, (Hollien & Tamburrino, and Michel et al. 1966). The device sampled the period signal approximately every 33 msec. Their results revealed a slight decrease in mean speaking frequency from young adulthood through the middle years of life suggesting that speaking frequency level of females may have decreased or perhaps reached a plateau through middle age before starting to rise

again to the levels found in McGlone and Holliens' (1963) elderly females.

Thus, Table 2 would indicate a fairly constant progression of the speaking fundamental frequency of females as they progress from puberty to later age. In males, the pitch seems to lower progressively until it begins to rise in later years (See Table 1). A possible explanation for this gender difference could have been that anatomical changes occurring during puberty are more extensive in the male versus the female population, and the later, degenerative changes that resulted had a greater impact on the male laryngeal system than on the females (McGlone & Hollien, 1963). The eventual changes in pitch characteristics in women would not have been as marked as they are in men (See Table 2).

Additional Considerations

Additional factors must also be considered if the impact of passing years in voice quality is to be more clearly understood. One factor is the influences of both physiological versus chronological age. Physical changes that occurred with age did not always coincide with chronological aging and not all elderly persons exhibit "old voices." Haberman (1972). Factors such as heredity, (Bourliere, 1970; Mann, Shaffer, Anderson, & Sanstead, (1964), exercise and nutrition, (DeVries, 1974; Smith & Bierman, 1973; Spirduso, 1980) have been reported to effect the process of physical change. Aging has also appeared to be directly influenced by physiological status (Ringel & Chodzko-Zajko, 1986). Ringel and

Table 2

Summary of Pitch Studies in Females

Study	Age	Mean Pitch
Herbert & Hammond (1949)	7	273.2
	8	286.5
Duffy (1958)	11	258.0
	13 (1)	251.7
	13 (2)	237.7
	15	229.5
Michel et al. (1966)	15	207.5
	16	207.3
	17	207.8
Linke (1953)	Young Adult	199.8
Saxman & Burke (1967)	30-40	196.3
	40-50	188.6
McGlone & Hollien (1963)		
Group A	72.6	199.6
Group B	85.0	199.8

Chodzko-Zajko (1986) suggested that while chronological age is one of the major contributors in age related changes in vocal performance, it was an inadequate measure when used as a sole reference for evaluating behavioral changes occurring with age. It has been shown that individuals of identical chronological age have exhibited significantly different levels of sensory, motor, and cognitive performance (Ringel & Chodsko-Zajko, 1986).

Researchers have attempted to determine the degree to which physiological health differences affect the level of deterioration observed in the vocal performances of elderly male subjects. The relationships between laryngeal performance and physiological health were studied in a group of 48 males divided into three chronological age groupings [25-35, 45-55, 65-75 years] (Ringel & Chodzko-Zajko, 1986). Each was evaluated by measures of resting heart rate, systolic and diastolic blood pressure, percent body fat, and forced vital capacity. Each subject was asked to provide samples of extended vowel phonation, spontaneous speech, oral reading and the production of a maximal phonatory range for a vowel. Fundamental frequency, jitter, shimmer, and maximum phonation range were also measured via a fundamental frequency analysis program. The groups were divided according to physiological health status, which revealed significant physiological differences between subjects of identical chronological age.

The authors found that the physiologically healthy subjects produced maximum duration phonation with significantly less jitter and shimmer and had larger phonatory ranges than did less healthy subjects of the same age. There were no significant differences

regarding fundamental frequency, suggesting that the above mentioned vocal parameters are more sensitive to more subtle changes in the laryngeal structures (Wilcox & Horii, 1980).

Most of the studies of the changes of the vocal mechanism which seems to accompany the normal aging process in females have used speaking fundamental frequency as an indirect acoutstic indicator of those processes. Such a dimension is only a general measure of group tendencies.

It would seem then, that the changes in the dynamics of precision of the laryngeal physiology would also be reflected, perhaps even more vividly, in dimensions which were more indicative of the variability of fundamental frequency use rather than just the average speaking fundamental frequency.

The aging female appears to exhibit a lowered speaking fundamental frequency as a result of structural and functional laryngeal changes. The impact of those changes should also be even more evident when vocal frequency use is described in terms of its variability. Thus, a 40-50 year old female with inherently less dynamic, precise, and flexible laryngeal system would be expected to have reduced extents and variabilities of pitch usage than similar 20-26 year olds. The older subjects would be expected to have reduced lower and upper limits and smaller overall frequency ranges than their younger counterparts because of the effects of the aging process on their laryngeal mechanisms.

The purpose of the present investigation was to ascertain the lower and upper limits and sizes of the frequency ranges used by both younger and older females and to compare those measures in both

groups to determine if older females exhibited less speaking fundamental frequency variability than the younger ones.

CHAPTER III

METHODS AND PROCEDURES

Subjects

Two groups of volunteer subjects participated in the study. Twenty college-aged females, aged 20 to 26 years of age with a mean age of 23.08 years, and twenty females between the ages of 40 and 50 years of age with a mean age of 45.3 years, participated in an informed consent process and completed a case history form (See Appendixes B and C.) Ten of the women in the second group were between 40 and 45 years of age with a median age of 42.5, and ten were between the ages of 45 and 50 years of age with a median age of 47.5 years. Each subject met the following criteria. Each subject must have (A) been able to read the selected material adequately, (B) been free of significant voice disorders or hearing impairment, (C) had pure tone thresholds no greater than 25dB HL. If appropriate pure tone thresholds were not observed, the subject was to be referred to a licensed audiologist for suggested follow up testing. Finally, each subject must have been able to stand erect for the sample readings. Subjects included students and staff recruited from the OSU campus and individuals from various other social settings. Information gathered from the case history form revealed that six out of the 20 older females were taking estrogen,

four out of 20 of the younger females admitted to taking birth control pills, and there was an equal incidence of allergy medications taken by both groups.

Procedure

Each subject was seated in an acoustically treated sound suite. Hearing was screened at the beginning of the session using a Graeson-Stadler 116 audiometer. The Buffalo III Voice Screening Profile (Boone, 1973) was used to evaluate each students vocal quality in conversational speech.

The subjects were asked to review The Rainbow Passage and The Grandfather Passages as many times as needed in order to feel competent to read the passages with minimal errors. Each subject then prepared to record either a reading of The Rainbow Passage, The Grandfather Passage, or a spontaneous speech sample. Prior to the recording of the spontaneous samples, each subject was shown a short segment of a popular television show. They were then asked to summarize what happened during the segment. Their responses were tape recorded after being presented with the following instructions, "Perform each speaking task as well as you can, at a loudness level which is similar to what you would use in a conversation with a small group of friends." As soon as the subjects felt comfortable with this task, their oral readings and summaries were tape recorded using a Sony Stereo Tapecorder TC-650 in a sound treated booth. A microphone was placed approximately 10 to 12 centimeters in front of the subjects mouth, and a contact microphone was placed on the

subjects throat above the larynx. The subjects were either asked to read from a large-type written version of the two passages, or spontaneously summarize the television show.

Ten percent of the subjects performed each speaking task a second time which formed the basis for subject and examiner reliability. A Pearson Product correlation for intersubject reliability was: Lower limit: .581; Upper limit: .667; In addition, the experimenter repeated measures on 10% of the subjects, and frequency scores correlated at Lower limit: .21; Upper limit: .372.

Reliability may be improved with the use of consistent instrumentation between investigations. Much of the instrumentation in previous research is dated 10 to 20 years and is not comparable to modern analysis techniques. Furthermore, practice in analysis procedures will undoubtedly reveal more accurate results.

Data Analysis

The audio recorded output from the contact microphone was played through a frequency counter sampling at one segment per second. The higher frequency was noted as the upper limit of the range, and the lower frequency constituted the bottom limit of the range. The bottom limit was subtracted from the top limit and the result constituted the size of the frequency range.

The upper and lower frequencies and the range were then contrasted using an Analysis of Variance procedure. Three separate analyses were used. First, the lower limit of the frequency range

for each sample was compared across two age groups, 20-26 years and 40-50 years, and across sample types. The Rainbow Passage and The Grandfather Passage were read orally and the spontaneous sample was a summary of a video-taped story. A second similar analysis contrasted the upper limit of the range across age groups and sample types. A third, contrasted the size of the range across the ages and samples.

CHAPTER IV

RESULTS

The first contrast compared the lower limit of the fundamental frequency range in both groups across the three sample types. There were differences among the sample types. However, there were no significant differences between the groups (See Table 3). Findings revealed significantly lower, lower limit frequencies for the spontaneous speech samples, across both age groups (See Appendix A).

The second contrast compared the upper limit of the frequency range. The two groups differed in the upper limits of their vocal ranges. The older group had higher upper limits than the younger group across all sample types (See Appendix A). There were no significant differences between the speech sample types. There were no significant interactions between groups (See Table 4).

The third contrast compared the overall range of the older and the younger speakers across the different sample types. The sizes of the ranges of the younger and older speakers differed significantly in that the older group showed larger ranges than the younger group. In addition, both groups revealed larger frequency ranges for the spontaneous speech sample than the read passages which were significant at the $< .01$ level (See Appendix A). The group X sample interaction was not significant (See Table 5).

Table 3

Results of Lower Limit Frequencies between Older and Younger Females and between Sample Types

Source	Sum of Squares	Degrees of Freedom (df)	Mean Squares	F-Ratio	Tail Prob
Between Groups (ages)	3119.06910	1	3119.06910	0.77	0.3862
Within Groups	18333.58908	2	9166.79454	8.67	0.0004
Inter-actions	843.90487	2	421.95244	0.40	0.6725

Table 4

Results of Upper Limit Frequencies Between Older and Younger Females and Between Sample Types

Source	Sum of Squares	Degrees of Freedom (df)	Mean Squares	F-Ratio	Tail Prob
Between Groups (ages)	56444.85624	1	56444.85624	23.13	0.0000
Within Groups (Sample Types)	6858.45867	2	3429.22934	2.95	0.0589
Inter-actions	590.14288	2	295.07144	0.25	0.7768

Table 5

Comparison of Mean Speaking Fundamental Frequency Ranges

Between Older and Younger Females

Source	Sum of Squares	Degree of Freedom (df)	Mean Squares	F-Ratio	Tail Prob
Between Groups (ages)	86101.09981	1	86101.09981	19.33	0.0001
Within Groups	43707.04113	2	21853.52057	8.66	0.0004
Inter-actions	2295.56745	2	1147.78372	0.45	0.6363

WSD-T follow up T tests were used to contrast the average vocal ranges for each particular stimulus type, achieved by both groups combined. While the Grandfather and Rainbow passages had similar ranges, the spontaneous samples prompted vocal ranges which were significantly larger than those achieved by either group in either orally read sample.

A separate set of contrasts comparing the 40-45 year olds with the 45-50 year olds were made. The age groups did not differ significantly in either the upper limits, lower limits, or entire vocal range dimensions (See Tables 6, 7, and 8).

Table 6

Comparison of Lower Limit Frequencies Between 40-45 Year Old and 45-50 Year Old Females

Source	Sum of Squares	Degrees of Freedom (df)	Mean Squares	F-Ratio	Tail Prob
Between Groups (ages)	424.37870	1	424.37870	0.06	0.8144
Within Groups	5197.06667	2	2598.53333	2.49	0.0949
Inter-actions	5287. 14074	2	2643.57037	2.54	0.0949

Table 7

Comparison of Upper Limit Frequencies Between 40-45 Year Old and 45-50 Year Old Females

Source	Sum of Squares	Degree of Freedom (df)	Mean Squares	F-Ratio	Tail Prob
Between Groups (ages)	3251.27797	1	3251.27797	4.40	0.0512
Within Groups	2262.93489	2	1131.46745	2.69	0.0822
Inter-actions	635.00507	2	317.50253	0.76	0.4775

Table 8

Comparison of Frequency Range Between 40-45 Year Old and 45-50 Year Old Females

Source	Sum of Squares	Degrees of Freedom (df)	Mean Squares	F-Ratio	Tail Prob
Between Groups (ages)	597.04537	1	5741750.00833	908.80	0.7625
Within Groups	11572.43889	2	5786.21944	3.52	0.0415
Inter-actions	5281.40185	2	2640.70093	1.61	0.2172

CHAPTER V

DISCUSSION

The first contrast of the lower limit of the frequency range, indicated that the speaking fundamental frequencies of the 40-50 year old females were not significantly lower than those of the 20-26 year old females. Saxman and Burke (1967) listed the lower limit of the frequency range of 30-40 year olds which was higher than of the 40-50 year old group. They did not, however, provide evidence whether the difference was significant. McGlone and Hollien (1963) suggested that, unlike males, there is no change in mean speaking frequency throughout adulthood in females. The lower limit frequencies for their older group was higher than that of their younger group, although these differences were not significant. By way of contrast, the lower limits of the groups in the present study were somewhat higher for the younger age group than for the older group, although the differences were not significant.

While there were no significant differences in lower limit frequencies between age groups, there were significant differences among the sample types. Results of the present study indicate that spontaneous speech tasks revealed lower, lower limit speaking frequency levels than oral reading tasks regardless of the ages of the speakers. There is evidence that suggests that differences in

mean speaking fundamental frequency (SFF), can be expected among various speaking tasks (Michel & Wendahl, 1971; Schultz-Coulon, 1975). However, there is a discrepancy regarding the specific effects of speaking tasks on SFF. A study by Moran and Gilbert (1978), suggested that counting tasks yielded significantly higher mean speaking frequencies than did sentence repetition tasks. A similar study by Schultz-Coulon (1975), however, reported that counting and spontaneous speech tasks yielded lower speaking fundamental frequency levels than did other speech tasks. The present results of the comparison of the upper limits of the frequency range indicated that the older group had a significantly higher upper limit of their frequency range than did the younger group. That trend existed regardless of the sample type observed.

The contrast of the overall range size also indicated that the older group had a larger frequency range than the younger group. Follow-up WSD-T tests indicated that while the difference was not marked on the Rainbow or Grandfather samples, it was significantly different in the spontaneous sample.

A further analysis was conducted in an effort to determine whether there were any intragroup differences in the 40-50 year olds. The 40-45 year olds were contrasted with the 45-50 year olds on lower limit, upper limit and range. The results of that analysis indicated that there were no significant differences on all three measures across the two subgroups in the age ranges (See Tables 6, 7, & 8). Apparently, there were few differences on all three measures across the 40-50 year age ranges.

The reasons for the differences in upper frequency limit and overall frequency range remain unclear. One would typically expect that a young, mature female vocal system would be at the height of variability, precision, and musculature tonus in general. That is most likely the case. The more mature female, is also probably naturally more restricted by the impact of passing years. Those differences, however, failed to be manifested in the present study. Apparently, the more mature female has the advantage of practice and experience in exploiting the vocal mechanism more efficiently and effectively even within the confines of some assumed increased physical constraints. Also, perhaps many are better and more practiced at story-telling skills given their probable increased wealth of interactions with children and other adults. Such that sociolinguistic competence may override the effects of physical changes. The video taped stimulus may also have evoked more enthusiastic samples in the mature speakers since it was of a television show which the older group may have been more familiar with than the younger one. Thus, it appeared that in the present study, the laryngeal changes occurring with age groups did not manifest themselves in the speech samples. On the contrary, whatever limits were imposed by passing years were easily surmounted by the older group when they engaged in a spontaneous story retelling task.

CHAPTER VI

SUMMARY

Tape recorded samples of the Rainbow Passage, My Grandfather, and spontaneous speech of groups of 20-26 year olds and 40-50 year olds were analyzed to determine whether the lower and upper limits and ranges of frequency variability were different in the two groups. A series of statistical contrasts using an Analysis of Variance technique revealed the following: First, there were no significant differences between the lower limits of the speaking frequency ranges; however, both groups had significantly elevated lower limits of the frequency range in the spontaneous speech sample as opposed to the Rainbow and Grandfather passages. Second, the older groups had significantly higher upper frequency range limits than the younger group, a trend which was consistent across all sample types. Third, the older group had a significantly larger frequency range size than the younger group. That trend was significantly evident in the spontaneous speech sample. Finally, the younger 40-50 year-olds did not differ significantly from the older individuals in that group on any of the three vocal pitch range parameters investigated in the present study.

Further investigation is needed to determine:

1. The differences in frequency range differences which may be present in other age groups of females.

2. The differences among a variety of age groups of any suprasegmental dimensions which might be present.

3. The potential factors which enable the older group in the present study to use greater pitch range than the younger group.

4. The potential impact of chemophysiological differences between the groups vocal pitch dimensions.

Once some of these areas are evaluated, a much more complete picture of pitch patterns and other phonational dimensions in different groups of adult females will emerge.

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APPENDIX A

FREQUENCY RANGES

Lower Limit Frequencies Between the Older and Younger Age Groups

	Younger	Older
Spontaneous	141.05000	138.05556 = 139.63158
Rainbow	167.45000	154.83333 = 161.47368
Grandfather	177.65000	161.83333 = 170.15789

Upper Limit Frequencies Between the Older and Younger Age Groups

	Younger	Older
Spontaneous	447.70000	487.22222 = 466.42105
Rainbow	423.550000	474.11111 = 477.50000
Grandfather	433.00000	476.31281 = 453.65789

Frequency Ranges Between the Older and Younger Age Groups

	Younger	Older
Spontaneous	306.65000	349.16667 = 326.78947
Rainbow	256.10000	319.27778 = 286.02632
Grandfather	255.35000	314.77778 = 283.50000

O = Older
Y = Younger
UL = Upper limit; LL = Lower limit; R = Range

Raw Data

Group		Spontaneous	Rainbow	Grandfather
01	UL	499	496	497
	LL	230	326	251
	R	269	170	246
02	UL	497	494	497
	LL	126	100	110
	R	371	394	387
03	UL	490	491	473
	LL	149	133	177
	R	341	358	296
04	UL	493	483	473
	LL	247	198	235
	R	493	483	493
05	UL	486	490	487
	LL	230	227	200
	R	256	263	287
06	UL	492	477	492
	LL	112	107	112
	R	380	370	380
07	UL	489	493	472
	LL	125	130	128
	R	364	373	344
08	UL	500	456	472
	LL	154	243	227
	R	346	213	245
09	UL	488	462	486
	LL	101	169	106
	R	387	293	380
010	UL	480	434	404
	LL	110	127	126
	R	370	307	278
011	UL	483	457	479
	LL	103	141	121
	R	380	316	358
012	UL	493	486	489
	LL	119	155	137
	R	374	331	352
013	UL	485	495	490
	LL	104	116	126
	R	381	379	364
014	UL	492	401	414
	LL	102	180	189
	R	390	311	225

015	UL	487	483	499
	LL	132	194	294
	R	355	289	205
016	UL	497	456	462
	LL	138	120	106
	R	359	336	356
017	UL	490	454	436
	LL	116	121	114
	R	374	333	322
018	UL	492	500	499
	LL	110	101	148
	R	382	399	351
019	UL	495	490	499
	LL	230	129	232
	R	265	361	267
020	UL	417	429	498
	LL	102	127	102
	R	315	302	396
Y1	UL	460	478	450
	LL	115	145	160
	R	345	333	290
Y2	UL	449	432	468
	LL	171	109	235
	R	278	323	233
Y3	UL	414	324	451
	LL	132	191	198
	R	282	133	253
Y4	UL	467	443	430
	LL	150	165	191
	R	317	278	239
Y5	UL	394	495	457
	LL	139	125	155
	R	253	370	302
Y6	UL	492	416	435
	LL	131	144	198
	R	361	272	237
Y7	UL	479	351	350
	LL	156	195	160
	R	323	156	190
Y8	UL	307	402	400
	LL	114	134	140
	R	193	268	260
Y9	UL	482	470	471
	LL	160	102	187
	R	322	368	284
Y10	UL	490	442	417
	LL	111	247	212
	R	379	195	205
Y11	UL	374	380	423
	LL	128	111	211
	R	246	209	212

Y12	UL	461	357	324
	LL	124	149	126
	R	337	208	198
Y13	UL	452	468	478
	LL	166	232	197
	R	286	236	281
Y14	UL	488	493	404
	LL	137	173	221
	R	351	320	183
Y15	UL	450	464	492
	LL	158	209	158
	R	292	255	334
Y16	UL	450	289	394
	LL	100	154	108
	R	350	135	286
Y17	UL	437	399	428
	LL	183	196	121
	R	254	203	307
Y18	UL	483	463	407
	LL	105	166	190
	R	378	297	217
Y19	UL	478	447	499
	LL	141	159	187
	R	337	288	312
Y20	UL	449	458	482
	LL	200	183	198
	R	249	275	284

Reliability Data

Subject		Summary	Rainbow	Grandfather
Y14	UL	492	490	480
	LL	124	135	175
	R	368	355	305
Y15	UL	477	489	487
	LL	105	134	108
	R	372	355	379
O2	UL	446	442	472
	LL	122	143	135
	R	324	299	337
O20	UL	486	481	416
	LL	112	125	103
	R	371	356	313

APPENDIX B

CONSENT FORM

OKLAHOMA STATE UNIVERSITY

Informed Consent Form

This is to inform you of an activity which may involve you. Beckham Linton, a Graduate Student of Speech-Language and Audiology, is conducting a study. She is interested in contrasting the pitch characteristics of college aged and "middle aged" female voices. For the purpose of this study, college age is between 18-25 years, and middle age is between 40-50 years. The information collected in this study will provide health professionals with additional methods of distinguishing between normal aging and non-age related effects on vocal pitch range. A better understanding of these effects on vocal pitch range will also be helpful in devising dignostic procedures that can be used to determine the presence or absence of a disorder.

Participants in this study will be volunteers within these age ranges, and will meet the following criteria. A volunteer has to be able to read the selected material adequately, be free of significant voice disorders or hearing impairment, and be ambulatory. A hearing screening will be administered to assure normal hearing.
If a passing score is not obtained, the subject will be referred to a community audiologist for suggested follow up testing.

Beckham has asked your permission to tape record a sample of your speech. You will be asked to read a series of paragraphs and summarize a short segment of a popular television show. The recording procedure creates no risk and requires perhaps 15-30 minutes.

The results of this research will be kept confidential in that each individual involved will be assigned a number. Your name will not be used for any reason. The tape recorded samples will be kept locked in a faculty members office when not in use. They will not be destroyed, however, for the information collected on these tapes could prove useful in future studies of similar nature. They will not be used without your authorization. Keep in mind that no names will be used, and anonimity will be preserved.

You have been asked to participate in this study because your age falls within the desired age requirements. You are in no way forced to participate and may discontinue your participation at any time without penalty.

If you are willing to participate in this study, please complete the following:

"I, _____, hereby authorize or direct Beckham Linton, or associates or assistants of his or her choosing, to perform the above mentioned procedure."
This is done as a part of an investigation entitled "A Contrast in Vocal Frequency Range in College-Aged and Middle-Aged Females".

"I understand that participation is voluntary, that there is no penalty for refusal to participate, and that I am free to withdraw my consent and participation in this project at any time without penalty after notifying the project director."

"I may contact Beckham Linton at telephone number (405) 743-3150 should I wish further information about the research. I may also contact Dr. Arthur Pentz, Graduate Advisor-Speech-Language Pathology Department, 120 Hanner Hall, Oklahoma State University, Stillwater, OK 74074; Telephone: (405) 744-6021."

"I have read and fully understand the consent form. I sign it freely and voluntarily. A copy has been given to me."

Date:_____Time_____(a.m./p.m.)

Signed _____
(Signature of Subject)

_____
(Person authorized to sign for subject, if required)

"I certify that I have personally explained all elements of this form to the subject before requesting the subject to sign it."

"Signed _____
(Project Director)

APPENDIX C

CASE HISTORY FORM

* All information will be kept in the strictest confidence and will be released to no one not directly involved in this study.

CASE HISTORY FORM Subject #_____

1. What is your occupation? _____
_____

2. What is your racial origin? options: ____ Caucasian
_____ Black _____ Oriental _____ African-American
_____ No comment

3. What is your age?_____ Birthdate? _____

4. Are you taking any medications at this time and if so, do you know what they are?_____
For what condition are you taking the medication?
_____
How long have you been taking the medication?_____
Are you taking any of the following forms of estrogen?:
Premarin_____ Estrace_____ Ogen_____ Provera___
Estroderm_____
5. Do you smoke?_____ If yes, how often do you smoke?_____How long have you been smoking?___
_____
_____

6. Is there any family or personal history of the following? If so, please explain in the space following the list:

Speech or Voice therapy_____
Hearing loss_____
Convulsions or epilepsy_____
Cerebral Vascular Accident (Stroke)_____
Brain tumor_____
Arteriosclerosis_____
Cancer of the larynx_____
Chronic laryngitis_____
Vocal nodules_____
Vocal polyps_____
Brain injury_____
Neurological diseases (please specify)_____
Multiple Sclerosis_____
Seizures_____
Heart diseases_____

7. When was your last physical examination?_____
What were the findings from that examination?_____

8. Would you consider your general health to be:

Excellent_____ Good_____ Fair_____ Poor_____

9. Is there any case history information not included on this form that you feel is important for the purposes of this study?_
_____

VITA

Beckham S. Linton

Candidate for the Degree of

Master of Arts

Thesis: A STUDY OF FREQUENCY RANGE IN COLLEGE-AGED AND MIDDLE-AGED FEMALES

Major Field: Speech

Biographical:

Personal Data: Born in Norfolk, Virginia, November 23, 1962, the daughter of Kermit and Burks Scarborough.

Education: Graduated from Edmond High School, Edmond, Oklahoma, in May, 1981; received Bachelor of Science in Arts and Sciences degree in Therapeutic Recreation from Oklahoma State University in May, 1985; completed the requirements for the Master of Arts degree at Oklahoma State University in July, 1991.

Professional Experience: Graduate Assistant, Department of Speech Pathology, Oklahoma State University, Stillwater, Oklahoma, 1987 to 1988; Research Assistant, Language Literacy Clinic, Department of Speech Pathology, Oklahoma State University, Stillwater, Oklahoma, Summer, 1989; Internship at Bersen Rehabilitation Center, St. John Medical Center, Tulsa, Oklahoma, September-November, 1990; Clinical Fellowship, Kaiger Rehabilitation Center, Tulsa, Oklahoma, January 1991 to present.