# THE FORMANTS IN ACCOUSTIC PHONETICS ANALYSIS OF FEMALE AND MALESTUDENT IN GSJA KABAR SUKACITA

**Gary Rando Ginting[1], Tengku Syarfina[2]**
**Universitas Sumatera Utara**
Email: garyrandoginting97@gmail.com[2], tengku.syarfina@usu.ac.id[2]

***Abstract***

*The aim of this study was to investigate the forming frequencies and amplitudes of GSJA KABAR SUKACITA in a wide age group and one adolescent class. The subjects were eight women and eight men in the following age groups, aged 7-15 years. Each subject performed the continuous three times. Formant frequencies were obtained using PRAAT and measured. Formant amplitudes were measured from the highest amplitude harmonic of each formant interval. In addition to following established trends previously published in other studies, it was hypothesized that the frequency of the first formant increases with increasing intensity, that women have a higher formant frequency than men of the same age, that women's vocal cords also reach a higher range.compared to men and that the formant amplitudes of women and children are smaller compared to men. The frequency of the first formant was found to increase with intensity and change as a function of age and sex. The frequency of the second and third formants changed according to age and gender.*
***Keywords:*** *Shapers, Frequency, Pupil, Intensity, PRAAT.*

***Abstrak***

Tujuan dari penelitian ini adalah untuk mengetahui frekuensi dan amplitudo pembentukan GSJA KABAR JUKACITA pada kelompok umur luas dan satu kelas remaja. Subyek penelitian adalah delapan orang perempuan dan delapan orang laki-laki pada kelompok umur berikut, yaitu usia 7-15 tahun. Setiap subjek dilakukan secara terus menerus sebanyak tiga kali. Frekuensi formant diperoleh dengan menggunakan PRAAT dan diukur. Amplitudo formant diukur dari amplitudo harmonik tertinggi pada setiap interval formant. Selain mengikuti tren yang telah ada sebelumnya yang diterbitkan dalam penelitian lain, terdapat hipotesis bahwa frekuensi forman pertama meningkat seiring dengan meningkatnya intensitas, bahwa wanita memiliki frekuensi forman yang lebih tinggi dibandingkan pria pada usia yang sama, bahwa pita suara wanita juga mencapai jangkauan yang lebih tinggi. .dibandingkan laki-laki dan amplitudo forman perempuan dan anak-anak lebih kecil dibandingkan laki-laki. Frekuensi forman pertama ditemukan meningkat seiring dengan intensitas dan perubahan seiring dengan usia dan jenis kelamin. Frekuensi forman kedua dan ketiga berubah menurut umur dan jenis kelamin.
**KataKunci:** Pembentuk, Frekuensi, Pupil, Intensitas, PRAAT.

## INTRODUCTION

Formants are high-energy frequency peaks in the spectrum. They are especially visible in song. Each formant corresponds to the resonance of the sound channel (roughly speaking, there is a formant every 1000 Hz in the spectrum). Shapers can be thought of as filters. Due to the co- resonant effect of sound cavities, sound filtering occurs in the source sound, which amplifies some frequency components (some harmonics) and suppresses others. Formant amplitudes provide information about loudness levels and the relationship between supraglottic cavities and subglottic spaces. Vocal tract configurations change during development due to changes in the size and shape of the vocal tract; therefore, it is important to study the acoustic aspects of speech at different ages (Eguchi and Hirsch, 1969; Kent and Forner, 1979).

A number of studies have been completed examining changes in the frequency of the second and third formants (F1, F2, and F3, respectively, were found to be greatest in children, decreasing with age and least in adult males; Hillens mark et al. ., 1995 ; Kent and Forner, 1979; Lee et al., 1999;Peterson and Barney, 1952. Busby and Plant ~1995! studied children and showed that F1, F2, andF3 were more important between ages 5 and 7. The decrease in formant frequency appears to be closely related to vocal tract size and growth so that the rate and magnitude of change among older age groups is lower than among younger age groups.

## 1. FORMANTFREQUENCY

Some of these studies showed trends that varied according to the studied vowel. (Eguchi and Hirsch 1969) reported in a classic study that /Ä/ F1 did not change with age. However, (Busby and Plant 1995) found greater changes in F1 of low vowels such as /Ä/ according to age and sex. They concluded that this may be because these vowels are produced with a relatively open vocal structure and may be affected by the size of the entire vocal tract. Eguchi and (Hirsch 1969) maynot have found age-related changes in vowel /Ä/ because they found the most variations for F1 ofvowel /Ä/ compared to other vowels. Therefore, although most studies show that F1 increases with age, the trend for the vowel /Ä/ is somewhat unclear. Most previous studies of formant frequencies dealt with young children and adolescents, categorizing the age distribution and forming them into groups, paying little attention to gender differences.

Eguchi and Hirsch, 1969; Hillenbrand et al., 1995; Petersen and Barney, 1952. More recently, gender differences in children have been studied. (after Lee et al. 1999) found that gender differences did not appear for F2 and F3 until approximately 15 years of age. Busby and Plant 1995 reported that F1 low vowels and F2 all vowels were higher in females than males in some age groups. (Bennett 1981) studied F1, F2, F3 and F4 in males and females aged 8-15 years. He found that male children produced lower formant frequencies than females for all formants. He stated that the sex differences observed in children are mainly due to differences in target pharyngeal length. He further hypothesized that sex differences in children, especially in F1, may be related to item differences such as mouth opening size and laryngeal height in addition to sizedifferences. He suggested that sex-specific articulatory differences can be used "in addition to

male-female perceptual differences" (Bennett, 1981). In addition, (Nordstrom 1977) found that "anatomical differences between males and females explain only part of the shape differences"

1. **Age**

   Previous studies have already shown that the frequency of formants decreases with age (Eguchi and Hirsch, 1969; Hillenbrand et al., 1995) (Peterson and Barney 1952).It was expected that the present study of Formants and Voice Intensity Variation 1533 would reveal the same tendency for F1, F2, and F3 and extend this finding to a more complete sample of subjects.

2. **Sex**

   Previous data on vocal tract size and shape have shown differences between age-matched males and females, especially after puberty Boersma et al., 1979; Walker, 1994 In addition, previous studies have shown differences in formant frequencies between males and females with age, especially in adults, see Bennett, 1981; Busby and Plant, 1995; Petersen and Barney, 1952. Based on that literature, it was hypothesized that all females would have higher F1, F2, and F3 than males of the same age. me

## METHOD

There were eight female students and eleven male students in the following age groups: 8-15 years. The average age of GSJA Child and Adolescent Students Kabar Sukacita and the author analyzed theclassification using normal speech, voice, hearing, and singing in class to find out the difference informing frequency between female and male students. GSJA Kabar Sukacita, and they tried to pronounce *"We don't have any books in the classroom"* with the vowels *"A, I, E, O"* as it seen in the sentence to show some vowels based on the sentence that they pronounced.

## DISCUSSION RESULT

Examined different cephalometric measurements of girls and boys aged 8 -15 years and found that males and females grow at different rates. In their study, the distance from the joint from the gland near the joint connecting the mandible to the temporal bone ~near the top of the jaw indicated that boys had a growth spurt. data for 12- to 14-year-olds, but no trend was observed for girls.

Girls showed earlier maturational growth and less growth at 10–12 years. These height-to- heightratios for women and men were also maintained in other reported linear measurements, includingthe distance from the nose ~ near the top of the nasal bone! let alone near the tip of the chin! andthe distance from the nose to the base of the anterior nasal bridge. In conclusion, because facial growth continues into late adolescence, it is important to continue studying children across theseage groups.

The unique perspective of these cross-sectional data determines the age at which children begin to behave like adults. As inferred from age-related formant frequency data, vocal tract growth in women appears to level off at a younger age than in men. Girls' formant frequencies became similar to females at age 12, suggesting an almost mature vocal tract,while boys' formant frequencies dropped significantly at age 14 and continued to decline, suggesting stabilization of growth at older ages than females. Second, it was hypothesized that the current study would replicate previous findings of postpubescent females producing higher formant frequencies than age-matched males and extend these findings to younger subjects. The data confirmed a known fact: for F1, F2 and F3, 10-, 13-, 15-year-old and adult females had significantly higher values than males of the same age.

This indicates that large differences in formant frequency between females and males occur mainly after puberty. However, what is less known is that in all age groups, female formant frequencies were almost always higher than those of males in the same age group, even in very young groups. Although size differences are considered to be the main cause of formant differences between thesexes, it is known that there is not a completely linear

relationship between the length of the vocaltract and the change in formant frequency. One reason for this may be that women not only haveshorter vocal tracts than men but also have a difference in the shape of their vocal tracts. For example (Walker 1994) vertical jaw by jaw! The facial growth of women is often greater than that of men. This is often associated with less mandibular growth! in women, which increases facial curvature in women (Walker, 1994.) In summary, differences in both size and shape of the vocaltract affect formant frequencies, resulting in a difference in formant frequencies.

Cephalometric data suggest small differences between adolescent boys and girls. According to the cephalometric drawings of the development of the face and oral cavity, comparing Merow et

DATA STATISTIC

| | (F1) | | (F2) | | (F3) | |
|---|---|---|---|---|---|---|
| AGES | Male | Female | Male | Female | Male | Female |
| 9 years | 856 (85) | 981 (141) | 1672 (219) | 1768 (219) | 3825 (172) | 4074 (248) |
| 9 years | 905 (105) | 1023 (125) | 1500 (178) | 1817 (143) | 3902 (215) | 4064 (289) |
| 9 years | 820 (65) | 865 (65) | 1753 (203) | 1825 (243) | 3603 (224) | 4067 (257) |
| 9 years | 837 (80) | 925 (125) | 1778 (219) | 1723 (161) | 3286 (191) | 3291 (203) |
| 10 years | 930 (40) | 934 (45) | 1533 (150) | 1817 (169) | 3251 (206) | 3300 (290) |
| 10 years | 755 (112) | 860 (122) | 1788 (183) | 1850 (161) | 3132 (193) | 4020 (233) |
| 10 years | 835 (80) | 950 (92) | 1471 (71) | 1865 (180) | 3044 (125) | 3220 (230) |
| 11 years | 880 (80) | 880 (80) | 1261 (68) | 1600 (218) | 2970 (267) | 3532 (232) |
| 12 years | 756 (105) | 995 (135) | 1260 (96) | 1603 (166) | 2745 (328) | 3223 (230) |
| 12 years | 800 (80) | 875 (75) | 1727 (104) | 1832 (132) | 3050 (359) | 4027 (227) |
| 12 years | 822 (88) | 1015 (125) | 1239 (75) | 1533 (150) | 3500 (402) | 4100 (256) |
| 13 years | 850 (95) | 850 (95) | 1203 (64) | 1502 (120) | 3025 (328) | 3150 (233) |
| 14 years | 733 (67) | 1023 (123) | 1661 (86) | 1554 (138) | 2711 (211) | 3220 (207) |
| 14 years | 660 (65) | 780 (65) | 1381 (112) | 1549 (99) | 2735 (235) | 4077 (277) |
| 15 years | 709 (78) | 788 (78) | 1535 (95) | 1669 (169) | 2500 (220) | 3006 (226) |

## CONCLUSION

The study of formants reveals dynamic interactions between vocal tract configurations, age-related changes, and gender differences. Formants, high-energy frequency peaks, serve as indicators of resonance in the vocal spectrum, with their patterns influenced by the co-resonant effects of sound cavities. Age-related studies demonstrate a consistent decrease in formant frequencies (F1, F2, and F3) with increasing age, indicating changes in vocal tract size and shape during development.

Gender differences in formant frequencies are particularly noteworthy, with females consistently exhibiting higher values, especially after puberty. These differences are attributed to both size and shape variations in the vocal tract. The complex interplay of articulatory differences, such as mouth opening size and laryngeal height, contributes to the observed distinctions between males and females. Notably, the study emphasizes the need for a comprehensive approach, considering both normal speech and singing, to understand formant frequency variations.

Cephalometric measurements further support the understanding of growth differences between boys and girls, reinforcing the idea that facial growth continues into late adolescence. The unique perspective provided by cross-sectional data highlights the age at which children exhibit adult-like behaviors, as inferred from age-related formant frequency data.

In summary, the study underscores the importance of considering age, gender, and the complex relationship between vocal tract size and shape when investigating formant frequencies. The findings contribute valuable insights into the acoustic aspects of speech and vocal development across different age groups.

## REFERENCES


Bennett, S. ~1981!. ‘‘Vowel formant frequency characteristics of preadolescent males and females,’’ J. Acoust. Soc. Am. 69, 231–238.

Busby, P. A., and Plant, G. L. ~1995. ‘‘Formant frequency values of vowels produced by preadolescent boys and girls,’’ J. Acoust. Soc. Am. 97, 2603–2606.

Eguchi, S., and Hirsch, I. J. ~1969. ‘‘Development of speech sounds in children,’’ Acta Oto-Laryngol. Suppl. 257, 5–51.

Fant, G. 1970. Acoustic Theory of Speech Production, 2nd ed. ~Mouton, Paris!.

Fant, G. 1973. ‘‘Acoustic description and classification of phonetic units, ’’in Speech Sounds andFeatures MIT, Cambridge! reprinted from Ericsson Technics, 1, 1959.

Gilbert, H. R., Robb, M. P., and Chen, Y. 1997. ‘‘Formant frequency development: 15 to 36 months,’’ J. Voice 11, 260–266.

Hanson, H. M. 1997. ‘‘Glottal characteristics of female speakers: Acoustic correlates,’’J. Acoust. Soc. Am. 101, 466–481.

Hillenbrand, J., and Gayvert, R. T. 1993. ‘‘Vowel classification based on fundamental frequencyand formant frequencies,’’ J. Speech Hear. Res. 36, 694–700.

Sundberg J. The singer’s formant revisited. Voice. 1995;4:106-119.