A Comparison of Vowel Productions between Adolescents, Middle-Aged, and the Elderly : the Case of Miyazaki Residents (Part 2)[1]

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This is third in a series of studies on vowel shifts in Japanese to be conducted in the next few years. Based upon Todaka's (2005a) preliminary study, we tentatively hypothesize that there is a tendency among adolescents to articulate vowels farther forward in the mouth. In this study, we focused on the differences in vowel productions between adolescents, middle-aged, and the elderly. We found that the adolescents produced the /u/ and /i/ farther forward and the /e/ and /o/ farther upward. This tendency was observed much more clearly among female adolescents, which indicates that women are leading the adoption of the new form. However, some discrepancies between the findings of the present and of the previous studies were found. Though much more data needs to be gathered, there might be geographical differences between adolescents residing in various cities.

Key words : vowel shift, apparent-time, real-time, diffusion patterns

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1. Introduction

Todaka (2005a) conducted a preliminary study of vowel shifts in terms of age and gender variables. Todaka (ibid.) used 22 adolescent and elderly subjects residing in five different areas in Japan and acoustically compared their productions of monosyllabic words (i.e., /a/, /i/, /u/, /e/, and /o/). In that study, Todaka reported the following findings:

Concerning the age variable, he found that (a) adolescents tend to pronounce the vowels slightly farther forward; (b) the vowel space of the young male group is wider than that of their elderly male counterpart; (c) young females articulate all the vowels except for /a/ farther forward than their elderly counterparts; and that (d) the perceptual distance between /e/ and /u/ is not so prominent in the case of the young females while the same tendency is found between /i/ and /e/ in the case of the elderly females.

Regarding the gender variable, he found that (a) the vowel positions of the female groups are farther forward than those of the male counterparts except for /a/; and that (b) the vowel space of the young male group is much narrower than that of the young female group, which seems to be triggered by the forward movement of /o/.

The above results indicate that the tendency for the young to articulate vowels farther forward in the mouth is seen not only among young American English speakers, but also among young Japanese speakers. Though the number of subjects was small and the recording conditions were not kept consistent, we can speculate that this tendency is a language-universal rather than language-specific feature. In other words, dialect and language-specific vowel rotation patterns have been observed both in Japanese and in American English; however, there might be a language-universal tendency among adolescents to produce vowels farther forward in the mouth.

The present study is second in a series of studies to investigate if such a tendency also exists among adolescents who reside in Miyazaki. The focus on Miyazaki residents is significant that the diffusion of linguistic change needs to be taken into consideration. Gordon, (2001: 6), citing Gallary's (1975) and Trudgill's (1983) studies, reports the significance of consideration of the diffusion patterns as follows:

The diffusion patterns observed by Gallary and Trudgill a common type of "hierarchical" diffusion in which innovations begin in large population centers and spread to other large population centers before trickling down to smaller centers.[2]

It is therefore important to examine the vowel productions by adolescents who live in various cities and towns so that the observed forward productions of vowels by adolescents in the previous studies and the findings of this study can shed some light on the new tendency. For instance, Inoue (1993) reported that there is a tendency among the young to pronounce /a/ farther forward in the mouth, and Imanishi (http:/www.hirojo-u.ac.jp/imaisi/sojitheory.htm, via Internet) reported on the fronting of /u/ and /e/ by Izumo, Hirokai village, Takajo, and Tsugaru dialect speakers, which causes /i/ and /e/ to come to close to each other. If so, it is interesting to examine if a similart endency can be found, which in turn may uncover a generational change in progress among the young. If not, we can ascertain some geographical differences among the young residing in various cities and towns.

As mentioned in Todaka (2005b), Miyazaki dialects can be roughly divided into (a) Morokata and (b) Hyuga dialects. The Morokata dialect is spoken in the southwestern regions of Miyazaki, and the Hyuga dialect, on the other hand, is spoken in the rest of the regions. Some of the prominent vowel features of Miyazaki dialects that have been reported are (a) the 7 vowel system (including centralized high and mid front vowels) used in the Gokase area (Hidaka, 1974); (b) a substitution of /i/ for /e/, and /u/ for /o/; and (c) frequent de-voicing of vowels in the Kiyotake area (Hidaka, 1975). The features described here are, however, based on aural coding and are, therefore, tentative pending the incorporation of acoustic measurement.

The present study was, therefore, conducted to see if the new tendency exists among adolescents residing in a relatively small city; that is, Miyazaki city. We asked a high school English teacher to help us collect samples from her students. In addition, we collected adult samples based on the "friend-of-a-friend" technique described by Milroy (1987).

2. Methods

2.1 Subjects

The subjects in this study were taken from three plainly separated age groups, rather than from a broad range of ages, in order to make diachronic inferences about the course of the vowel productions of adolescents (Gordon, 2001: 42). In other words,

[2] Two types of diffusion (i.e., hierarchical and contagious) were found, and a single innovation may show features of both types of diffusion (see Bailey et al., 1993 and Labov, 1966 for details, cited in Gordon, 2001: 6)

we can examine more clearly the generational differences expected of a change in progress. Twenty high school students (10 male and 10 female) were asked to participate in the present study. All the students were born and raised in Miyazaki city. In addition, fifteen (6 male and 9 female) middle-aged and fifteen (7 male and 8 female) elderly people participated in this study. The adults' data were gathered based on the "friend-of-a-friend" technique, as mentioned earlier.

The following table provides some information about the subjects.

Table 1 subject information

Subjects	Sex	Age	Group	Subjects	Sex	Age	group
M1	Male	16	Young	F1	Female	15	Young
M2	Male	16	Young	F2	Female	15	Young
M3	Male	16	Young	F3	Female	15	Young
M4	Male	15	Young	F4	Female	15	Young
M5	Male	15	Young	F5	Female	17	Young
M6	Male	16	Young	F6	Female	17	Young
M7	Male	16	Young	F7	Female	16	Young
M8	Male	16	Young	F8	Female	16	Young
M9	Male	16	Young	F9	Female	16	Young
M10	Male	16	Young	F10	Female	16	Young
M11	Male	38	Middle-aged	F11	Female	41	Middle-aged
M12	Male	38	Middle-aged	F12	Female	35	Middle-aged
M13	Male	45	Middle-aged	F13	Female	35	Middle-aged
M14	Male	41	Middle-aged	F14	Female	36	Middle-aged
M15	Male	32	Middle-aged	F15	Female	34	Middle-aged
M16	Male	37	Middle-aged	F16	Female	35	Middle-aged
M17	Male	63	Elderly	F17	Female	41	Middle-aged
M18	Male	64	Elderly	F18	Female	40	Middle-aged
M19	Male	64	Elderly	F19	Female	38	Middle-aged
M20	Male	74	Elderly	F20	Female	62	Elderly
M21	Male	73	Elderly	F21	Female	69	Elderly
M22	Male	58	Elderly	F22	Female	64	Elderly
M23	Male	77	Elderly	F23	Female	71	Elderly
F24	Female	75	Elderly	F25	Female	77	Elderly
F26	Female	65	Elderly	F27	Female	59	Elderly

2.2 Reading Material

A list of fifty Japanese sentences was made based on Inoue's study (1989). All the sentences were recorded in the form of "*soshite ---- to iimashita* ('And I said _____ again')". Fifty Japanese words were thus framed in the same sentence format. These sentences allowed us to control the influence of differences of variations in the rate of utterance. In other words, we could assume that the subject was reading at a constant rate on the premises that the words "say" and "again" were about the same on each occasion. In addition, we could also extract the influence of vowel lengthening and the intonation pattern on the final word.

Of fifty target words, ten words, "*ki, ke, ko, ka, ku, shi, seki, sara, sora, and su*", were acoustically analyzed in this study. These words were used to maintain the effect of "target undershoot" (Lindblom, 1963) of the production of the target vowels constant between the subjects.

2.3 Experimental Procedures

Recordings were made at various locations. We asked a high school English teacher to record her students at the high school. Middle-aged and elderly residents were individually recorded at their houses. We asked a member of the community to help us record this data. The material which was read by the subjects was pre-amplified and recorded on a Panasonic tape recorder. All of the subjects read a list of 50 sentences that contained 5 Japanese vowels one time at a normal speaking rate. There were 10 target words on the list, as mentioned earlier. All of the productions were digitized using the Kay Computerized Speech Lab (CSL).

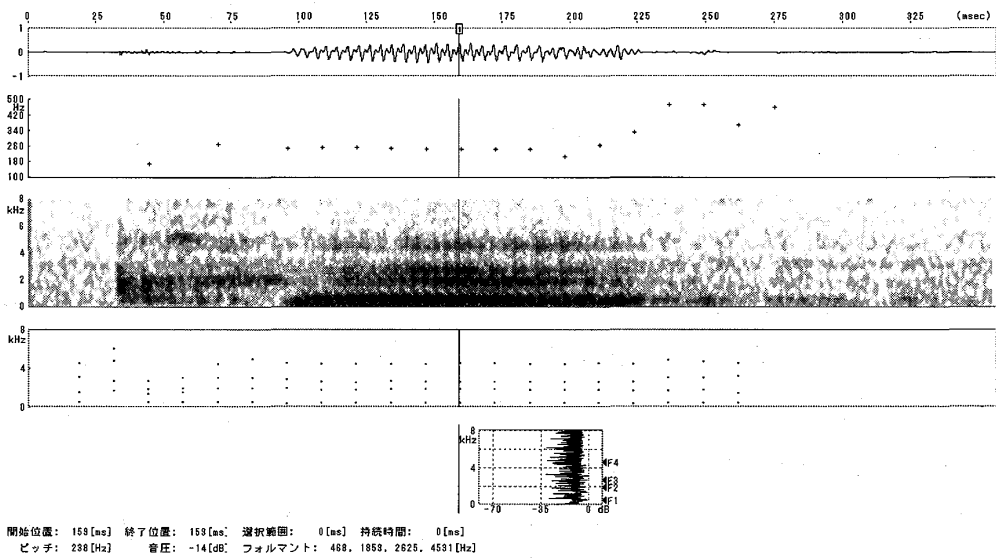
Productions were digitized at a 20-kHz sampling rate, which automatically set a low-pass filter to a cut-off frequency of 8 kHz. Impulse markers (i.e., marks each glottal pulse for pitch synchronous formant extraction) were inserted onto each of the digitized waveforms, and corresponding wideband spectrograms were obtained. In addition, a pitch-synchronous LPC derived formant history was superimposed on the formants. F1, F2, and F4 were obtained using the formant history information.

As formants produced by different individuals vary not only because of the way they pronounce words, but also because of anatomical differences such as the size of individual subject's resonating cavities. It is, therefore, important to filter out such differences derived from anatomical differences when conducting a study of sound changes. We therefore decided to take the average frequency of the fourth formant as

an indicator of an individual's head size, and then expressed the values of the first and second formants as percentages of the mean fourth formant (Ladefoged, 2001). The fourth formant values of all the target words were obtained using the method mentioned earlier, and the first and the second formant values in frequency were then converted to percentages of the mean fourth formant values in frequency.

The obtained first and second formant values in percent of each word were plotted on a graph in a way that the percentages of the first formants of all the subjects in producing a target word would be shown on the ordinate and the percentages of the second formants would be shown on the abscissa.

Figure 1 Sample of waveform, pitch, wideband spectrogram, formant history, and spectral envelope of /ku/ produced by a 41-year-old woman



The aforementioned technique was utilized to indicate the acoustic relationship between vowels produced by the subjects in three age groups.

3. Results and Discussion

3.1 Comparison of Japanese vowels in terms of age

As mentioned earlier, the normalization problem of speech signals was taken into account by the use of the mean fourth formant frequency value of each subject as an indicator of an individual's head size.

The following tables show the average F1, F2, and F4 values in percentage of Japanese vowels produced by the subjects in the three age groups.

Table 2

F1, F2, and F4 in Percentage: Adolescents

	Sex	/i/	/e/	/a/	/o/	/u/
F1	male	9.5	12.5	19.6	14.3	11.3
	female	10.4	12.7	24.2	13.1	11.3
F2	Male	64.0	58.2	34.3	25.6	47.3
	female	62.0	53.6	30.7	21.7	42.8
F4	Male	100	100	100	100	100
	female	100	100	100	100	100

Table 3

F1, F2, and F4 in Percentage: Middle-Aged

	sex	/i/	/e/	/a/	/o/	/u/
F1	male	8.6	13	20.7	13.6	10.6
	female	11	15.2	19.8	14.3	11.3
F2	male	64	57.2	34.1	33.7	32.4
	female	56.2	54.5	34.4	27.1	37.4
F4	male	100	100	100	100	100
	female	100	100	100	100	100

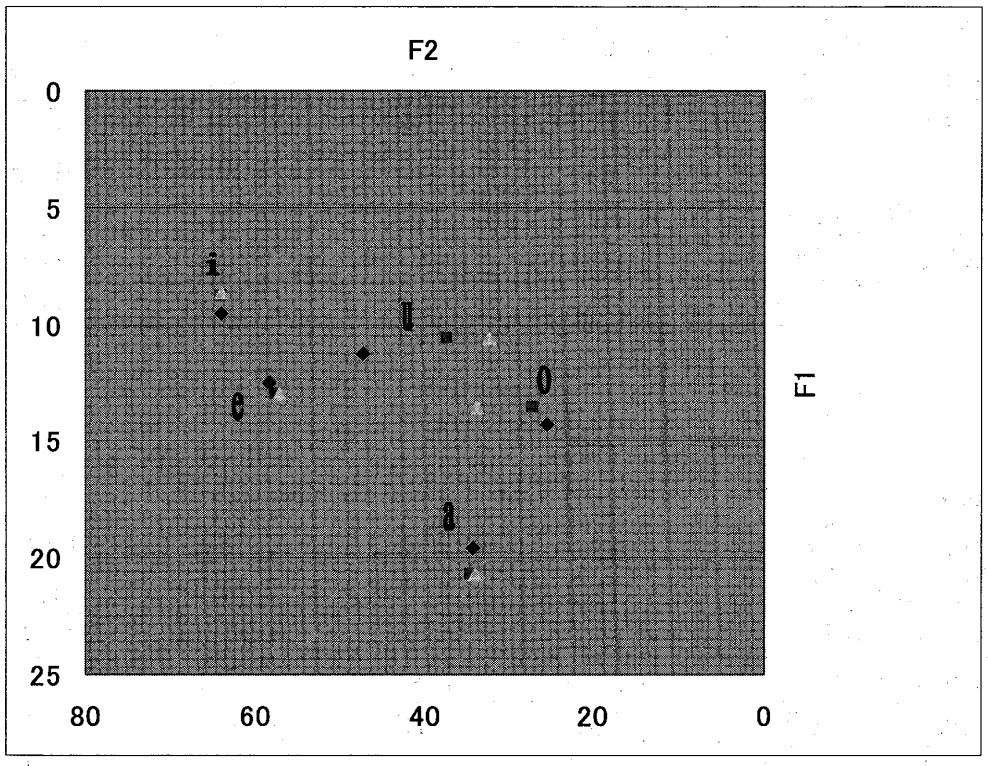
Table 4

F1, F2, and F4 in Percentage: Elderly

	sex	/i/	/e/	/a/	/o/	/u/
F1	Male	8.6	13	20.7	13.6	10.6
	Female	11	14.1	21.1	14.7	11.1
F2	Male	64	57.2	34.1	33.7	32.4
	female	54.1	52.1	39.4	26.6	31
F4	male	100	100	100	100	100
	female	100	100	100	100	100

The next figure indicates the comparison of the average Flland F2 in percentage of Japanese vowels produced by the male subjects in the three age groups.

Figure 2
Japanese vowels by F1 and F2 in Percentage: Male Subjects



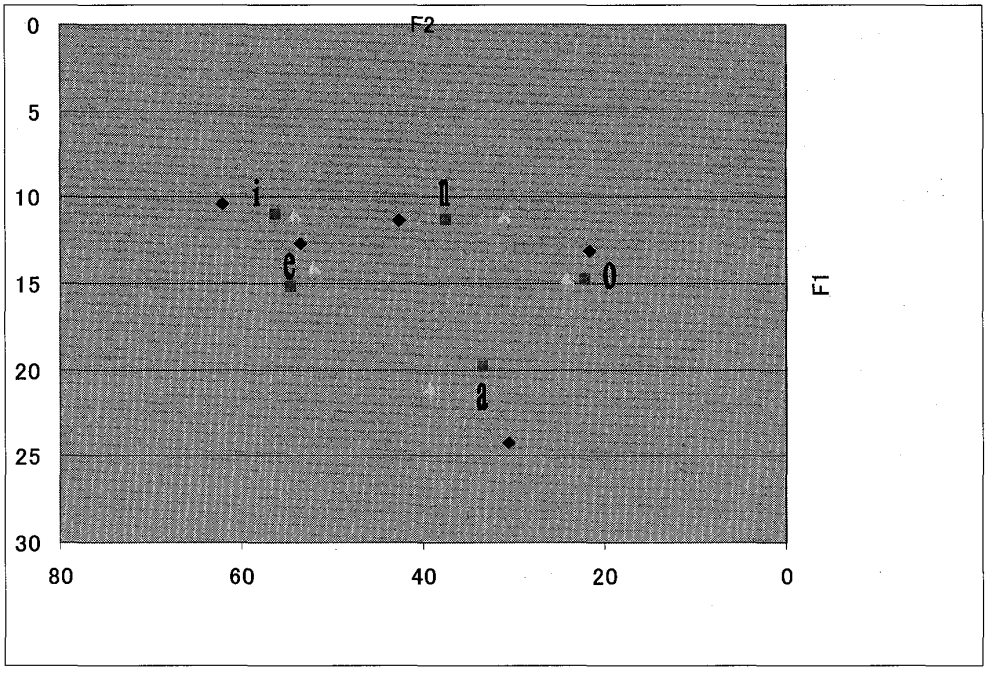
The diamonds indicate the productions of vowels by the adolescents. The triangles and the squares indicate those by the elderly and the middle-agedsubjects, respectively.

As can be seen, the obvious differences between the three generations are as follows: (1) the forward production of the /u/ by the adolescents; and (2) the forward production of the /o/ by the elderly.

As for the first case, the vowel /u/ was progressively produced farther forward by adolescents, middle-aged, and elderly, respectively. However, the vowel /o/ was produced farther forward by the elderly, and the productions by the adolescents and the middle-aged subjects were almost the same. In addition, the other vowels were produced similarly by the subjects in the three age groups.

Figure 3 indicates the comparison of the average F1and F2 in percentage of the Japanese vowels produced by the female subjects in the three age groups.

Figure 3
Japanese vowels by F1 and F2 in Percentage: Female Subjects



As can be seen, the /i/, and the /u/ were produced farther forward by the adolescents, and the /e/, and the /o/ were produced slightly higher by the adolescents than the subjects in the other two age groups; however, the /a/ was produced farther forward by the elderly, not by the adolescents.

Shiotsuki (2005) examined the Japanese vowel productions of adolescents, middle-aged, and the elderly living in Miyazaki city. She reported that all the vowels were produced much farther forward by the adolescents than the middle-aged and the elderly people. In addition, she incorporated "real-time" observations of productions recorded in 1954, 1961, 1975, and 1991. As the "apparent-time" interpretation of changes in progress assumes that individuals in a community retain their childhood patterns, certain precautions must be taken before asserting age effects as change in progress. In other words, a series of studies re-examining earlier observations of variants carried out in the past can disambiguate and disentangle the two interpretations of age grading and generational change for a particular community under investigation (Gordon, 2001). Thus, Gordon (ibid.) suggests that misdiagnoses of age-differences as changes in progress based on "apparent-time" reasoning should be guarded against by verifying observed apparent-time age effects in consultation with the records of previously mentioned studies conducted some time ago.

Shiotsuki (2005) reported that no apparent age grading or generational changes

were found between the subjects recorded in 1954, 1961, 1975, and 1991. Based on the apparent-time and the real-time observations, she concluded that the farther forward productions of vowels by adolescents observed in 2005 might be interpreted as a new tendency among adolescents in recent years.

The observed discrepancy between the findings of the present study and of Shiotsuki' (2005) study needs to be carefully considered. One of the major factors we need to take into account is the effects of social factors such as gender, and race on vowel productions, as Shiotsuki (ibid.) did not consider them in her study.

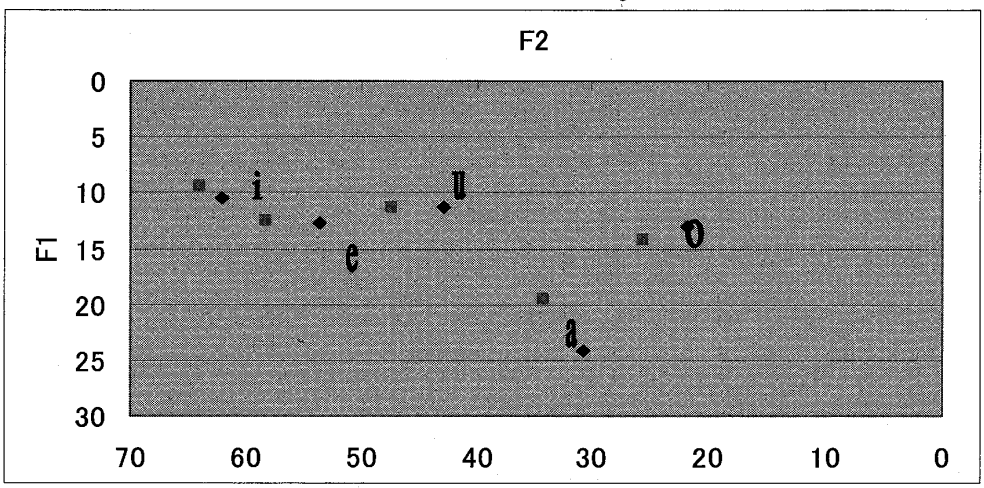
Linguistic differences between men and women have been observed in speech communities around the world. Numerous studies have reported females leading males in the use of innovative forms (Lobov, 1963 cited in Gordon, 2001). For instance, Eckert (1989a) found significant differences between boys and girls in the use of Northern Cities Vowel Shift variables. In other words, girls were found to lead the changes observed in the study. Though Herndobler (1977, 1993) found the opposite, Gordon (2001) interprets the differences attributed to either a generational or a geographical difference. Though other social factors such as social class have been reported, those factors could not be considered in the present study, as the amounts of income, the levels of education, and the types of profession of the adult subjects had not been asked.

3.2 Comparison of Japanese vowels in terms of gender

The following figure indicates the comparison of the average F1and F2 in percentage of the Japanese vowels produced by the male and female subjects in the adolescent group.

Figure 4

Vowel Productions of the Male and Female Subjects in the Adolescent Group

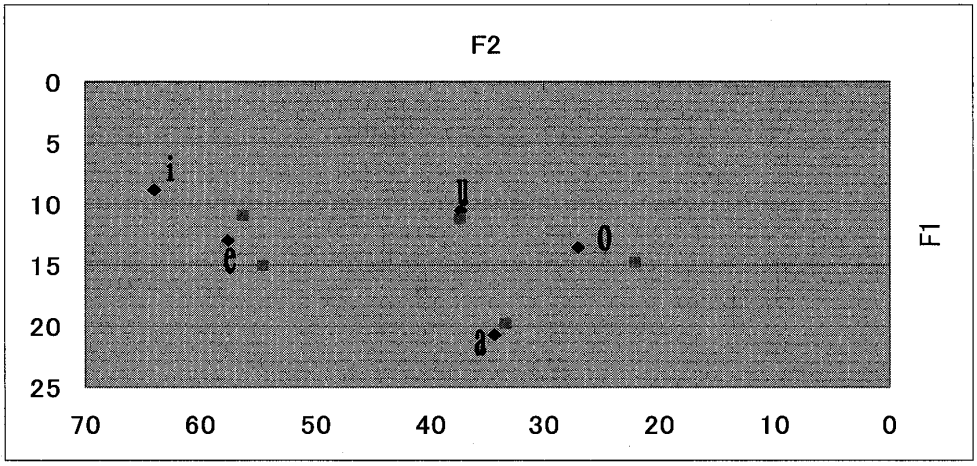


The squares indicate the female productions while the diamonds indicate the male productions.

As can be seen, all the vowels were produced farther forward by the female subjects when compared with those of the male counterparts.

The next figure indicates the vowel productions of the male and female subjects in the middle-aged group.

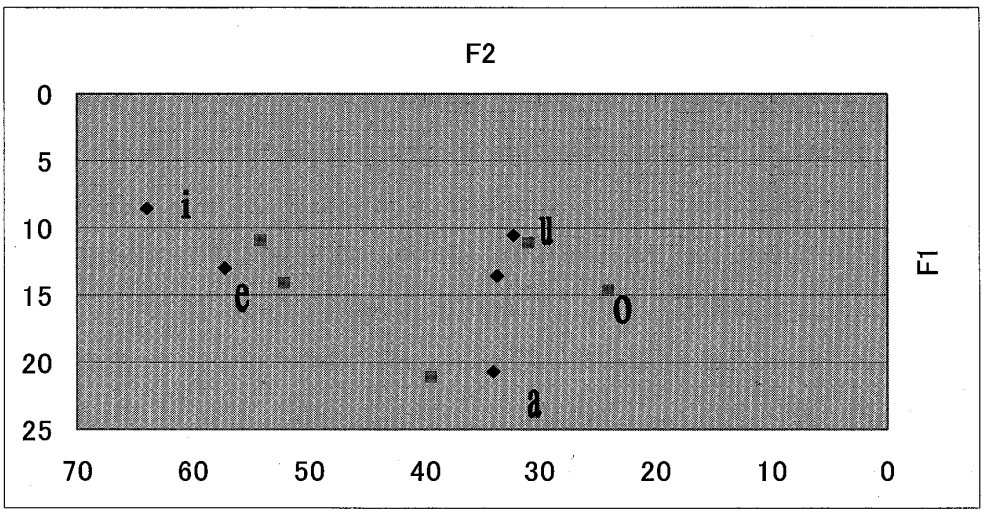
Figure 5
Vowel Productions of the Male and Female Subjects in the Middle-Aged Group



As seen above, the opposite can be said about their productions with those of the adolescents. In other words, the male, not the female, produced all the vowels except for the /a/ farther forward in the vowel space.

The next figure indicates the vowel productions of the male and female subjects in the elderly group.

Figure 6
Vowel Productions of the Male and Female Subjects in the Elderly Group

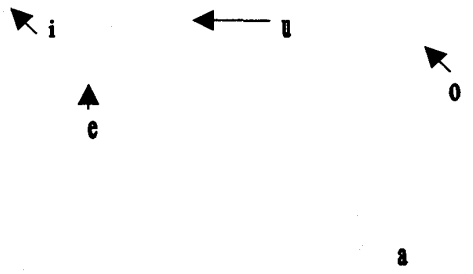


As can be seen, all the female vowels were also produced farther forward by the male subjects than the male counterparts, as observed between the male and female subjects in the middle-aged group.

Though necessarily speculative, the same difference observed between the male and female subjects in the middle-aged and in the older group is indicative of the way the Japanese vowels had been produced by Miyazaki residents. In other words, the vowels had been produced farther forward by males than females; however, the new tendency observed in the previous study might be lead by females rather than males. Furthermore, this tendency would be observed among males in the near future, as a similar tendency was observed in the previous study.

This speculation is in line with the findings reported earlier. That is, no significant difference between the male subjects in the three groups was found, because the male adolescents are still in the transitional stages and have not fully adopted the innovative form. The /a/ was produced farther forward by the elderly, not by the adolescents, however. Nonetheless, this finding is in line with those of Todaka's (2005a) study, which is the antithesis of Inoue's (1993) study. Inoue reported that there is a tendency among the young to produce /a/ farther forward in the mouth. Furthermore, Todaka (2005a) reported that the vowel space of the young male group was much narrower than that of the young female group, which was triggered by the forward movement of /o/, which was not observed in the present study. Todaka's (ibid.) subjects were residents of Ehime, Fukuoka, Miyazaki, Kumamoto, and Hiroshima. The reason why such a discrepancy was found cannot be tested here; however, one possible interpretation is that the observed difference is due to a geographical difference between various cities. Inoue's report was based on adolescents residing in Tokyo area, while Todaka's (2005a) subjects live in Ehime, Fukuoka, Miyazaki, Kumamoto, and Hiroshima. This type of geographical variation was found between Chicago and Detroit (Gordon, 2001: 22). It is, however, important to conduct further studies incorporating vowel productions in various phonetic environments, as a common source of phonetic influence affecting vowel quality has been seen in the place differences of adjacent consonants (e.g., Olive, Greenwood, and Coleman, 1993). In addition, Shiotsuki (2005) reported on the fronting of all the vowels produced by adolescents living in Miyazaki, though the number of her adolescent subjects was only two. Though tentative, we can provide an image portrayed in the diffusion patterns observed in the present studies.

Figure 7
Schematic View of the Shift: Adolescents Residing in Miyazaki



As seen above, the /i/ and the /u/ have already moved farther forward, and the /e/ and the /o/ have moved upward and may see forward movement in the near future. The movement of the /a/ can not be predicted at the moment; however, the /a/ may remain as it is in the case of adolescents residing in Miyazaki, while the /a/ moves forward in the case of adolescents living in Tokyo.

4. Conclusion

Todaka (2005a) conducted a preliminary study to examine the vowel production differences between adolescents and the elderly residing in Ehime, Kumamoto, Hiroshima, Fukuoka, and Miyazaki. Though the number of subjects was small, the adolescents produced all the vowels except for the /a/ slightly farther forward in the vowel space.

The present study is, therefore, third in a series of studies to investigate a new tendency among adolescents to produce vowels farther forward in the mouth. We asked twenty adolescents, fifteen middle-aged, and fifteen elderly people living in Miyazaki to take part in this study to investigate if such a tendency could be found.

We found the fronting of the /i/ and the /u/, and the upward movement of the /e/ and the /o/. In addition, this tendency was much more clearly observed among the female adolescents rather than the male counterparts, which in turn indicates that women are leading the adoption of the new form. In fact, all the vowels were produced much farther forward by the female adolescents than the male counterparts. It is however important to note that the fronting of the /a/ among adolescents residing in Tokyo observed in Inoue's (1993) study was not confirmed in the present study. That is, our subjects did not produce the /a/ farther forward in the vowel space. Though

speculative, these differences are due to a geographical difference between Tokyo and Miyazaki. If so, the fronting of the /e/ and the /o/ observed in Todaka's (2005a) study might be a regional variation or it might be possible to speculate that the fronting of those vowels by adolescents residing in Miyazaki is still in progress. We can not confirm our speculations at this point, as the number of subjects in Todaka's (2005a) study was small, and we also need to take into account the effects of places of articulation on the vowel productions.

It is further important to consider the effects of "social network" on the vowel productions. For instance, Eckert (1987, 1988, 1989a, 1991, 2000) observed her participants for two years and reported on the significance of group identity on the productions. If so, the categories of group identity needs to be incorporated in our subsequent studies so that we can obtain a much clearer picture of the differences in the vowel productions between adolescents residing in the same or various geographical areas.

We are still in the preliminary stages to uncover the yet unpredictable advances that will be made in this new area of sound change investigations during the new few years. However, we hope that our findings codify important directions in examination of recent Japanese vowel diffusion patterns among adolescents.

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