

F0 differences in reading Japanese and English passages: Japanese male learners of English

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Todaka (1993) investigated voice pitch differences between speakers of Japanese and American English using bilingual subjects. He found that the female subjects had higher F0 values in Japanese than in English and that the observed difference was due to a cultural factor. Based upon his findings, Todaka and Shimazaki (1999) replicated his study using Japanese female college students. Their findings supported Todaka's (1993) study in that the observed difference was in fact due to a cultural rather than a linguistic factor. As part 2 of the voice pitch investigation, the present study examined F0 differences in reading Japanese and English passages using male college students.

Key words : F0, normal voice quality, cultural factors, linguistic factors, L2 input

I . Introduction

Some experimental studies on normal voice quality differences between speakers of various languages have been conducted. Hanley et al. (1966), for instance, carried out an experiment that investigated voice quality differences between the speakers of Spanish, Japanese, and English using male subjects. They employed oral and reading samples in their experiment. They found that the subjects in the Spanish and the Japanese groups were considerably higher in pitch level and lower in sound pressure level than the subjects in the American group. They therefore attributed the observed differences to some cross-language factors.

Loveday (1981), on the other hand, reported that the mean Fundamental Frequency (henceforth, F0) values of Japanese males were generally lower than those of English males. Seward (1968:111) also reported that "Japanese men generally adopt a deep voice in order to express their masculinity of their speech."

Todaka and Shimazaki (1999), however, reported that it would be difficult to be sure that the differences observed in the previous studies were in fact due to cross-language factors. In other words, individuals differ greatly in pitch and in loudness in speech because of their anatomical and speech-style differences. It is therefore important to use bilingual speakers to eliminate such differences in order to conduct an objective study. In addition, it is crucial to separate linguistic factors from cultural factors in a voice quality study.

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Voice quality differences between speakers of various languages may be attributed to language structure differences such as sound structure or phonemic frequency counts. If a language differs from another in terms of sound inventories, the natural samples of the two languages may vary, and it may therefore affect the difference in overall voice properties. For instance, suppose there is a language in which low vowels frequently occur. Since low vowels are intrinsically louder than high vowels, the overall loudness level of the language would assumably be higher than that of other languages. The differences that come from such language structure differences should be classified as "linguistic" factors.

Some cross-language differences may be caused by cultural factors, however. For instance, Wardhaugh (1986) reported that the differences in voice quality between the sexes might be accounted for by general beliefs about what men and women should sound like when they talk. Lakoff (1975) reported that women are generally politer in their speech than men. However, such expectations of sexual and social roles may vary from one language to another. For example, Loveday (1981) investigated the pitch correlates of politeness formulae produced by Japanese and English informants of both sexes. He found that the Japanese female subjects adopted an extremely high-pitched voice clearly separating themselves acoustically from the Japanese males, while the pitch of the English females' voices was less differentiated from that of the English males'. Similar findings were also made in other studies. Miller (1967) reported that in Japanese a high pitch level serves to express a stereotypically female role. The cross-language differences derived from such sociolinguistic factors should be categorized as "cultural."

Todaka (1993), therefore, investigated voice pitch differences between speaking Japanese and English using bilingual subjects. He found that both the male and female subjects had higher F0 values in Japanese than in English. The differences were statistically significant only in the case of the female subjects, however. In addition, the ratios of low to high vowels in Japanese samples were much higher than the ones in the English samples. He therefore attributed the observed differences to a cultural rather than a linguistic factor. However, the number of subjects used in his study was small, and the subjects were bilingual speakers whose mother tongue was English. If the observed differences were in fact due to some cross-language factors, such voice pitch differences should also be found among bilingual speakers whose mother tongue is Japanese.

As part 1 of the voice pitch investigation, Todaka and Shimazaki (1999) replicated Todaka's (1993) study using Japanese female learners of English. They measured the mean F0 value of each of the subjects in reading Japanese and English passages. They further divided the subjects into three groups. Group 1 consisted of 10 Miyazaki Municipal University (henceforth, MMU) students, and they had never been abroad nor had studied English at any private institutes at which the target language is taught by native speakers of English. Group 2, on the other hand, consisted of 10 MMU subjects, who had either received phonetic training or had studied at a private institute. Finally, Group 3 consisted of 4 MMU students who had studied abroad for at least a year when the recordings were made. All of the subjects were female.

They found that the number of subjects who read the English passage lower in pitch than the Japanese one

increased in the order of Group 1, Group 2, and Group 3. In other words, the subjects in Group 3 clearly differentiated their F0 values in reading the two passages while the subjects in Group 1 did not. They therefore speculated that the amount of authentic L2 input had the effect on the degree of voice pitch differences in reading the two passages. In addition, their findings confirmed Todaka's (1993) speculation in that the observed differences were due to a cultural factor.

As part 2 of the voice pitch investigation, the present study examined the aforementioned differences using Japanese male learners of English.

II. Hypotheses based upon the previous studies

2.1 Predictions from cultural factors

Loveday (1981) reported that his Japanese male subjects spoke lower in pitch than his American male counterparts. In addition, Seward (1968 cited in Loveday 1981) reported that Japanese men adopt a deep-voice in order to emphasize the masculinity of their speech. Loveday (ibid) also stated that this was reflected in the low pitch level of Japanese male speakers in comparison with American males of generally equivalent phonational limits. Therefore, Loveday (ibid) speculated that Japanese expectations of sexual and social role are far more rigid than those prescribed by English norms.

It is however important to note that the above studies didn't take inter-speaker anatomical differences into consideration. As F0 values are influenced by anatomical differences, the observed differences might be attributed to either cultural or anatomical factors. In addition, Todaka's (1993) findings were different to Loveday's (1981) findings. In other words, he found that the mean F0 values of his male subjects were higher in Japanese than in English. However, the differences were not statistically significant. Since Todaka (ibid) used bilingual subjects in his study, no consideration for the anatomical factor is needed. In addition, Todaka and Shimazaki (1999) found significant voice pitch differences in the case of female subjects. This means that the non-significant differences found in the case of male subjects can not be accounted for by a linguistic factor. Todaka and Shimazaki (1999) reported that the differences between Japanese and English accentual systems had little effect on the mean F0 values, provided that the compared utterances had similar intonational patterns. In addition, Miller (1967) reported that in Japanese a high pitch level serves to express a stereotypically female role, as mentioned earlier.

Having considered the aforementioned findings, it can be speculated that no apparent voice pitch differences between male speakers of Japanese and American English exist. If so, no effects of the amount of authentic L2 input on F0 values should be observed in the present study.

The following hypothesis was therefore generated based upon cultural factors:

Hypothesis: Japanese male speakers of English speak/read both Japanese and English with similar F0 values.

III. Methods

3.1 Subjects

The subjects in the present study were divided into three groups. Group 1 consisted of 10 MMU students. They had never been abroad nor had studied at any private institute where the target language is taught by native speakers of English. Group 2 consisted of 10 MMU students, who had either received phonetic training or had studied at private institutes. With respect to the phonetic training, not only phonetic aspects but also some cultural differences between Japan and America were emphasized. Finally, Group 3 consisted of 5 subjects. Three of them are MMU students, and one is a Miyazaki University student. The other subject has been studying English for three years in Los Angeles. Unlike the subjects in the other two groups, the subjects in Group 3 had studied abroad for at least one year when the recordings were made.

3.2 Reading Materials

The reading materials used in Todaka and Shimazaki's (1999) study were utilized for the purpose of comparing the present results with those of Todaka and Shimazaki's (ibid) study.

A Japanese passage was taken from a driving school textbook, while an English passage was taken from an EFL textbook. The two passages were approximately the same in length, and it took the subjects about one and a half minutes to read each of the passages. Since some of the subjects had difficulty in speaking English fluently, no spontaneous speech samples were collected.

3.3 Questionnaire

A questionnaire was formulated to get information on their daily study habits and motivation toward learning English.

3.4 Experimental Procedures

Recordings were made in a recording room using a Panasonic microphone. The read material was preamplified and recorded on a Panasonic tape recorder. All of the subjects read the two passages once at a normal speaking rate. All the productions were digitized using Kay Computerized Speech Lab (CSL).

Productions were digitized at a 10 kHz sampling rate, which automatically set the lowpass filter to a cut off frequency of 4 kHz. A total of 50 utterances (25 x 1 repetition x 2 reading passages) was measured.

The temporal measurements were made in each utterance. As the CSL instruction manual provided us with a quick reference for pitch settings, the following settings were used in the present study.

Frame Length: 15ms

Frame Advance: 10-15ms

Analysis Range: 70-350Hz

Display Range: 0-350Hz

An average reading $F0^{\text{注}2}$ value was obtained by dividing each utterance into chunks of 10ms segments, and we calculated the mean F0 value of each utterance using the statistical program provided by CSL.

IV. Results & Discussion

4.1 The Subjects in Groups 1 and 2

The mean F0 value of each of the subjects in Group 1 and 2 was calculated first, as they had never been abroad.

The results are shown in Table 1. The second column represents the mean F0 values of Japanese, while the fourth column shows those of English. The parentheses represent standard deviations.

^{注2} F0 is considered here as an acoustic correlate of auditory pitch.

Table 1. Mean F0 values of the subjects in Group 1 and Group 2^{注3}

Sub	Japanese (Hz)	S.D.	English (Hz)	S.D.	Pvalue
S1	123.35	(41.34)	121.38	(37.83)	0.9429
S2	112.84	(31.51)	121.23	(43.56)	0.007*
S3	165.72	(40.07)	133.10	(31.49)	0.0001*
S4	162.64	(29.23)	168.69	(35.50)	0.1256
S5	113.94	(18.92)	120.68	(32.11)	0.3158
S6	117.95	(19.74)	113.26	(17.08)	0.004*
S7	155.54	(32.82)	148.82	(26.16)	0.0612
S8	124.19	(30.75)	113.93	(28.66)	0.0001*
S9	120.87	(27.76)	126.13	(43.14)	0.7004
S10	120.42	(26.85)	123.40	(25.90)	0.0929
S11	119.31	(22.74)	121.29	(29.77)	0.0774
S12	112.36	(25.10)	111.20	(25.79)	0.5879
S13	165.68	(38.15)	166.75	(31.81)	0.4193
S14	143.37	(33.36)	142.52	(35.66)	0.7673
S15	113.32	(23.79)	119.11	(21.23)	0.0146*
S16	173.94	(39.98)	161.04	(31.99)	0.0001*
S17	115.64	(24.70)	114.43	(21.06)	0.6873
S18	140.90	(37.21)	137.46	(39.08)	0.3
S19	125.99	(36.42)	125.08	(40.49)	0.1703
S20	106.00	(32.48)	107.37	(28.85)	0.9336
Av.Mean	131.70	(30.65)	129.84	(31.36)	0.7726

The mean F0 values of the twenty subjects in reading the Japanese and English passages were 131.70 Hz and 129.84 Hz respectively.

Of the twenty subjects, only two subjects (i.e., S2, S15) read the Japanese passage lower in pitch than the English one. S2 had the mean F0 value of 112.84 Hz in Japanese and that of 121.23 Hz in English. In the case of S15, the mean F0 value in Japanese was 113.32 Hz while that in English was 119.11 Hz.

Four out of twenty subjects (i.e., S3, S6, S8, S16), on the other hand, read the English passage (instead of the Japanese passage) lower in pitch. Regarding S3, the mean F0 values in reading the Japanese and English passages were 165.72 Hz and 133.10 Hz respectively. As for S6, the mean F0 value of Japanese was 117.95 Hz, while that

注3 * denotes that the observed pitch difference was statistically significant at the 5%.

of English was 113.26 Hz. S8 had the mean F0 value of 124.19 Hz in Japanese and that of 113.93 Hz in English. Regarding S16, the mean F0 values in reading the Japanese and English passages were 173.94 Hz and 161.04 Hz respectively.

Finally, 14 subjects (i.e., S1, S4, S5, S7, S9, S10, S11, S12, S13, S14, S17, S18, S19, S20) did not differentiate their F0 values in reading the two passages. Concerning S1, the mean F0 value of Japanese was 123.35 Hz, while that of English was 121.38 Hz. As for S4, the mean F0 value in reading the Japanese passage was 162.64 Hz while that in reading the English passage was 168.69 Hz. Concerning S5, the Japanese F0 value was 113.94 Hz while the English counterpart was 120.68 Hz. With respect to S7, the Japanese and English F0 values were 155.54 Hz and 148.82 Hz respectively. Regarding S9, the mean F0 value in reading the Japanese passage was 120.87 Hz while that in English was 126.13 Hz. As for S10, the mean F0 value of Japanese was 120.42 Hz, while that of English was 123.40 Hz. Regarding S11, the mean F0 values in reading the Japanese and English passages were 119.31 Hz and 121.29 Hz respectively. S12 had the mean F0 value of 112.36 Hz in Japanese and that of 111.20 Hz in English. Concerning S13, the mean F0 value of Japanese was 165.68 Hz, while that of English was 166.75 Hz. As for S14, the mean F0 value of Japanese was 143.37 Hz, while that of English was 142.52 Hz. Regarding S17, the mean F0 values were 115.64 Hz and 114.43 Hz in reading the Japanese and English passages respectively. S18 had the mean F0 value of 140.90 Hz in Japanese and that of 137.46 Hz in English. Concerning S19, the mean F0 value of Japanese was 125.99 Hz, while that of English was 125.08 Hz. As for S20, the mean F0 value of Japanese was 106.00 Hz, while that of English was 107.37 Hz.

As can be seen from Table 1, six of the twenty subjects showed statistically significant pitch differences in reading the Japanese and English passages. Of six subjects, two subjects (i.e., S2, S15) read the Japanese passage lower in pitch than the English passage. On the other hand, the other four subjects (i.e., S3, S6, S8, S16) read the English passage lower in pitch than the Japanese passage. The other fourteen subjects in Groups 1 and 2 did not differentiate their pitch levels in reading the two passages.

In summary, the percentage of subjects who read the Japanese passage lower in pitch than the English passage was 10%. The percentage of subjects who read the English passage lower in pitch than the Japanese one, on the other hand, was 20%. Finally, the percentage of subjects who did not differentiate their F0 values was 70%.

The mean F0 value of each of the subjects in Group 1 and Group 2 are shown in Table 2 and Table 3 respectively.

Table 2. Mean F0 value of each of the subjects in Group 1

Sub	Japanese (Hz)	S.D.	English (Hz)	S.D.	Pvalue
S1	123.35	(41.34)	121.38	(37.83)	0.9429
S2	112.84	(31.51)	121.23	(43.56)	0.007*
S3	165.72	(40.07)	133.10	(31.49)	0.0001*
S4	162.64	(29.23)	168.69	(35.50)	0.1256
S5	113.94	(18.92)	120.68	(32.11)	0.3158
S6	117.95	(19.74)	113.26	(17.08)	0.004*
S7	155.54	(32.82)	148.82	(26.16)	0.0612
S8	124.19	(30.75)	113.93	(28.66)	0.0001*
S9	120.87	(27.76)	126.13	(43.14)	0.7004
S10	120.42	(26.85)	123.40	(25.90)	0.0929
Av.Mean	119.41	(29.89)	129.06	(32.14)	0.7576

Table 3. Mean F0 value of each of the subjects in Group 2

Sub	Japanese (Hz)	S.D.	English (Hz)	S.D.	Pvalue
S11	119.31	(22.74)	121.29	(29.77)	0.0774
S12	112.36	(25.10)	111.20	(25.79)	0.5879
S13	165.68	(38.15)	166.75	(31.81)	0.4193
S14	143.37	(33.36)	142.52	(35.66)	0.7673
S15	113.32	(23.79)	119.11	(21.23)	0.0146*
S16	173.94	(39.98)	161.04	(31.99)	0.0001*
S17	115.64	(24.70)	114.43	(21.06)	0.6873
S18	140.90	(37.21)	137.46	(39.08)	0.3
S19	125.99	(36.42)	125.08	(40.49)	0.1703
S20	106.00	(32.48)	107.37	(28.85)	0.9336
Av.Mean	131.65	(31.39)	130.62	(30.57)	0.9186

In each table, the second column shows the mean F0 values of Japanese, and the fourth column indicates those of English. In addition, the standard deviations are shown in the parentheses.

Concerning the subjects in Group 1, the mean F0 value of all the subjects in reading the Japanese passage was 119.41 Hz, while that in reading the English passage was 129.06 Hz. As for Group 2, the mean F0 value of all the subjects in reading the Japanese passage was 131.65 Hz, while that in reading the English passage was 130.62 Hz. In other words, no statistically significant differences in reading the two passages were found in both groups when all the data were taken into consideration.

Concerning the individual subjects in Group 1, four subjects (i.e., S2, S3, S6, S8) showed significant differences in F0 values in reading the two passages. Of four subjects, only one subject (i.e., S2) read the Japanese passage lower in pitch than the English passage. The other three subjects (i.e., S3, S6, S8) read the English passage lower in pitch than the Japanese passage. The rest of the subjects (i.e., S1, S4, S5, S7, S9, S10) did not differentiate their F0 values in reading the two passages.

In the case of the subjects in Group 2, two subjects (i.e., S15, S16) differentiated their F0 values in reading the two passages. However, S15 read the Japanese passage lower in pitch than the English passage. S16, on the other hand, read the English passage lower than the Japanese passage.

In summary, 10% of the subjects in Groups 1 and 2 read the Japanese passage lower in pitch. On the other hand, 30% of the subjects in Group 1 and 10% of the subjects in Group 2 read the English passage lower in pitch. 60% and 80% of the subjects in Groups 1 and 2 did not differentiate their F0 values in reading the two passages.

4.2 The Subjects in Group 3

Table 4 represents the mean F0 value of each of the subjects in Group 3. As mentioned earlier, the second and fourth columns show the mean F0 values of Japanese and English respectively. In addition, the standard deviations are shown in the parentheses.

Table 4. Mean F0 value of each of the subjects in Group 3

Sub	Japanese (Hz)	S.D.	English (Hz)	S.D.	Pvalue
S21	116.02	(23.75)	113.61	(29.77)	0.3143
S22	150.46	(26.57)	150.83	(28.12)	0.6721
S23	147.16	(51.58)	150.60	(53.61)	0.5063
S24	131.72	(35.87)	130.31	(36.66)	0.5186
S25	131.75	(31.86)	141.13	(29.85)	0.0015*
Av.Mean	135.42	(33.93)	137.30	(35.60)	0.8463

The mean F0 values of the five subjects in reading the Japanese and English passages were 135.42 Hz and 137.30 Hz respectively.

Four out of the five subjects in Group 3 did not differentiate their F0 values in reading the two passages. As for S21, the mean F0 value of Japanese was 116.02 Hz, while that of English was 113.61 Hz. Regarding S22, the mean F0 values in reading the Japanese and English passages were 150.46 Hz and 150.83 Hz respectively. S23 had the mean F0 value of 147.16 Hz in Japanese and that of 150.60 Hz in English. Concerning S24, the mean F0 value of Japanese was 131.72 Hz, while that of English was 130.31 Hz.

On the other hand, S25 read the Japanese passage lower in pitch than the English passage. The mean F0 value of Japanese was 131.75 Hz, while that of English was 141.13 Hz.

In summary, 20% of the subjects in this group read the Japanese passage lower in pitch. The rest of the subjects did not differentiate their F0 values in reading the two passages, however.

4.3 Comparison

60% of the subjects in Group 1 did not differentiate their F0 values in reading the two passages while 80% of the subjects in Group 2 did not. In addition, 80% of the subjects in Group 3 did not differentiate their F0 values in reading the two passages. In other words, no apparent inter-subject differences in Groups 2 and 3 were found. Contrary to our expectations, more subjects in Group 1 differentiated their F0 values in reading the two passages, however.

As stated earlier, the subjects in Group 1 had never been abroad nor had studied English at any private institute. On the other hand, the subjects in Group 2 had either studied English at a private institute where English is taught by native English speakers, or had taken pronunciation classes. In addition, some cultural differences between Japan and America as well as phonetic aspects were emphasized in the pronunciation classes. Unlike the subjects in Groups 1 and 2, the subjects in Group 3 had studied abroad for at least one year when the recordings were made.

Todaka and Shimazaki's (1999) study reported that almost all of the female subjects who had studied abroad did differentiate their F0 values in reading the two passages. In other words, those who had studied abroad read the English passage lower in pitch than the Japanese one. In contrast, the subjects who had received little authentic L2 input did not differentiate their F0 values in reading the two passages.

They speculated that the observed differences were due to a cultural rather than linguistic factor. This was because only Japanese (not American) female speakers adopt a high-pitched voice to express politeness. In addition, no effects of language structure differences between Japanese and American English on F0 values were found in the aforementioned studies.

In the present study, no apparent differences between the subjects in Groups 2 and 3 were found. Furthermore, it seems that the amount of authentic L2 input had the reverse effects on F0 values in reading the two passages. In

other words, the number of female subjects who differentiated their F0 values in Todaka and Shimazaki's (1999) study increased as the amount of authentic L2 input increased. In the present study, the male subjects who had the least authentic L2 input differentiated their F0 values the most. However, the auditory judgment of the readings by all the subjects gave us a possible interpretation of the discrepancy.

We re-examined all the data auditorily. As a result, we found that those subjects in Group 1 who differentiated their F0 values were rather nervous at the time of their recordings. Especially S3, S6 and S8 were very tensed up when they read the Japanese passage. The rest of the subjects, however, seemed to have been relaxed when the recordings were done. Though necessarily speculative, it can be said that the observed inter-group differences were not derived from a cultural factor. It was rather caused by a psychological factor at the time of recordings.

V. Conclusions

The present study is a continuation of the investigation of voice pitch differences in reading Japanese and English passages. Todaka (1993) compared voice pitch differences between speakers of Japanese and English. He used bilingual subjects in his study to filter out the effects of anatomical differences on pitch. Todaka (ibid) found that all of the subjects had higher F0 values in Japanese than in English. Having considered the effects of sound structure differences between Japanese and English, he concluded that the observed difference might have been caused by a cultural factor.

Todaka and Shimazaki (1999) replicated his study as the number of subjects in Todaka's (ibid) study was small. Todaka and Shimazaki (1999) focused upon female subjects in their study. As part 1 of their voice pitch investigation, they found that the amount of authentic L2 input had much effect on reading F0 values. In other words, those subjects who had studied in America differentiated their F0 values in reading Japanese and English passages. On the other hand, the subjects who had received little authentic L2 input did not differentiate their F0 values. They concluded that the observed differences were due in fact to a cultural factor as the pitch correlates of politeness formulae produced by Japanese female subjects had been found. In other words, Japanese female subjects employed a high-pitched voice to express politeness.

As part 2 of the voice pitch investigation, the present study replicated Todaka and Shimazaki's (1999) study using male speakers. Though some previous studies reported that Japanese males employ a low-pitch voice to express masculinity, their studies did not take a crucial factor into consideration. As F0 values are influenced by the height of an individual, their results might have been affected by the anatomical differences of the subjects used. As no consistent findings of the differences between male speakers of the two languages were found, the present study hypothesized that there would be no F0 differences in reading Japanese and English passages. In addition, no effects of authentic L2 input on F0 values were speculated.

The subjects in the present study were divided into three groups. Group 1 consisted of 10 MMU students. They

had never been abroad nor had studied at any private institute where the target language is taught by native speakers of English. Group 2 consisted of 10 MMU students, who had either experienced phonetic training or had studied at a private institute. In the phonetic training, not only phonetic aspects but also some cultural differences between Japan and America were emphasized. Finally, Group 3 consisted of 5 subjects, three of whom are MMU students. One is a Miyazaki University student. The other subject has been studying English for three years in Los Angeles. All of the subjects in Group 3 had studied abroad for at least one year when the recordings were made.

It was found that no apparent differences in reading Japanese and English passages exist. In addition, no intergroup differences derived from a cultural factor were found. The present findings thus confirmed our hypothesis. In other words, the voice pitch differences between male speakers of Japanese and American English do not exist. The noticeable voice pitch difference between speakers of Japanese and American English was only found in the case of female speakers. Furthermore, the difference can be accounted for by a cultural rather than a linguistic factor.

Todaka and Shimazaki (1999) and the present study replicated Todaka's (1993) study. These studies confirmed Todaka's (1993) findings in that the voice pitch differences between speakers of Japanese and American English are prominent in the case of female speakers. It is however important to note that Todaka (1993) employed both reading and spontaneous speech samples in his study. Todaka and Shimazaki (1999) and the present study didn't use speech samples as most of the subjects in Groups 1 and 2 were unable to speak English fluently. It is therefore important to conduct another study focusing on speech samples in the future in order to fully understand the voice pitch differences between speakers of Japanese and American English.

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