

The Influx of Different Language Rhythms and Cultures into Musical Rhythms because of the Occupation by Other Countries

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Abstract

It has been found that musical rhythms are often influenced by language rhythms in the composers' native language. The objective of this study was to test whether Japanese history has influenced the Japanese native speaker musical compositions. As Japan was occupied by the United States after World War II, many languages and cultures were imported. In this study, Japanese musical phrases composed after 1800 were evaluated and the index values (nPVI; normalized Pairwise Variability Index) were calculated. It was found that Japanese musical rhythms changed significantly after it was occupied by the United States; however, it was also observed that Japanese musical rhythms differed from one historical period to another historical period. It was concluded that complex historical and cultural influences from other countries have indeed affected Japanese musical rhythms.

Introduction

There has been an ongoing discussion on the relationship between language and music. In 1871, Darwin proposed the "musical protolanguage" hypothesis (see Fitch, 2010 for an overview). The Generative Theory of Tonal Music (GTTM) (Lerdahl & Jackendoff, 1983) applied linguistic analysis to music, which dramatically changed music analysis. More recently, Evolutionary Developmental Biology (Evo-Devo) scholars have also shown more interested in this field (Fitch, 2010; Fitch & Martines, 2014; Masataka, 2007; Patel, 2010). It has been found in many studies that linguistic skills are strongly related to musical ability and vice versa (Aleander et al., 2005; 2008; 2011; Anvari et al., 2002; Chan et al., 1998; Marie et al., 2011; Milovanov et al., 2004; 2007; 2008; 2009; 2010; Parberry-Clark et al., 2009; Perfors & Ong, 2012; Piro & Oriz, 2009; Sadakata & Sekiyama, 2011; Shabni & Torkrh, 2014; Slater et al., 2014; Slevc & Miyake, 2006; Skoe & Kraus, 2012).

Rhythm is one of the most important elements in both music and language (Patel, 2002; 2003; 2008). Language rhythm can be categorized into stress-timed languages, syllable-timed languages, and mora-timed languages (Abercrombie, 1967; Bloch, 1942; Ladefoged, 1975; Ladefoged & Johnson, 2010; Pike, 1945). Grabe and Low (2002) used a pairwise variability index (PVI) to categorize these three linguistic speech rhythms. PVI gives the average value of the differences between the vocalic intervals or the intervocalic intervals in a sentence and is calculated from the differences in the durations between the adjacent vocalic intervals or the intervocalic intervals. The PVI values in stress-timed languages tend to be greater as the vowels in the stressed syllables are longer and the vowels in the unstressed syllables are shorter. However, the PVI values in syllable-

timed languages tend to be smaller as the variations in vowel durations are relatively smaller.

Table 1. nPVI for Each Language (Based on Grabe & Low, 2002)

Language	nPVI	Language rhythm
Dutch	65.5	Stress-timed
German	59.7	
British English	57.2	
Japanese	40.9	Mora-timed
Spanish	29.7	Syllable-timed
Mandarin	27.0	

Patel and Daniele (2003) adapted the nPVI (normalized PVI) language measurement to music and found that the nPVI value for French (a syllable-timed language) was similar to the nPVI value in pieces by French composers and the nPVI in English (a stress-timed language) was also similar to the nPVI in pieces by British composers. These results suggested that native language rhythms influenced native musical rhythms. Jekiel (2014) compared the nPVI values in British English and Polish (a mixed stress-timed/syllable-timed language) pieces composed in the 19th century; however, the results were not significant. It was therefore surmised that Poland's history may have been a factor. First, Poland had been divided into the Russian Empire, Prussen, and Austria in the 18th century, and in the early 19th century, a Polish Duchy, a French-bloc country was founded by Napoléon Bonaparte, which meant that Polish language rhythm had been influenced by Russian (a stress-timed language) and French (a syllable-timed language) through the various occupations. Therefore, it made sense that it was difficult to find significant differences between British English and Polish musical pieces as the influx of other languages had influenced Polish musical rhythms. In the same manner, as Japan was occupied by the United States after World War II (WWII)/the Pacific War (1945), language rhythms and musical rhythms may have been affected by history. A recent study also found that history impacted musical rhythms (Daniele & Patel, 2013, 2015).

In this study, two hypotheses about Japanese language and musical rhythms are proposed: (a) the composers' native

language (Japanese) influences musical rhythms, and (b) Japan's history of the US occupation influenced more recent musical rhythms. To assess the validity of these hypotheses, the musical nPVI of native Japanese compositions were calculated and analyzed.

Method

Musical Materials

One thousand and fifty-nine phrases from 220 pieces composed by 104 native Japanese speakers were collected (the mean number of notes per phrase = 16.19, SD = 6.11, for more details about the composers, see Supplemental Table 1). All composers were born after 1800, and 562 of the 1059 phrases were taken from 136 pieces that also had lyrics (79 composers, mean number of notes per phrase = 14.70, SD = 4.37), and 497 of the 1059 phrases were taken from 85 instrumental pieces (30 composers, mean number of notes per phrase = 17.87, SD = 7.27). Each phrase had at least 10 notes and no internal pauses/rests; grace notes and ornamentations were omitted from the calculation.

In this study, the musical nPVI values for the Japanese pieces with and without lyrics were not found to be significantly different (Fig. 1, Song-Instrumental: *t*-test, *p* = 0.85, Cohen's *d* = 0.005) and the mean for the nPVI values in the Japanese music phrases were similar (mean total: nPVI = 40.99, Song: 41.11, Instrumental: 40.86); therefore, the "Song" and "Instrumental" pieces were not distinguished in the advanced analyses.

The Japanese language nPVI value identified by Grabe and Low (2002) came from "modern Japanese." Therefore, modern musical and modern Japanese language nPVI values were compared. Of the 159 musical phrases from composers born after 1950, the results were found to be similar (mean nPVI: 44.53, SD = 18.15) and the differences between the musical nPVI values with and without lyrics were not significant, with the nPVI values being very similar to the linguistic nPVI reported in Grabe and Low (2002). Therefore, the materials in the present study confirmed that Japanese linguistic speech rhythms affected Japanese composed musical rhythms regardless of whether or not there were lyrics.

Measurement of the Musical nPVI

The rPVI is the row PVI, defined as:

$$rPVI = \left[\sum_{k=1}^{m-1} |d_k - d_{k+1}| / (m-1) \right],$$

where *m* is the number of intervals, and *d* is the duration of the *k*th item. The nPVI is the normalized rPVI, which is defined as:

$$nPVI = 100 \times \left[\sum_{k=1}^{m-1} \left| \frac{d_k - d_{k+1}}{(d_k + d_{k+1})/2} \right| / (m-1) \right],$$

where *m* is the number of items in an utterance, and *d* is the duration of the *k*th interval.

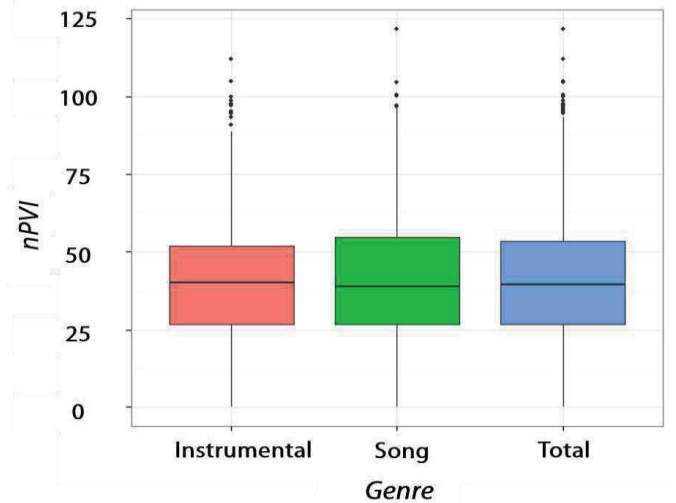


Figure 1. Musical nPVI values for three groups (Instrumental, Song, and Total; 0.05 < *p*; n.s.): the black dots are the outliers, the bottom of each box is the lower quartile, the top is the upper quartile, and the line in the middle is the median; the upper and lower whiskers are drawn.

All durations between the notes in the phrases were counted: a quarter note was counted as "one" in four-four time phrases, and an eighth note was counted as "one" in six-eight time phrases (Figure 2). To simplify the calculations, Patel and Daniel (2003) set the first note in each phrase as "one" regardless of the meter when they counted the note duration; that is, both calculation results were the same. The nPVI calculator (The Neuroscience Institute, California, http://www.nsi.edu/~ani/nPVI_calculator.html) was used to calculate the nPVI values from the counted note durations using formula (2). R (Ihaka & Gentleman, 1996) and EZR (Kanda, 2013) were used for the statistical analysis.



Figure 2. Example of a musical nPVI calculation ("Akatombo (Red Dragonfly)" composed by Kosaku Yamada): where *m* is the number of notes in the phrase. As this phrase is three-four time, each note was counted as follows: a crotchet was 1, a semiquaver was 1/2, a minim was 2, and a dotted crotchet was 3/2.

Background Analysis

Context of history in Japan. The years between 1800 (the Edo period) and 2015 (the Heisei period) were broken down into eight periods based on *genko* (i.e., era names; most of them are changed when a new emperor ascends the throne): "Edo (the late Edo period, 1800–1868)," "Meiji A (the early Meiji period, 1868–1890)," "Meiji B (the late Meiji period, 1890–1912)," "Taisho (1912–1926)," "Showa A (from pre-WWII to wartime: 1926–1945)," "Showa B (the Allied Occupation after the WWII/the Pacific War: 1945–1952),"

“Showa C (post-WWII: 1953–1989),” and “Heisei (1989–present).”

The late Edo period (Edo, 1800–1868). The “Tokugawa shogunate” was the period between 1603 and 1868 when Japan was under Tokugawa rule. The third shogun, Tokugawa Iemitsu, issued a National Isolation Edict from 1633 to 1639 (known as *sakoku* or the “locked country”), which was maintained until the arrival of the Black Ships of Commodore Matthew Perry in 1853. Therefore, during this period, no foreigners could enter Japan and no Japanese could travel to or return from foreign countries; however, the Netherlands had trade privileges in Dejima, Nagasaki. Japan opened its doors to the world in 1854 when it realized the necessity to establish a modern state government to resist Western influences. The last and fifteenth shogun, Tokugawa Yoshinobu, stepped down, and Emperor Meiji came to the throne in 1867.

The Meiji (Meiji A and B: 1868–1912) and Taisho periods (Taisho, 1912–1926). The Meiji period began in 1868, at which time the samurai warrior class was disbanded, Japan moved toward democratization, and Western culture began to influence Japan (Meiji A). In the latest Meiji period (Meiji B), the Sino-Japanese War and the Russo-Japanese War occurred as Japan began to expand its territories. After the Meiji period, Emperor Taisho took over the throne from 1912 to 1926 (Taisho), and as Japanese culture and Western culture began to merge, a new Japanese culture emerged.

The Showa (Showa A, B and C: 1926–1989) and Heisei periods (Heisei, 1989–present). The Showa period started in 1926. The Japanese empire entered war and launched the Pacific War in 1941. Consequently, Japan was one of the defeated countries and was occupied by the GHQ (General Headquarters) and the offices of the Supreme Commander for the Allied Powers (SCAP) in 1945 (Showa A: pre-WWII-war-time), with the main occupier being the United States. As many Americans were living in Japan, they brought their culture with them. The Treaty of San Francisco was concluded in 1952, which ended the occupation of Japan by the United States, and Japan gained sovereignty (Showa B: the Allied Occupation). Subsequently, the cultures that had been introduced in the period of occupation by the United States became naturalized. The Showa period ended (Showa C: post-WWII) and the Heisei period started in 1989 (for details, see Totman, 2014).

Context of musical history in Japan. The Japanese musical history classification by Yoshikawa (1965) was referred as: “Before the arrival of the Black Ships by Matthew Perry (1800–1852),” “the period of imported Western music (1853–1912),” “the period of digested Western music (1912–1945),” and “the period of the rising of folk music (1946–present)” (author’s translation into English).

Western music was imported from 1853–1912. After the arrival of the Commodore Matthew Perry’s Black Ships in 1853, Japanese music began to be influenced by Western music and Japanese traditional music began to decline, with many *koto* (Japanese traditional stringed musical instrument) pieces barely surviving. The *Rokumeikan* (“Dear-cry Hall”) was built in 1883 to wine and dine state guests and diplomats

from foreign countries, and high-ranking Japanese officials began to practice Western manners there for the first time, which became famous for its parties and balls. Therefore, the opportunities to perform Western music increased and Japanese sheet music was also westernized.

The digested Western music (1912–1945) in the Taisho period and the rise in folk music (1946–present) in the early Showa period (1912–1945) saw developments and improvements in Japanese traditional instruments; however Western music provided the initiative. The new words *haikara* and *bankara* were created; *haikara* stemmed from the English phrase “high color” and indicated a Westernized lifestyle, while *bankara* came from the Japanese word *yaban* (“barbarism”) and was the antithesis of *haikara*. In music and the arts, *haikara* referred to Western cultural influences such as the violin and moving pictures (“*katsudo shashin*”), whereas *bankara* referred to traditional Japanese music and the arts such as *Kabuki* (classical Japanese drama) and the Shamisen (Japanese traditional instrument). However, at this time *bankara* was in decline. After the Great Kanto area earthquake in 1923, the radio was introduced and popular songs spread among the common people with the introduction of records and record players.

In “the period of the rising of folk music,” folk (classical) music underwent a renaissance, and sensationalism morphed into intellectualism. In addition, music that dispelled stereotypes and was iconoclastic spread among the Japanese.

Statistical Analysis

The Brown–Forsythe test, a one-way Analysis of Variance (ANOVA), Tukey’s HSD test, the Kruskal–Wallis test, and the Steel–Dwass test (Dwass, 1960; Steel, 1960) were performed as statistical analyses using R and MATLAB (Mathworks Inc., Natick MA). The Brown–Forsythe test was used to determine whether the group variances were equal or not, and if the results indicated that the group variance was equal, a one-way ANOVA was used; when the group variance was not equal, the Kruskal–Wallis test was used. The Tukey’s HSD test is a subordinate test of the one-way ANOVA, and the Steel–Dwass test is a subordinate test of the Kruskal–Wallis test. Judging the results of the Brown–Forsythe test, the Kruskal–Wallis test was used for the analysis of the context of history in Japan ($F(7, 1051) = 4.10, p < 0.001$), and the one-way ANOVA was used for the analysis of the context of musical history in Japan ($F(3, 1055) = 1.99, p = 0.11$).

Permutation (randomized) test. After each test, the data sets were automatically shuffled into eight and four groups randomly to break the time structure, and a one-way ANOVA or Kruskal–Wallis test was performed 1000 times in MATLAB to estimate the statistical thresholds of each empirical distribution of the test statistics to confirm whether the results were affected by historical effects or not. If the statistical thresholds were lower than the value in the exact grouping, the effects were a result of historical events.

Results

Figure 3 shows the results for the musical nPVI measurements for Japanese music in the different historical periods (Kruskal–Wallis test: $\chi^2 = 16.21, p = 0.001, \eta^2_G =$

0.02), and the value of the test statistic was higher than its permutation test ($p < 0.0001$). The Steel–Dwass test showed the effect of the influx of other languages and cultures after the “locked country” period and blended with the original Japanese language (Meiji A-Showa A: $p = 0.040$, Cohen’s $d = 0.36$), the effects of the influx of other languages and cultures in the United States occupation (Taisho-Showa B: $p = 0.015$, Cohen’s $d = 0.25$; Showa A-Showa B: $p = 0.0002$, Cohen’s $d = 0.38$), and the effect of the merging of the languages and cultures after the war and the original Japanese (Showa B-Showa C: $p < 0.0001$, Cohen’s $d = 0.47$; Showa B-Heisei: $p = 0.0001$, Cohen’s $d = 1.05$). Additionally, the musical rhythms were different from they were before (Edo-Heisei: $p = 0.015$, Cohen’s $d = 1.11$; Meiji A-Showa C: $p < 0.0001$, Cohen’s $d = 0.41$; Meiji A-Heisei: $p = 0.003$, Cohen’s $d = 0.84$; Meiji B-Heisei: $p = 0.029$, Cohen’s $d = 0.77$). It was concluded that historical events had a significant influence on Japanese musical rhythms at around the US occupation.

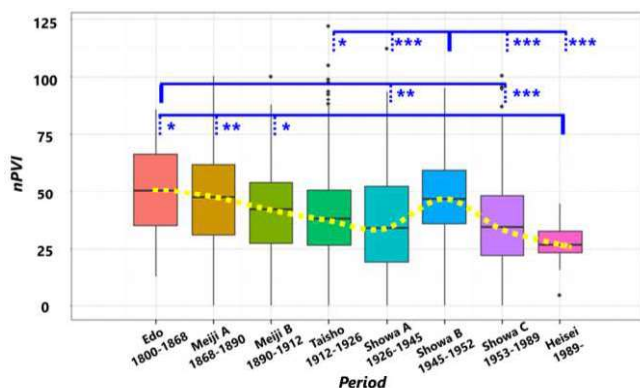


Figure 3. Musical nPVI values for historical periods: the black dots are the outliers, the bottom of each box is the lower quartile, the top is the upper quartile, and the line in the middle is the median; upper and lower whiskers are drawn. Blue lines are the results of the Steel–Dwass test. Solid lines are the starting point compared to each connected dashed line (** $p < 0.001$, ** $0.001 < p < 0.010$, * $0.010 < p < 0.050$)

Figure 4 shows the results of the musical nPVI measurements for Japanese music from period to period (one-way ANOVA: $F(3,1055) = 5.51$, $p < 0.001$, $\eta^2_G = 0.02$), with the F -value being higher than its permutation test ($p < 0.0001$). Tukey’s HSD test showed the changes in the times and the musical rhythms in Japan (the period of imported Western music- the period in which Western music was digested: $p = 0.006$, Cohen’s $d = 0.22$; and the period of imported Western music-the period of the rising of folk music: $p = 0.028$, Cohen’s $d = 0.18$).

Conclusion

Japanese musical nPVI values changed because of the cultural influences of other countries and particularly because of the US occupation. The results supported the hypotheses that Japan’s complex historical background influenced musical rhythms, which was inconsistent with the findings in Jekiel (2014).

In this research, the nPVI value in the Edo period was found to be high even though this period included the period of the “locked country.” It is presumed that most of the data in this period was after the opening of the country in 1853,

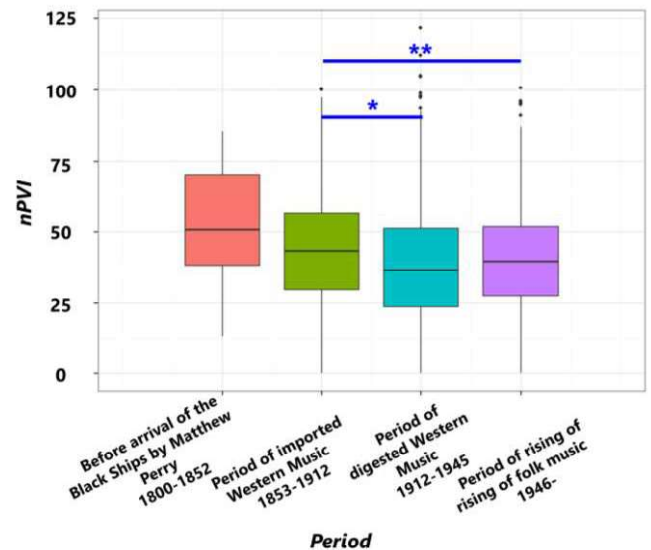


Figure 4. Musical nPVI values for music historical periods: the black dots are the outliers, the bottom of each box is the lower quartile, the top is the upper quartile, and the line in the middle is the median; and the upper and lower whiskers are drawn (** $0.001 < p < 0.010$, * $0.010 < p < 0.050$).

and therefore, it might have been influenced by other languages.

London and Jones (2010) noted that “the relation between musical and linguistic rhythm seems more subtle and complex than that proposed by Patel & Daniele.” In particular, the culture has significantly changed many times in the last 200 years in Japan; the “Galapagosization” (the process of the isolation) or “locked country,” the importing of new cultures from other countries as Japan opened to the world, the merging of Japanese culture with others, the importing of American culture as a result of the US occupation, and the restoration of sovereignty; have all affected the musical nPVI values.

Therefore, researchers need to consider the historical and cultural background of countries when studying the relationships between language and music.

Acknowledgments. Thanks are due to Dr. Hiroaki Mizuhara, Graduate School of Informatics at Kyoto University, for offering me constructive comments, especially statistical analysis, and for his warm encouragement.

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Appendix

Supplemental Table 1. Composer information of musical materials (for details of pieces, see http://www.hida-net.jp/downloads/icmpc15_suppleInfo.pdf)

<i>Name of Composers</i>	<i>Dates Lived</i>	<i>Name of Composers</i>	<i>Dates Lived</i>	<i>Name of Composers</i>	<i>Dates Lived</i>	<i>Name of Composers</i>	<i>Dates Lived</i>
Yoshizawa Kengyo	1800-1872	Simizu Osamu	1911-1986	Uchida Masato	1940-1997	Okamura Takako	1962-
Hayashi Hiromori	1831-1896	Ifukube Akira	1914-2006	Murai Kunihiko	1945-	Fujii Fumiya	1962-
Koyama Sakunosuke	1864-1927	Otake Hisatada	1914-2006	Oda Kazumasa	1947-	Hotei Tomoyasu	1962-
Okano Teiichi	1878-1941	Koyama Kiyoshige	1914-2009	Kato Kazuhiko	1947-2009	ak.homma	1964-
Taki Rentaro	1879-1903	Ishiketa Mareo	1915-1996	Inoue Yosui	1948-	Tortoise Matsumoto	1966-
Atarashi Seijiro	1880-1970	Isobe Toshi	1917-1998	Kako Takashi	1948-	Inoue Yoshimasa	1966-
Komatsu Kosuke	1884-1966	Nakada Yoshinao	1923-2000	Serizawa Hiroaki	1948-	Hirose Komi	1966-
Motoori Nagayo	1885-1945	Ohnaka Megumi	1924-	Hisaishi Jyo	1950-	Tachikawa Toshiyuki	1966-
Yanada Tadashi	1885-1959	Dan Ikuma	1924-2001	Hoshi Katsu	1948-	Okui Kaori	1967-
Nakada Akira	1886-1931	Akutagawa Yasushi	1925-1991	Ise Syozo	1951-	Yamazaki You	1967-
Yamada Kosaku	1886-1965	Eguchi Hiroshi	1927-2010	Chiba Kazuomi	1951-	Hakase Taro	1968-
Nobutoki Kiyoshi	1887-1965	Okumura Hajime	1929-	Sada Masashi	1952-	Igarashi Michiru	1969-
Funabashi Eikichi	1889-1932	Mamiya Michio	1929-	Hamada Shogo	1952-	Fukuyama Masaharu	1969-
Sugiyama Haseo	1889-1952	Izumi Taku	1930-1992	Ogikubo Kazuaki	1953-	Fukushima Hirokazu	1971-
Matsushima Tsune	1890-1985	Kobayashi Hideo	1931-	Yoshimatsu Takashi	1953-	Suemitsu Atsushi	1971-
Kashima Meisyu	1891-1954	Takemitsu Toru	1930-1996	Sakamoto Ryuichi	1953-	Fukuda Yosuke	1975-
Hirota Ryutaro	1892-1952	Nakamura Hachidai	1931-1992	Matsutoya Yumi	1954-	Kobuchi Kentarou	1977-
Narita Tamezo	1893-1945	Hayashi Hikaru	1931-2012	Kuwata Keisuke	1956-	Kitagawa Yujin	1977-
Ohno Tadasuke	1895-1929	Hagihara Hidehiko	1933-2001	Mitake Akira	1956-	Mashiko Tatsuro	1978-
Onaka Toraji	1896-1982	Hara Hiroshi	1933-2002	Nagura Akira	1957-1980	Maeyamada Ken'ichi	1980-
Ohkawa Hachiro	1901-	Yuyama Akira	1933-2002	Oda Tetsuro	1958-	Nakata Yasutaka	1980-
Hashimoto Kunihiko	1904-1949	Miyoshi Akira	1933-2013	Nakamura Masato	1958-	Ai	1982-
Takagi Touroku	1904-2006	Kubota Satoshi	1935-	Funky Sueyoshi	1959-	Mizuno Yoshiki	1982-
Taku Koji	1904-2006	Kaneda Bin	1935-2002	Ito Shintaro	1960-	Fukase	1985-
Hattori Tadashi	1908-2010	Sato Toshinao	1936-2002	Matsumoto Takahiro	1961-	miwa	1990-
Hirai Kouzaburo	1910-2002	Ikebe Shin'ichiro	1943-	Ohshima Michiru	1961-	Sumida Shinya	1994-