

Nasalization and Nasality in Japanese

Masaki TSUZUKI

(Chikushi Jogakuen Univ., Japan)

1. Purpose

① The specific purpose of this monograph is to examine and clarify the phonetic features or actual realization of the nasals, nasalization, uvular nasal [N], nasality and vowelness by using Rion's flow-nasalitygraph (FNC).

② It is within the purpose of this article to support the articulatory feeling or auditory impression by showing evidence obtaining through flow-nasalitygraphic experiments. (See, Masaki Tsuzuki, 1997b)

2. Attitude

As recent studies in phonetics have been increasingly concerned with observing attributes of sounds, this study has been carried out using flow-nasalitygraph. The author's attitude to phonetic study is based on considering the sense impression aurally and orally as well as the observation of acoustic data.

3. Survey

3.1 [N] and nasalized vowel

In regard to the Japanese nasals, it is widely known that there are five variants: namely, [m], [n], [ɲ], [ŋ] and [N], of which all occur in word-initial positions except [ŋ] and [N]. Among these, in syllable-final

positions, [ŋ] and [ɴ] commonly occur. Inter-vocalically, [m], [n], [ɲ], [ŋ] and [ɴ] occur.

All nasals (except [ɴ]) occur by exhalation through the nasal cavity with a tight and complete closure between articulators in the oral cavity. In the articulation of the Japanese [ɴ], there is always a lax and incomplete closure around the velum against the back of the tongue so that the [ɴ] is idiosyncratic in that the air from the lungs flows out not only from the nasal cavity but also from the oral cavity in specific contexts. From this viewpoint, this articulatory feature is common to the [ɴ] and the nasalized vowel.

However, in the case of the nasalized vowel, the 'vowelness' is the dominant feature of the sound, whereas the 'nasality' is the dominant feature of the sound, and the 'vowel-ness' is the secondary feature (Tsuzuki 1992a). In the case of [n], it has full 'nasality'.

	Dominant feature	Secondary Feature	Other Features	Uvula
[ɴ]	Nasality	Vowelness	Vowel-coloured-nasal	Down
[ĩ]	Vowelness	Nasality	Nasal-coloured-vowel	Down

The terms Vowelness and Nasality are authors' inventions (1992a) to designate vowel or nasal quality in certain articulations.

3.2 [ɴ] in the inter-vocalic position

The Japanese [ɴ] by itself in the inter-vocalic position can form one syllable or one unit. Therefore in the word se n i [se ɴ i] (fibre), the [ɴ] is a syllabic consonant and the word can be divided into three syllables ([se-ɴ-i]). The uvular [ɴ] as a syllabic consonant is very common in Japanese. However, in the case of the word se ni [seni] (on one's back), the [n] by itself cannot form one syllable. But the combination of [n] and vowel [i] can form one syllable. So there are two syllables in the latter case.

4. Methodology

4.1 Function of Flow-nasalitygraph

The author investigates some phonetic features of speech sounds using experimental data obtained from the flow-nasalitygraph, SN-01 (Japan). (See, Masaki Tsuzuki 1997b)

The flow-nasalitygraph was originally invented by Rion Co. in the late 1970's for observing the conditions of airflow from the nose and the mouth. As Rion Co. explained in its pamphlet (1988), the flow-nasalitygraph is an effective means for diagnosis and therapy of serious physical disorders. It has been widely used for diagnosing physical disorders such as cleft palate, paralysis of the speech organs, congenital disfunction of the nasopharynx, serious myasthenia and improper articulatory movements. The flow nasalitygraph is extremely useful for examination and diagnosis of the nasopharynx closing function.

The flow-nasalitygraph is useful and helpful not only for the patient with such speech disorders but also for the phonetician. The author applied Rion's flow-nasalitygraph to the phonetic study of the Japanese nasals and nasalization.

Using the flow-nasalitygraph, we can detect and calculate the respective airflows from the nasal and oral cavities simultaneously. The detected airflow can be easily monitored graphically and, moreover, if necessary, printed out clearly.

The subject of flow-nasalitygraphic experiments was the author for the Japanese nasals and non-nasals, using his live voice.

The experiments using the Rion flow-nasalitygraph were carried out under Hiroyuki Umeda's supervision at his phonetic laboratory at the Institute for the Study of Languages and Cultures of Asia and Africa of Tokyo University of Foreign Studies and at the author's office at Aichi Gakuin University under Hun Bok Lee's supervision. (See, Masaki Tsuzuki 1997b)

4.2 Flow-nasalitygraphic Analysis

Full details of the reason for using the Flow-nasalitygraph are as follows:

(1) To observe the condition of the airflow through the oral cavity in different contexts.

- (2) To observe the condition of the airflow through the nasal cavity in different contexts.
 - (3) To detect the airflows from the nasal and oral cavities.
 - (4) To calculate the ratio of the airflow from the nasal and oral cavities.
 - (5) To compare the data with those of other variants conditioned by different contexts.
 - (6) To graphically show the condition of the airflow.
 - (7) To graphically show the intensity of the airflow.
 - (8) An observation of vowelness in the articulation of nasalized vowel.
 - (9) An observation of nasality and vowelness.
 - (10) An observation of nasalized sounds.
- (See, Masaki Tsuzuki 1997b)

4.3 Display of the Airflow

The condition of the airflow through nose and mouth are graphically shown either in M-N (Mouth-nose airflow) Display or NFQ (Nose Airflow Quotient) Display.

On the M-N Display, the centre is the zero line. The expiration of the airflow from the oral cavity is shown on the upper part of the zero line. The expiration of the airflow from the nasal cavity is shown on the lower part of the zero line in a symmetric figure.

NFQ means the ratio of the expiration of the airflow from the nasal cavity to the expiration of the airflow from the oral cavity. The zero line on the NFQ Display indicates that the total amount of the airflow from the nose and the mouth are equal. If the amount of the airflow from the nose is greater than that from the mouth, the NFQ is shown on the upper (plus) zone. On the other hand, if the amount of the airflow through the oral cavity is greater than that through the nasal cavity, the NFQ is shown on the lower (minus) zone. (See, Masaki Tsuzuki 1997b)

5. Materials

Selected materials pronounced for flow–nasality–graphic analyses were obtained live from the author. The flow–nasalitygraphic experiments of the Japanese consonants conditioned (preceded or followed) by vowels, an adjacent sounds and in the final position were made using the following sounds.

Materials for flow–nasalitygraph:

- (1) Non–nasalized a “あ” [a]
- (2) Nasalized a “あ” [a] (complete nasalization)
- (3) mi me ma mo mu “み め ま も む”
[mi me ma mo mu] (complete nasalization)
- (4) mya myu myo “み や み ゆ み よ”
[mja mju mjo] (complete nasalization)
- (5) se–ni “せに” (背に) [seni]
- (6) sen–i “せんい” (繊維) [se N i]
(oral–coloured syllabic nasal)
- (7) ke–n–gaku “けんがく” (見學) [ke ŋ ŋ a ku]
- (8) to–nyu “とーにゅー” (豆乳) [to:n u:] (palatalized)
- (9) e–n–totsu “えんとつ” (煙突) [e n totsu]
- (10) sa–m–po “さんぽ” (散歩) [sa m po]
- (11) shi–n–ya “しんや” (深夜) [ʃ i N ja]
(oral–coloured syllabic nasal)
- (12) e–n–soku “えんそく” (遠足) [e N soku]
(oral–coloured syllabic nasal)

6. Equipments

The author used a microphone (Sony, ECM-16T), cassette tape recorder (Sony, TC-D5M), cassette decks (Sony, TC-U4, Sony, TCK-22), amplifier (Sony, TA-F35), personal computer hardware (NFC, PC-9801 RX PC-9801 RA) and software (3D · PERS, ASCII Corp., ART-V, System Soft Corp., ICHITARO V4.3, JUST SYSTEMS, Windows 95). (See Masaki Tsuzuki, 1997b)

The flow-nasalitygraphic data was fed into the personal computer. The experimental data obtained by using the above equipment are highlighted graphically in the Appendix.

The period of experimentation using the Rion flow-nasalitygraph was from 18th Japanese, 1989 to 28th September, 1991. (See, Masaki Tsuzuki 1992a, 1992b)

7. Observation and Consideration

(1) Non-nasalized a “あ” [a]

In the articulation of vowels, the soft palate is raised to touch the back of the pharynx, so that no air can pass out through the nasal cavity. The flow-nasalitygraphic experiment shows the vowelness of [a]. The airflow from the oral cavity can be clearly detected by using the flow-nasalitygraph and monitored graphically as demonstrated here. (See, Fig. 1)

(2) Nasalized a “あ” [a]

Either the airflow from the nasal cavity or oral cavity can be detected simultaneously. The data shows that there is an incomplete oral closure during the production of this nasalized vowel. The velum is lowered allowing the air to pass out through the nose as well as the mouth. (See, Fig. 2)

(3) mi me ma mo mu “み め ま も む” [mi me ma mo mu]

Vowels [i], [e], [a], [o] and [u] are fully nasalized under the influence of the adjacent nasals. It is clarified from the flow-nasalitygraphic data that airflows from the nasal cavity and oral cavity are clearly observed simultaneously. (See, Fig. 3)

(4) mya myu myo “みや みゆ みよ” [mja mju mjo]

Vowels [a], [u] and [o] are fully nasalized under the influence of the preceding nasals. The velum is lowered and airflows from the nasal cavity and oral cavity are clearly observed simultaneously. (See, Fig. 4)

(5) se-ni “せに” (背に) [seni]

The vowel [e] is partially nasalized under the influence of the following [n]. The vowel [i] is completely nasalized under the influence of the preceding [n]. (See, Fig. 5)

(6) sen-i “せんい” [se N i] (oral-coloured syllabic nasal)

The uvular [N] is a syllabic consonant and the word can be divided into three syllables ([se-N-i]).

The off-glide of the first vowel [e] is fully nasalized under the influence of the following syllabic [N]. The on-glide of the second vowel [i] is completely nasalized under the influence of the preceding syllabic [N]. There is vowelness in the articulation of the [e] and [i]. The data obtained by using the flow-nasalitygraph shows that the 「ん」[N] which occurs inter-vocally is articulated by an incomplete closure or a restriction at the uvula.

In the production of the Japanese [N], a lax and incomplete closure around the velum is observed by using FNG. And it is clarified that the air from the lungs flows out not only from the nasal cavity but also from the oral cavity. (See, Fig. 6)

(7) kengaku “けんがく” [ke ŋ ŋ aku]

The vowels [e] and [a] are fully nasalized. (See, Fig. 7)

(8) to-nyu “とーにゅー” (豆乳) [to:n u:] (palatalized)

The explosion of [t] is clearly observed in the flow-nasalitygraphic mouth data. The off-glide of [o:] is nasalized by the regressive assimilation. The vowel [u:] is completely nasalized by the progressive assimilation. The Japanese [n] is palatalized under the influence of vowel [i] or palatal [j]. In the articulation of [nj(j)u:], for instance, the tip and sides of the tongue make wide contact with the palate.

In the production of [j u:], the front of the tongue is fully raised towards the hard palate, because of the influence of the following palatal [j]. At maximum

tongue-palate contact, all parts of the palate are completely contacted.

When conditioned by [j], the [ɲ] in “にゅー” has full palatality. (See, Fig. 8)

(9) e-n-totsu “えんとつ” (煙突) [e n totsu]

The vowel [e] is fully nasalized by the regressive assimilation. The explosion of [t] is clearly observed in the flow-nasalitygraphic mouth data. It is observed that the Japanese 「ん」[n] by itself before [t] can form one syllable or one unit. (See, Fig. 9)

(10) sa-m-po “さんぽ” (散歩) [sa m po]

The author describes 「ん」 as a bilabial syllabic nasal [m] considering the data, articulatory feeling and aural impression. The vowel [a] is fully nasalized by the regressive assimilation.

The explosion of [p] is clearly observed in the flow-nasalitygraphic mouth data. The first [a] is fully nasalized by the regressive assimilation. The author describes 「ん」 as a bilabial syllabic nasal [m] considering the data, articulatory feeling and aural impression. The on-glide of the second [a] is nasalized by the regressive assimilation. The data obtained by using the flow-nasalitygraph shows that the 「ん」[N] which occurs word-finally is articulated by an incomplete closure or a restriction at the uvula. In the case of 「ん」[m] before [b], the M-N Display shows that the air does not escape through the mouth. It is observed that the Japanese 「ん」[m] by itself before [b] can form one syllable or one unit. (See, Fig. 10)

(11) shi-n-ya “しんや” (深夜) [ʃi n ja] (oral-coloured syllabic nasal)

The off-glide of [i] is nasalized. The vowel [a] is completely nasalized. The author describes 「ん」 as an oral-coloured syllabic nasal [N] considering the data, articulatory feeling and aural impression. The experimental data shows that there is an incomplete closure during successions of the production of [N] under the influence of the following [j]. It is observed that the Japanese 「ん」[N] by itself before [j] can form one syllable or one unit.

In the production of the Japanese [N] in [-i N j-], there is a lax and incomplete closure around the velum. The air from the lungs flows out not only from the nasal cavity but also from the oral cavity. (See, Fig. 11)

(12) e-n-soku “えんそく” (遠足) [e N soku] (oral-coloured syllabic nasal)

It is difficult to determine the phonetic quality of 「ん」 in examining the data. The author, however, describes 「ん」 as an oral-coloured syllabic nasal [N] considering the articulatory feeling and aural impression. The initial vowel [e] is completely nasalized by the regressive assimilation. Vowels [o] and [u] have no nasality. In the articulation of the [N], the amount of the airflow from the nose is greater than that from the mouth in the M-N Display and the NFQ Display. The data shows that the 「ん」[N] before [s] is articulated by an incomplete closure or a restriction at the uvula. It is observed that the Japanese 「ん」[N] by itself before [s] can form one syllable or one unit. (See, Fig. 12)

(See, shin-kan-sen “しんかんせん” (新幹線) [ʃi ŋ ka N se N], 1997b)

8. Conclusion

The observations of the conditions of the airflow were established using Rion's flow-nasalitygraph.

In the production of the Japanese 「ん」[N], a lax and incomplete closure around the velum is observed by using Rion's flow-nasalitygraph. And it is clarified that the air from the lungs flows out not only from the nasal cavity but also from the oral cavity. From this viewpoint, the [N] is similar to nasalized vowels. However, in the case of the Japanese [N] before vowels, nasality is the major feature. Therefore [N] needs more air through the nose than the nasalized vowel in which 'nasality' is the minor feature. (See, Masaki Tsuzuki 1997b)

In regard to palatalization of nasal, considering the experimental data, the articulatory feeling and auditory impression, it can be said that palatalized [ɲ] occurs either word-initially or inter-vocally.

The actual realization of Japanese nasals in different contexts is clarified by the experimental data and examined by the articulatory feeling and auditory impression.

Various articulatory movements of nasals influenced by adjacent vowel qualities and the manner of palatalization which occurs and varies during the production in different positions are examined.

The Flow-Nasalitygraph is very useful to examine, analyze and clarify the

actual realization of the sounds. Nasalization of vowels and nasality are easily observed by the flow-nasalitygraphic data. FNG is a useful device to show sounds graphically.

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I would also like to express my sincere gratitude to Prof. John Wells of London University for his invaluable advice and continued help for our EPSJ. Last but not least, to Prof. Masao Onishi, for his great help, patience and love.

References

- Chiba, Tsutomu & Kajiyama, Masato (1958), *The Vowel, Its Nature and Structure*, Phonetic Society of Japan.
- Fry, Dennis Butler (1982), *The Physics of Speech*, Cambridge University Press.
- Jakobson, Roman and Fant, C. Gunnar M. and Halle, Morris (1976), *Preliminaries to Speech Analysis*, The MIT Press, 11th Printing.
- Ladefoged, Peter (1971), *Elements of Acoustic Phonetics*, The University of Chicago Press, 7th Impression.
- Lee, Hyun Bok (1980), A study of Korean Speech Sounds Using Electro-Palatography and Its Application to Speech Pathology, Language Research Institute, Seoul National University, Korea. and Zhi, Min-Je (1987), "A Spectrographical Study of Korean Vowels", *Korea Journal*, Vol. 27. No. 2, *Korean Phonetics*, pp.37~41.(1989), *Korean Grammar*, Oxford University Press.

- Paget, Richard (1930), *Human Speech*, Harcourt Brace & company.
- Potter, R.K. and Kopp, G.A. and Green, H. C. (1947), *Visible Speech*, D.Van Nostrand Company.
- Tsuzuki, Masaki (1979), "A Study of Articulatory Movements of Uvular", Phonetic Society of Japan, *Bulletin*, No. 161, PSJ, Tokyo.
- Tsuzuki, Masaki (1986a), "A Study on the Discrimination between Fricatives and Affricates Reinforced by the Use of a Sound Spectrograph", The Journal of Aichi Gakuin University, *Humanities & Sciences*, Vol. 34, No. 2.
- Tsuzuki, Masaki (1986b), "Some Suggestions for Using Flow-nasalitygraph for Teaching Pronunciation", Phonetic Society of Japan, *Bulletin* No. 183, PSJ, Tokyo.
- Tsuzuki, Masaki (1987a), "Various Aspects of Sound Changes and Contrasts in Japanese Reinforced by the Use of a Sound Spectrograph", The Journal of Aichi Gakuin University, *Humanities & Sciences*, Vol. 35, No. 1~2.
- Tsuzuki, Masaki (1987b), "Various Aspects of the Japanese /ㄣ/", *MALSORI*, Journal of the Phonetic Society of Korea, No. 11~14, PSK.
- Tsuzuki, Masaki (1989), "A Study on the Similarities between [d] and [r] in Japanese by the Use of a Sound Spectrograph", *Foreign Languages & Literature*, Vol. 14, No. 1, Foreign Languages Institute, Aichi Gakuin University.
- Tsuzuki, Masaki (1990a), "A Contrastive Study of the Korean and Japanese Consonants, Part 1, Lateral and Flap Consonants", *Foreign Languages & Literature*, Vol. 16, No. 1, Foreign Languages Institute, Aichi Gakuin University.
- Tsuzuki, Masaki (1990b), "A Contrastive Study of the Korean and Japanese Consonants, Part 2-1, Nasal Consonants (1)", The Journal of Aichi Gakuin University, *Humanities & Sciences*, Vol. 37, No. 3.
- Tsuzuki, Masaki (1990c), "A Contrastive Study of the Korean and Japanese Consonants, Part 2-2, Nasal Consonants (2)", The Journal of Aichi Gakuin Univ., *Humanities & Sciences*, Vol. 37, No. 3.
- Tsuzuki, Masaki (1990d), "A Contrastive Study of the Korean and Japanese Consonants, A Supplement to Part 1, Part 2-1, Part 2-2", The Journal of Aichi Gakuin University, *Humanities & Sciences*, Vol. 38, No. 1.
- Tsuzuki, Masaki (1991a), "An Acoustic Analysis of Liquids and Nasals in the Korean and Japanese Languages (1)", *Foreign Languages & Literature*, Vol. 16, No. 1, Foreign Languages Institute, Aichi Gakuin University.
- Tsuzuki, Masaki (1991b), *A Comparative Study of Laterals and Nasals between Korean and Japanese Languages*, Research Report, Institute of Asia and African Studies, Tokyo University of Foreign Studies.
- Tsuzuki, Masaki (1992a), A Phonetic Study of the Korean and Japanese Lateral, Flap and Nasal, Dr. Litt. thesis, Linguistics Dept., Seoul National University, Korea.
- Tsuzuki, Masaki (1992b), "An Electro-palatographic Study of the Japanese Nasal [n] Conditioned by [j]", *Foreign Languages & Literature*, Vol. 17, No. 1, Foreign

- Languages Institute, Aichi Gakuin University.
- Tsuzuki, Masaki (1992c), "A Sound-spectrographic Analysis of Speech Sounds", The Journal of Aichi Gakuin University, *Humanities & Sciences*, Vol. 40, No. 2.
- Tsuzuki, Masaki & Hyun Bok Lee (1995), "An Electro-palatographic Study of the Korean and Japanese Nasals", *Linguistics in the Morning Calm* 3, The Linguistic Society of Korea.
- Tsuzuki, Masaki (1996a), "An Electro-palatographic Study of Palatalization of the Japanese Alveolar Nasal", *MALSORI*, Journal of the Phonetic Society of Korea, No. 31~32, PSK.
- Tsuzuki, Masaki (1996b), "A Sound-spectrographic Study of Vowel on-glide Accompanying Lateral and Flap in the Japanese Language", *Phonetics and Linguistics*, In Honour of Professor Hyun Bok Lee, Festschrift, Seoul, Korea.
- Tsuzuki, Masaki (1996c), "An Allophonic Study of Japanese Vowels and Consonants", The Journal of Aichi Gakuin University, *Humanities & Sciences*, Vol. 43, No. 2.
- Tsuzuki, Masaki (1997a), "A Phonetic Analytical Study of the Japanese [n]", Journal of the English Phonetic Society of Japan, EPSJ, No. 1.
- Tsuzuki, Masaki (1997b), A Phonetic Analytical Study of English, Korean and Japanese, Dr. of Arts thesis, Bond University, Australia.
- Tsuzuki, Masaki (1998), "A Flow-nasalitygraphic Study of Speech Sounds", *Journal of the English Phonetic Society of Japan*, EPSJ, No.2.
- Umeda, Hiroyuki (1980), "Observation of Some Selected Articulation in Korean and Japanese by Use of Dynamic Palatography", Papers of the 1st International Conference on Korean Studies, The Academy of Korean Studies, Seoul, Korea, pp.869-880.

Appendix (Figs. 1-12)

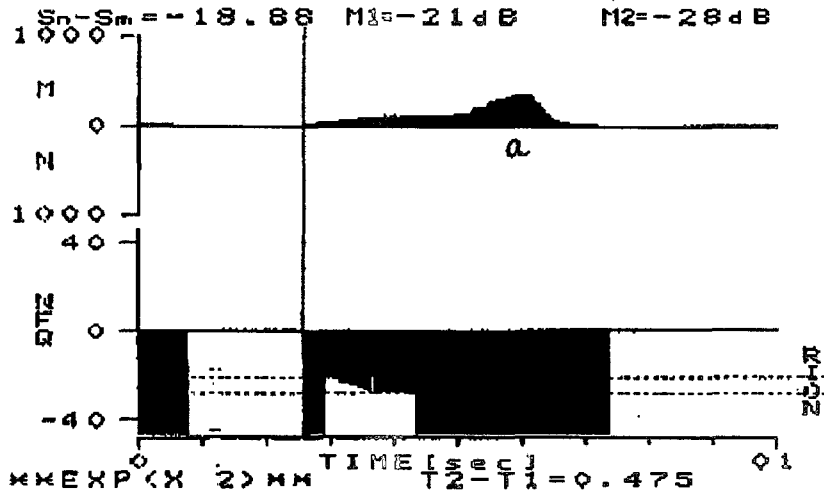


Fig. 1. Mouth-nose airflow of FNG: Non-nasalized
 a "あ" [a] by M. Tsuzuki
 Ratio of Mouth nose airflow of NFQ

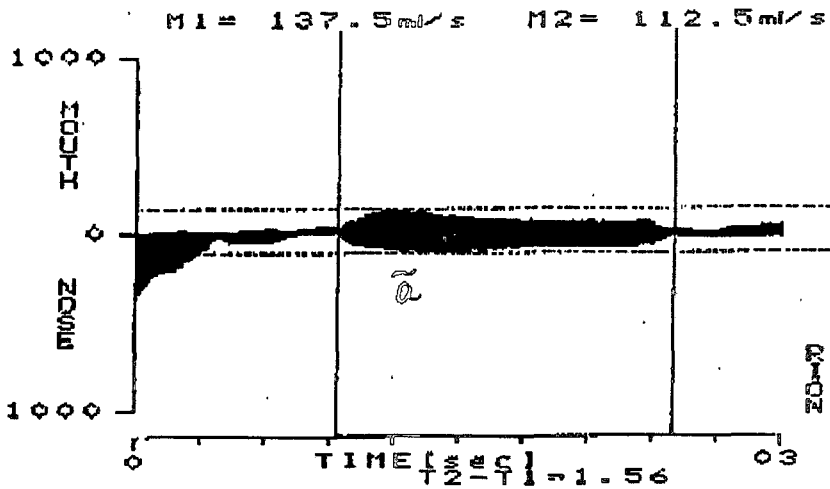


Fig. 2. Mouth-nose airflow of FNG: Nasalized
 a "あ" [ã] by M. Tsuzuki

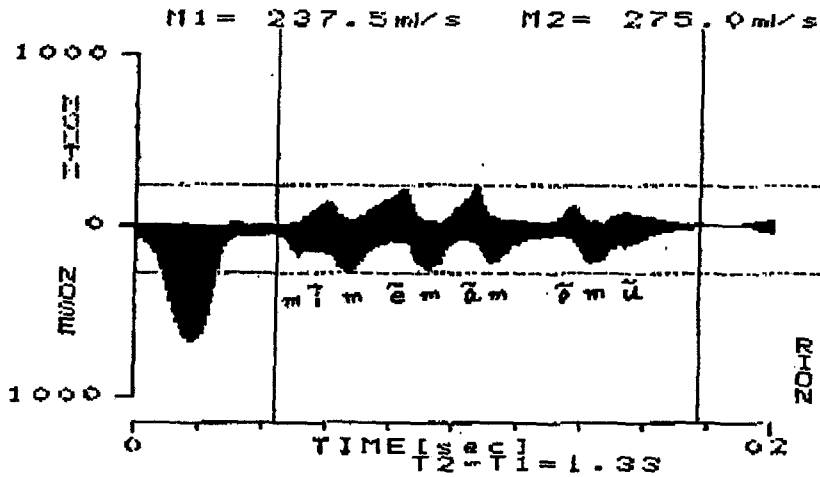


Fig.3. Mouth-nose airflow of FNG: Fully nasalized
mi me mo mu "みめもむ"
 [mĩ mē mō mū] by M. Tsuzuki

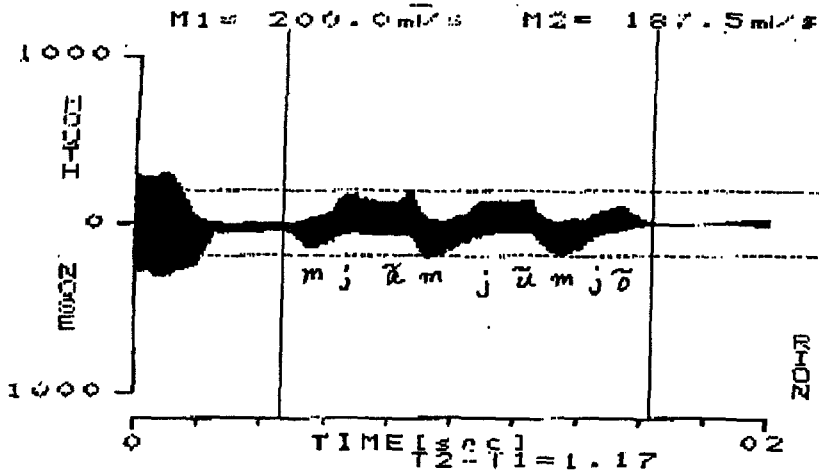


Fig.4. Mouth-nose airflow of FNG: Fully nasalized
mya myu myo "みゃ みゅ みょ"
 [m̃jã m̃jũ m̃jõ] by M. Tsuzuki

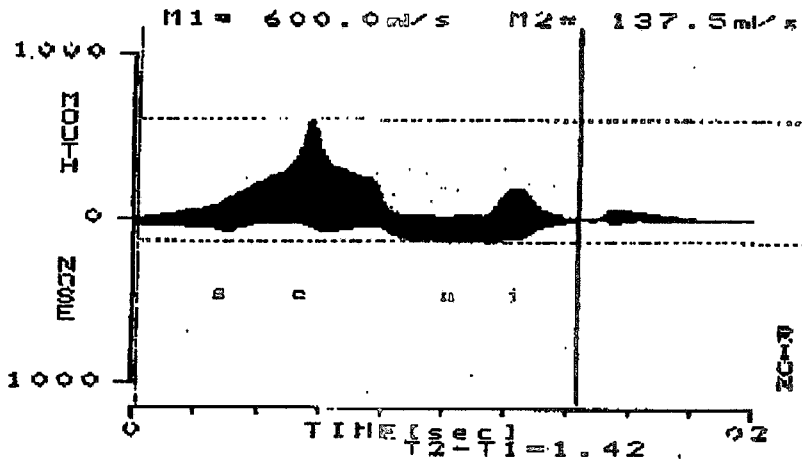


Fig. 5 . Mouth-nose airflow of FNG:
se-ni “せに” (背に) [seni] by M. Tsuzuki

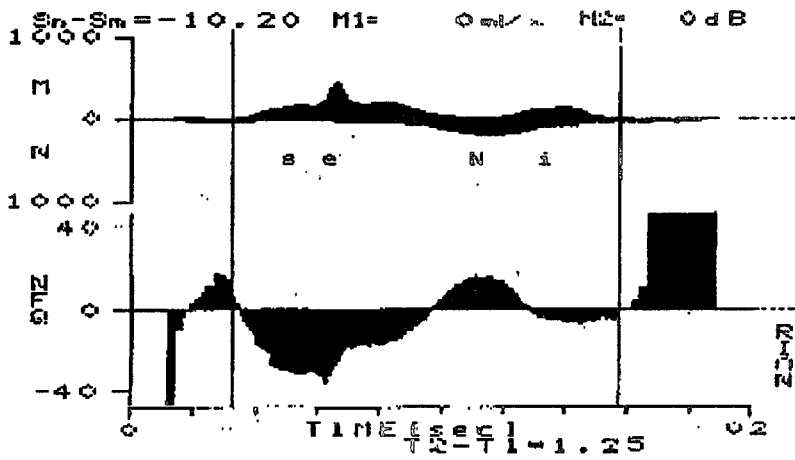


Fig. 6 . Ratio of mouth-nose airflow of NFQ:
sen-i “せんい” (線維) [seni] by M. Tsuzuki

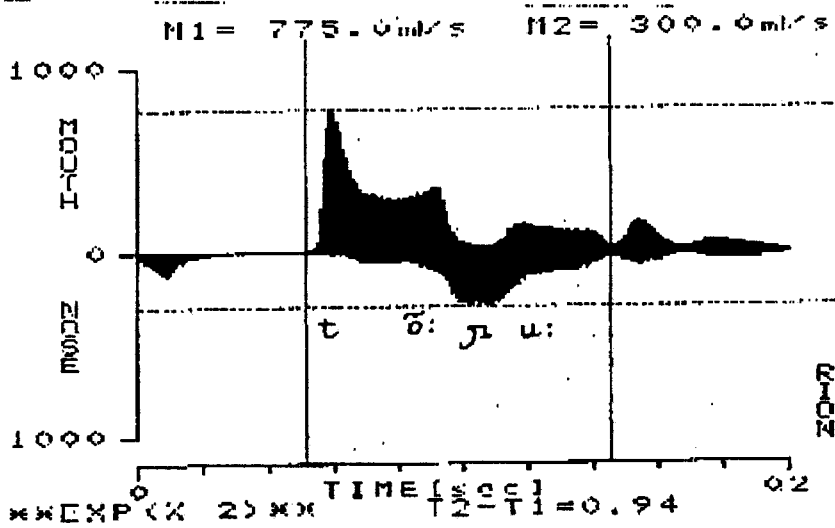
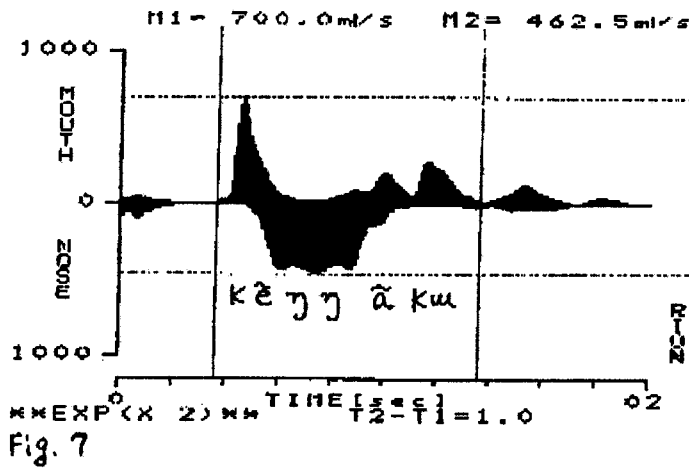


Fig. 8 Mouth-nose airflow of PNG:
 tanyu "とーにゆー"
 [to:ju:] by M. Tsuzuki

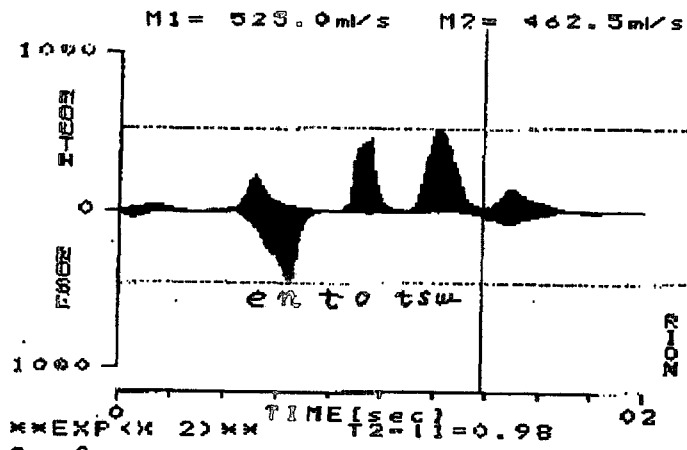


Fig. 9.

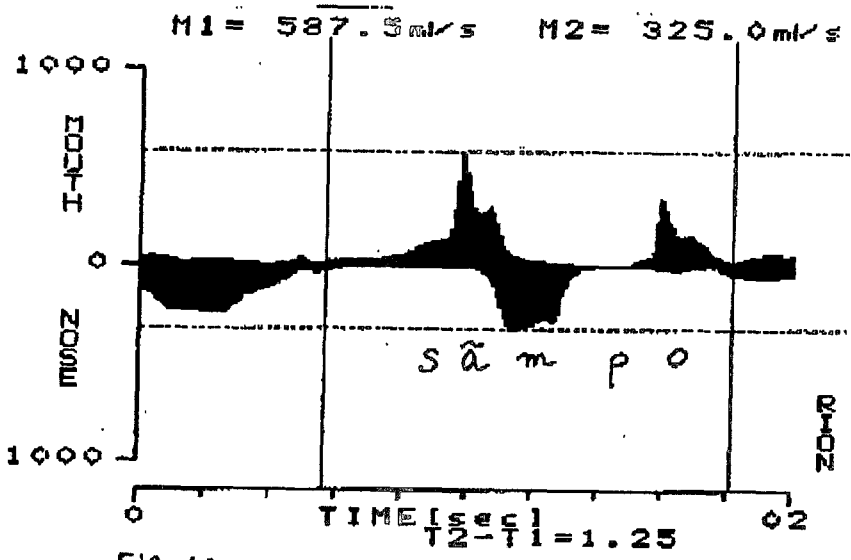


Fig. 10.

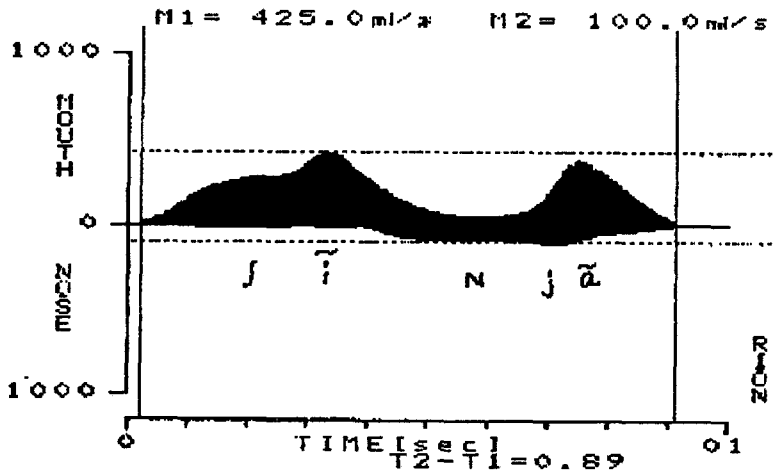


Fig.11. Mouth-nose airflow of FNG:
shinya "しんや" [ʃinja] by Masaki Tsuzuki

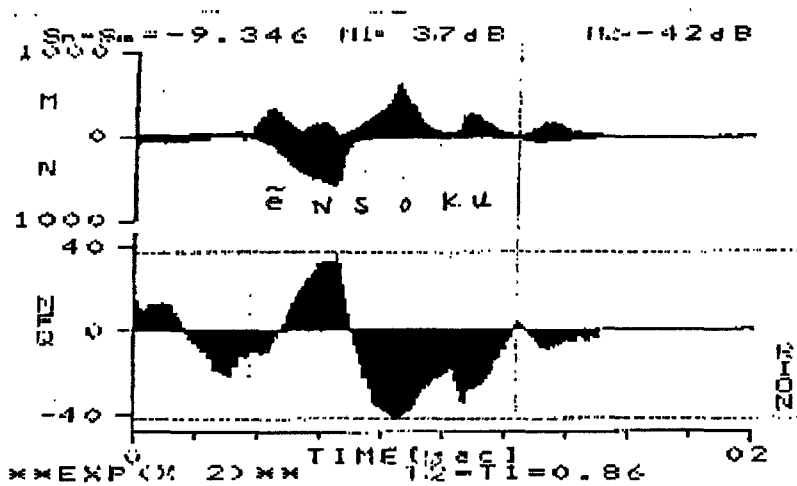


Fig.12 Mouth-nose airflow of FNG:
Ratio of Mouth-nose airflow of NIQ
ensoku "えんそく" [ɛnsoku] by M. Tsuzuki