

PALATOGRAPHIC OBSERVATION OF VCV ARTICULATIONS
IN JAPANESE *

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The use of a thin artificial palate embedded with electrodes has been reported on elsewhere, together with some computer-processed articulatory data (Fujimura;1973, Miyawaki;1972, Tatsumi;1972). This work has been continued at the University of Tokyo, Research Institute of Logopedics and Phoniatrics, and we would like to discuss one aspect of consonant-vowel interactions within the syllable, the problem of consonant palatalization.

It is generally recognized that, in Japanese, consonants become 'palatalized' when followed by a high frong vowel /i/ or by a glide /j/. Thus the phonemic sequence /si/ will be pronounced as [i] rather than [si], and /ni/ as [i] rather than [ni]. The phonemic sequences /sjo/, /nju/, etc.,

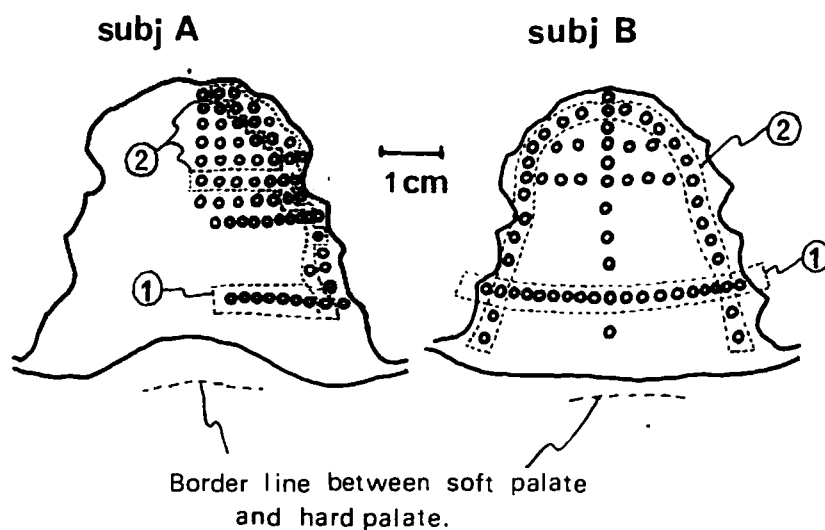


FIG. 1 ARTIFICIAL PALATES FOR SUBJECT A AND SUBJECT B. THE TWO GROUPS OF ELECTRODES, LABELLED ① AND ②, ARE USEFUL IN QUANTIFYING THE MIDDLE-PERIPHERAL AND THE FRONT-BACK MOVEMENTS OF THE OUTLINE OF THE PALATO-LINGUAL CONTACT AREA, RESPECTIVELY.

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are similarly pronounced with palatalization. What is this so-called palatalization in Japanese? Can it be considered as a straightforward articulatory assimilation of the consonant to the following vowel /i/ or the glide /j/, so that this so-called allophonic variation can be treated as a kind of smoothing in the time domain? This is the topic of this study.

The speech material to be discussed here consists of disyllabic nonsense words, embedded in a carrier sentence, which were spoken by two native speakers of the Tokyo dialect. These samples were drawn from a larger body of data which was obtained by having the subjects utter a randomized series of similar sentences containing a wide range of consonants as well as vowels.

The artificial palates, which were specifically designed for this study, are embedded with 63 electrodes as shown in Figure 1. Two groups of electrodes, labelled 1 and 2, are distributed as shown, for each of the two subjects A and B. These two arrays of electrodes are useful in quantifying the front-back and the middle-peripheral movements of the outline of the palato-lingual contact area. The rest of the electrodes are placed in the anterior half of the palate, in order to observe the tongue tip/blade articulations that characterize the lingual consonants under study.

Figure 2 shows typical contact patterns at the moment of maximum contact for /i/ and /j/ in the utterances /ui/ and /uju/ respectively. The filled circles represent on-electrodes, i. e., the electrodes showing the tongue contact, and the open circles off-electrodes, i. e., those showing no contact. The /j/-patterns, to the right, are characteristically different from the /i/-patterns, to the left. The contact boundary forms a C-shape for /j/, but a more sharply cornered rectangular shape for /i/.

In Fig. 3 we see the articulatory movements in terms of the number of on-electrodes in the two selected groups of electrodes. The forward spread of contact along the edge is plotted along the ordinate, against the abscissa which represents the extent of the spread toward the midsagittal line in the posterior region. Here we compare the temporal change in the state of contact for /ui/ with that for /iu/ and /uju/. The entire stretch of curve starts at the moment the contact for /u/ appears, and ends at the moment the maximum contact for /i/ or /j/ is achieved. For /iu/, in the middle, the curve runs in the other direction in time. The trajectories for four utterance samples are superimposed on each other for each of the utterance types. For comparison, the average of the leftmost curves, i. e., for /ui/, is represented by a broken line and is plotted on the other two displays. The open circle represents the moment of maximum contact in this average trajectory for /ui/, and the filled circles represent the corresponding state of contact of /i/ and /j/ in the /ui/ and /uju/, respectively. As shown in the figure, the trajectories for the vowel sequences /ui/ and /iu/ are very similar. The change of state takes place in the opposite direction in time, but the trajectories discussed here are almost identical. In contrast, the difference between the trajectories is clear when we compare /ui/ (at the left) with the first part of /uju/ (at the right). The peripheral contact in the anterior portion extends further forwards for /j/ than for /i/ and this /j/-pattern does not appear at any stage in the time course of /u/→/i/ transition. This should mean that /i/ and /j/ are inherently different in the lingual gestures employed. Considering also the actual shapes of the contact area, as we saw in Fig. 3, there seems to be a characteristic 'bulging' of the tongue

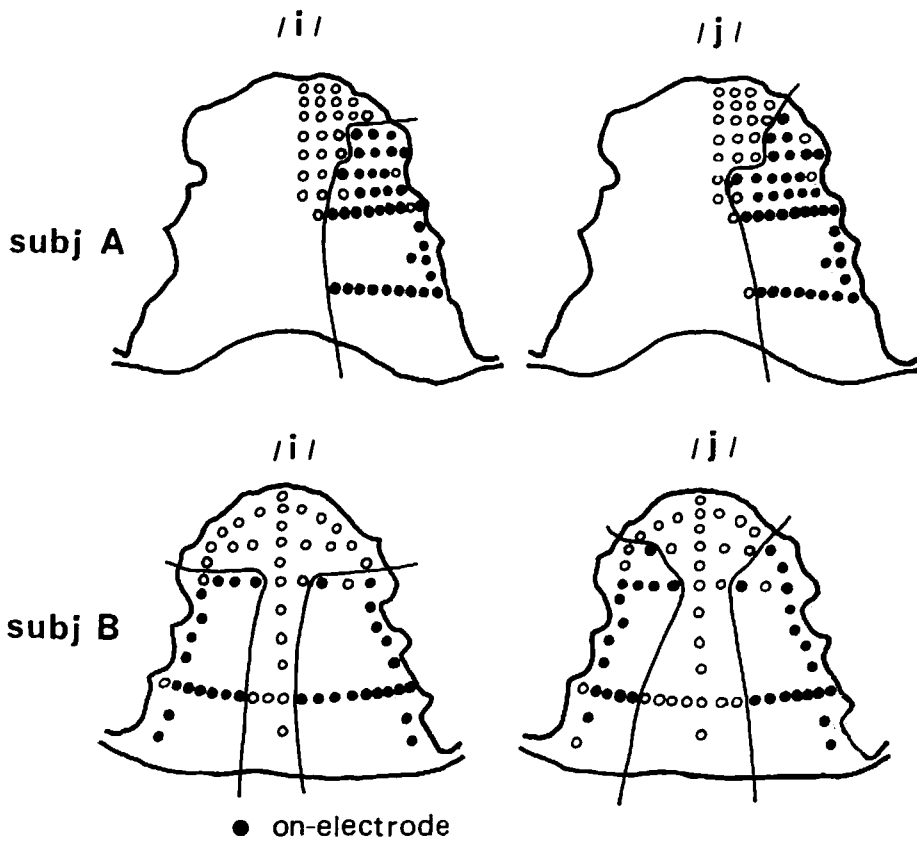


FIG. 2 TYPICAL CONTACT PATTERNS AT THE MOMENT OF MAXIMUM CONTACT FOR /i/ AND /j/ IN T THE UTTERANCES /ui/ AND /uju/, RESPECTIVELY.

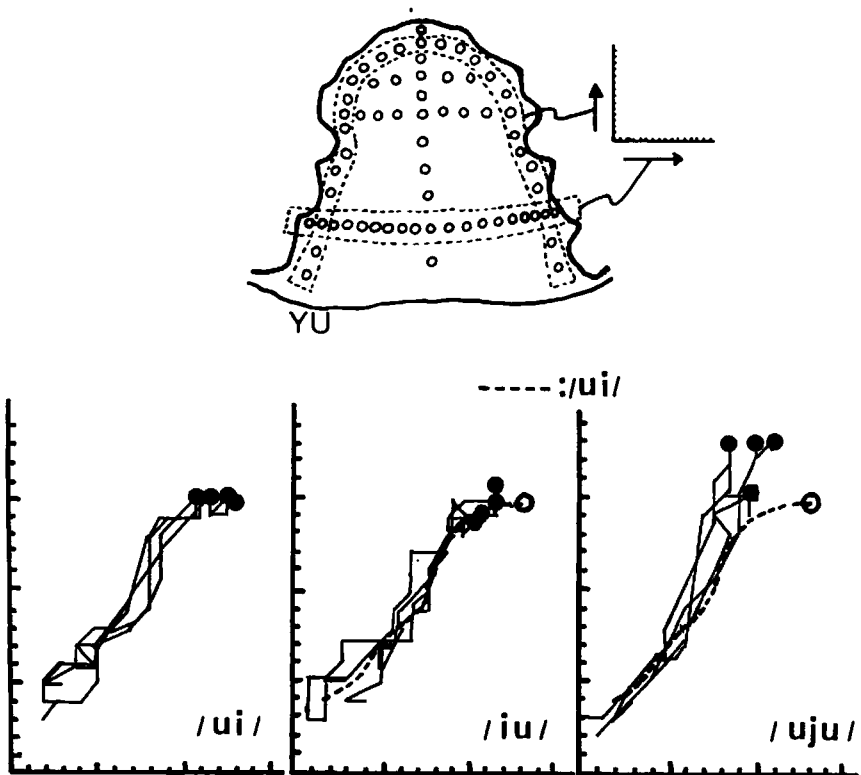
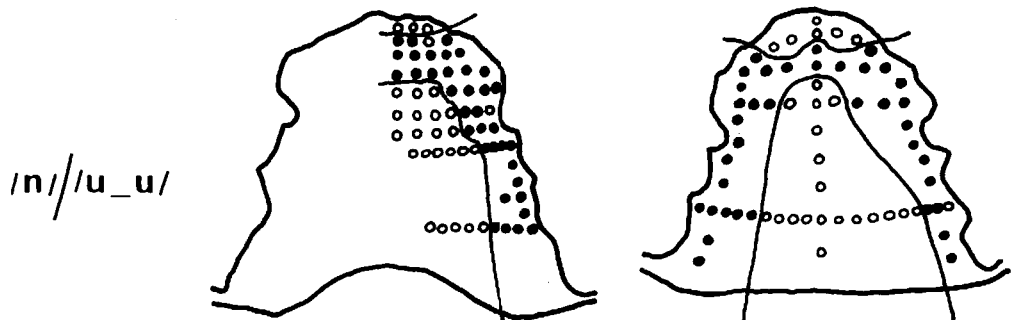


FIG. 3 THE TEMPORAL CHANGE IN THE STATE OF CONTACT FOR /ui/, /iu/ AND /uju/ IN TERMS OF THE NUMBER OF ON-ELECTRODES IN THE TWO SELECTED REGIONS ON THE ARTIFICIAL PALATE. (SEE TEXT FOR DETAILS.)

non-palatalized



palatalized

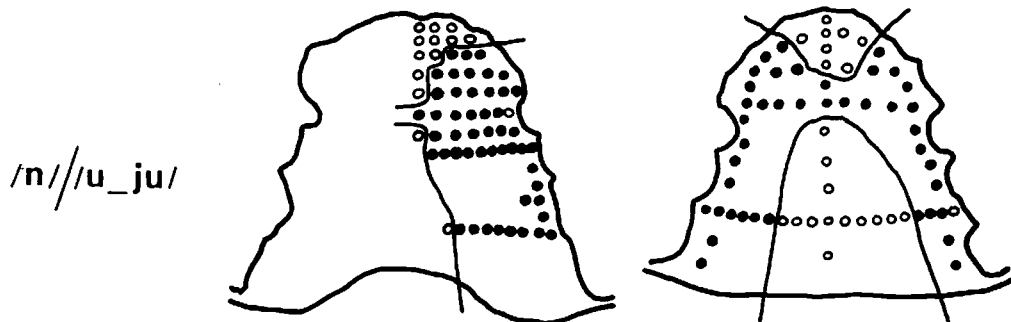
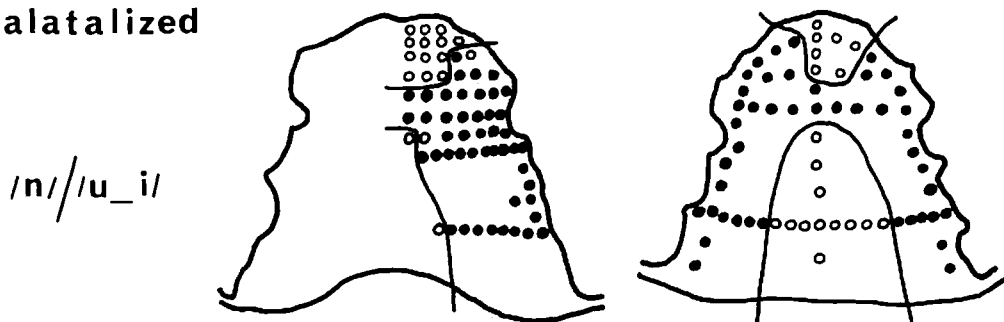


FIG. 4 TYPICAL CONTACT PATTERNS OF */n/* AT THE MIDDLE OF THE */n/*-CLOSURE IN VARIOUS CONTEXTS.

specifically towards the mid-anterior portion of the hard palate for /j/, that is not found in the case of the vowel /i/.

Let us now examine the dental nasal consonant. Fig. 4 shows typical contact patterns of /n/ at the middle of the /n/-closure in various contexts. When we compare contact patterns for the two /n/'s in /unu/ and in /unju/, the latter (the patterns at bottom) show more contact towards the top of the mouth roof, forming a complete closure in a relatively posterior part of the palate, in comparison with /unu/ (the patterns at top). Also, for the /n/ in /unju/, the electrodes in the foremost part of the palate maintain off-contact. This backward shift of the point of articulation, which amounts to approximately 8 mm on the surface of the palate, accompanied by a sort of 'recession' of contact towards the edge of the palate in the posterior region, characterizes the effect of /j/ when it is superimposed on the lingual gesture for the consonant /n/. This characterization conforms with the traditional phonetic notion of palatalization.

In /uni/, the next to bottom pattern, /n/ is distinctly different from the /n/ in /inu/, the next to top, in that the /n/ in /uni/ characteristically shows the backward shift of the closure, just as in the case of /unju/. This shift in the point of articulation is not observed in the case of /inu/ at any time during the closure period. It must also be noted that, as in the case of /unju/, the contact in the posterior region 'recedes' towards the edge of the palate when /n/ is palatalized (compare the second-from-top pattern with the third and the lowest, particularly for subject B (to the right)).

Figure 5 shows the shift of the point of articulation more clearly. There are four samples for each of the different contexts for /n/. The circles connected by lines indicate the range of contact area within the mid-sagittal line of the palate, the top position (number 1) being the frontmost electrode. This figure indicates that there are two distinct categories of the phonetic versions of /n/, in this respect, one for that followed by /u/ (non-palatalized) and another for that followed by either /j/ or /i/ (palatalized).

It seems appropriate to conclude that when we have a sound sequence of the type /n/ + /i/, there characteristically appears the above-mentioned /j/-like effect that results in an overall increase in contact, especially in the anterior half of the palate, and a backward shift of the place of articulatory closure, accompanied by a sort of evacuation of contact both in the frontmost and posterior regions near the mid-sagittal line. The characteristic gesture for /j/ in the full form does not seem to characterize the vowel /i/ itself, as we have seen before by comparing /ui/ with /uju/, but nevertheless a dental consonant shows this effect when it is followed by /i/. Thus the palatalization of consonants in Japanese is not simply a copying effect of the tautosyllabic vowel features. This point, which has important linguistic implications, will have to be examined more closely and widely in future studies by combining more of the available observational techniques, including X-rays and electromyography. These additional studies are in preparation.

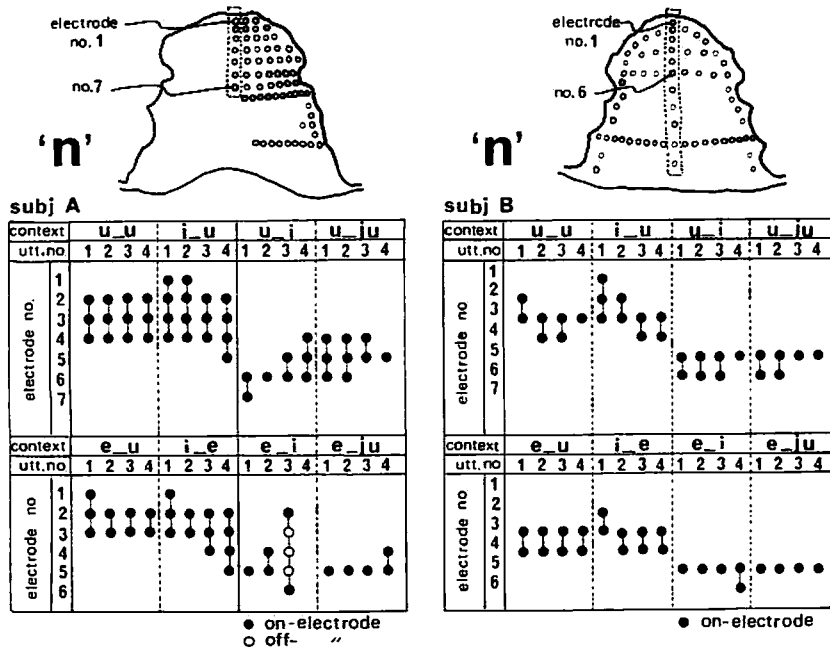


FIG. 5 PLACE OF ARTICULATION FOR /n/ IN VARIOUS CONTEXTS.
(SEE TEXT FOR DETAILS.)

References

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