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JAPANESE IOTAZISM AND ARTICULATORY ACQUISITION*

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Abstract

Schane (1971) has argued for the necessity of a non-autonomous phonemic level within generative phonology based partly on historical evidence from palatalization in Japanese. Japanese iotazism--an articulation disorder involving only the initial segment(s) of syllables of the form C/i/...or (C) /y/ non-/i/ V...--offers an interesting piece of evidence for both Schane's analysis of the historical facts of palatalization in Japanese and his claims in support of a nonautonomous phonemic level. Japanese iotazism also poses significant questions for neurolinguistic theory in general; in particular, such a theory must provide a systematic framework in which different phonological levels can be separately--but inter-dependently--represented in the brain.

Schane's (1971) analysis of Japanese palatalization

The arguments of Halle (1959), Chomsky (1964), Postal (1968) and others against an autonomous phonemic level of description in linguistic theory--as advocated by taxonomic linguists--have been widely accepted. In place of such a level, generative phonology posits a more abstract, "systematic phonemic," level of description related to the phonetic level via rules with no intervening levels of significance for linguistic explanation. Thus, generative phonology--as typified by the works cited above--not only argues against the autonomous character of taxonomic phonemics but also against the necessity for any level of phonological description below the phonetic level other than a systematic phonemic one.

Schane (1971, 1973) basically accepts the arguments against an autonomous phonemic level. However, his position is that an intervening, nonautonomous level of phonological description is necessary to explain certain phenomena and that this intervening level largely corresponds to a phonemic one which "is deducible from the function of the rules within a generative phonology" (1971, p. 503). In his 1971 paper, Schane presents evidence from several languages for his position, but here I will only be concerned with his analysis of Japanese palatalization in relation to the debate over a phonemic level of phonological description.

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* In this paper I will use mostly the transcription of Japanese sounds adopted throughout the larger part of McCawley (1968, see pp. 6ff. and 75ff.)-- a slightly modified version of the Bloch-Jorden romanization--since I will be relying on his work for my phonological analysis of Japanese. Where necessary I will use IPA symbols in square brackets for phonetic descriptions.

Schane (ibid., p. 509) begins by noting that in the Tokyo five-vowel system plain and palatalized consonants contrast (at some level, depending on the analysis of the underlying representations) before /a o u/. This remains true even if we analyze the palatalized consonants which occur before the non-front vowels as resulting from underlying sequences of plain consonant and semivowel /y/, as in McCawley (1968). For the front vowels, only plain consonants appear (phonetically or in underlying representations) before /e/, and only palatalized ones occur (phonetically) before /i/. (These remarks do not always apply to non-Chinese loanwords in Japanese.) Thus, plain and palatalized consonants are in complementary distribution before the Japanese front vowels.

Now, Tokyo Japanese at one time had only palatalized consonants before both /e/ and /i/ at the surface level. Historically, the palatalization before /e/ was allowed to disappear because--according to Schane's hypothesis--palatalized consonants before /e/ were not involved in any surface contrasts with plain consonants since the latter could not occur before /e/. The palatalized consonants before non-front vowels--however derived--were involved in surface contrasts with the plain consonants which could appear in the same environments. This situation is shown in Table 1 below. Schane (ibid., pp. 503-504) claims that this low level of surface contrasts which determines whether certain historical processes--such as depalatalization--occur or not is basically equivalent to that of taxonomic phonemics. However, it would seem that, by Schane's own reasoning, the consonants before /i/ should also have been expected to undergo depalatalization. The way Schane gets out of this apparent counterexample results in an even stronger argument for his claim regarding the necessity of an approximately phonemic level in explaining some phonological phenomena.

Table I

Palatalized and corresponding plain consonants before each of the five Japanese vowels before 1600 and now

Tokyo front vowels and palatalized consonants before 1600	The same syllables in modern Tokyo Japanese and the corresponding underlying forms (McCawley's (1968) analysis)	Surface and underlying forms of Tokyo non-front vowels with palatalized (L) and plain consonants (R) both before 1600 and now
[dʒi]	[dʒi] /zi/	[dʒu] /zyu/* | [zu] /zu/
[tʃi]	[tʃi] /ti/	[tʃu] /tyu/ | [tsu] /tu/
[ʃi]	[ʃi] /si/	[ʃu] /syu/ | [su] /su/
		[dʒo] /zyo/ | [zo] /zo/
		[tʃo] /tyo/ | [to] /to/
[dʒe]	[ze] /ze/	[ʃo] /syo/ | [so] /so/
[tʃe]	[te] /te/	[dʒa] /zya/ | [za] /za/
[ʃe]	[se] /se/	[tʃa] /tya/ | [ta] /ta/
		[ʃa] /sya/ | [sa] /sa/

* Note that sequences of initial consonants other than those shown above followed by an underlying /y/ are phonetically realized as C[j] sequences.

Basically, what prevented depalatalization before /i/ was--according to Schane--the fact that both front and non-front high vowels devoice and delete in certain environments, giving rise to a surface level contrast between palatalized consonants derived from underlying representations with /i/ and nonpalatalized consonants from underlying representations with /u/. The palatalized consonants remaining after deletion of /u/ pose no problem for this analysis since they are kept distinct at the phonetic level from both of the former types by a retained labialization acquired from the underlying /u/. Thus, at the level of phonological description occurring after vowel deletion, palatalized consonants, palatalized consonants with labial articulation and plain consonants are involved in a three-way contrast. And the failure of consonants to depalatalize before /i/ in the history of Japanese is an exception which actually strengthens Schane's claims for the necessity of an intermediate level of phonological description which can capture such surface contrasts.

Schane's arguments outlined above deal with the occurrence or non-occurrence of historical processes as conditioned by the existence or non-existence of certain surface contrasts in the sound system of Japanese. Smith (1973) has also argued for the necessity of a phonemic level of description within generative phonology for the purpose of explaining certain phenomena in the child's acquisition of a sound system. Considering these two references together naturally leads to a question about the role played in the ontogenetic development of language by the kinds of surface contrast discussed by Schane.

Japanese iotazism

Assuming McCawley's (1968 , pp. 75-77) analysis of palatalized consonants in Japanese as underlying sequences of plain consonants followed by the glide /y/, we can begin to characterize iotazism as involving only syllables of the form C/i/... or (C) /y/ non-/i/ V... . The two preceding notations signify, respectively, "any of the Japanese consonants followed immediately by the vowel /i/, which in turn may or may not be followed by any of a restricted set of segments" and "the semivowel /y/--which may or may not be preceded by a consonant--followed by a non-/i/ vowel (/u/, /o/ or /a/), which in turn may or may not be followed by any of a restricted set of segments." The primary manifestation of this disorder is a problem with the articulation of the initial C or (C)/y/ of such sequences. Syllables of the form C/i/...include instances of /i/ preceded by a constriction of the glottis as noted in McCawley (ibid., p. 67). McCawley (loc. cit.) notes that "not all 'mora-initial' vowels are preceded by a glottal constriction: specifically, the second mora of a dipthong or long vowel is not preceded by glottal constriction." Although I am not in a position to make any definitive statements, from the data available, it would seem that these instances of /i/ not preceded by a glottal constriction are not subject to the articulation problem being discussed here.

As far as I know, the term "iotazism"--for the Japanese 「ラ 列 構音 障害」-was first used by Furuya and Fujita (1956) in a discussion of two male patients in late adolescence. According to Furuya and Fujita, one of their patients had no organic defects, auditory discrimination problems or other language or speech impairments. In this, this one patient resembles the children who make up our data. Because of this lack of organic and

other defects--and because of the nature of the articulation errors to be discussed below--Japanese iotazism falls into the category of "functional articulation disorders" as defined in Carrell (1968, p. 12).

Our own data derive from tests administered to children entering Ōmiya Elementary School in Saitama Ken. The great majority of the children so tested were either six or seven years of age. These tests administered to entering children at Ōmiya since 1974 have resulted in the incidences of iotazism cases shown in Table II below.

Table II

Incidences of iotazism cases among children entering Ōmiya Elementary School since 1974

Year	Total no. of entering students	Boys	Girls	Total no. of iotazism cases	Boys	Girls
1974	6, 017	3105	2912	8	5	3
1975	6, 126	3172	2954	7	5	2
1976	6, 440	3259	3181	7	5	2
1977	6, 763	3503	3260	8	6	2
1978	7, 030	3513	3517	11	7	4
Totals:	32, 376	16, 552	15, 824	41	28	13

From Table II, we can see that the yearly incidence of iotazism cases at Ōmiya is well under 1% of the entering population, but that the number of cases occurring from year to year is fairly consistent. Only the totals in Table III show a statistical significance ($p < .05$) for the difference between the number of iotazism cases among boys and girls. In this paper, I will not discuss why such a difference occurs; however, the consistently higher number of iotazism cases among boys from year to year seems to be in agreement with observations about the greater incidence of speech disorders among boys in general.

Of the total of 41 cases of iotazism from Ōmiya since 1974, we possess tape recordings and the results of a later articulation test for 25 children: 19 boys and 6 girls; 18 6-year-olds, 5 7-year-olds, 1 8-year-old, and 1 10-year-old. This lower number from the total of 41 represents the number of children who actually returned for therapy after the initial screening. In addition, we also possess records of the same articulation test for 4 children who visited the speech clinic of the hospital at the University of Tokyo: 2 boys and 2 girls; 2 5-year-olds, 1 7-year-old, and 1 8-year-old.

In the articulation test mentioned above, the examiner asked the children to repeat single-mora syllables. These syllables were made up of 101 of the possible combinations of Japanese segments--including all those of the forms uniquely involved in Japanese iotazism. The children were asked to repeat these isolated syllables several times in order to determine the consistency of their responses.

The syllables of the test corresponding to the forms C/i/...or (C)/y/ non-/i/V...are listed below in Table III. The number next to each of the syllables in Table III indicates the number of children--out of a possible 29 --having some problem with its articulation. Some of the children counted as exhibiting articulation problems for each of the syllables shown in Table III had consistent errors; i.e., they were unable to correctly articulate the syllable on any--or almost any--trial. Other children counted in Table III showed inconsistent errors. Furthermore, our tapes indicate that the childrens' performance varied slightly among the various times they were tested. But although the results in Table III are taken from a single testing they give a good idea of the relative frequency of errors for each syllable and of the fact that these types of syllables are clearly problematic.

Table III

48 syllables of the forms involved in iotazism on a test of articulation administered to 29 children with iotazism and the number of children having difficulty with each

Syllable	No. of children	Syl.	No.	Syl.	No.	Syl.	No.
ʔi	14	tyo	16	syu	18	ryo	25
ki	28	pi	5	syo	19	ni	22
gi	28	bi	5	zya	15	nya	17
kya	27	pya	5	zyu	14	nyu	16
kyu	26	pyu	4	zyo	14	nyo	17
kyo	26	pyo	4	hi	22	mi	5
gya	25	bya	4	hya	15	mya	5
gyu	25	byu	4	hyu	16	myu	4
gyo	26	byo	5	hyo	17	myo	6
ti	24	si	25	ri	29	ya	7
tya	16	zi	25	rya	26	yu	6
tyu	16	sya	21	ryu	26	yo	4

To be sure, some of the 29 children in our data exhibited some articulation problems with syllables other than those of the forms relating to iotazism. For example, 14 of the children showed some form of trouble with at least several of the syllables beginning with either /s/ or /z/ when these segments were not followed by either /i/ or /y/ (and were thus realized as [s] and [z], respectively), as is consistent with the language-independent difficulty these two segments pose for language acquisition (cf. Salus and Salus, 1974). Among these 14 children, the consonants of such syllables were subject to inappropriate palatalization, affrication, lateralization, interdental articulation and other distortions. Besides the trouble with these [+ strident] segments, the only other errors of any note

among the 29 children involved the syllables /ke/ and /ge/ (9 and 10 children, respectively) and /tu/ (15 children). Since the phonetic realization of /t/ before /u/ is [ʦ], I feel that the non-iotazism errors (except for those with /ke/ and /ge/) shown by the children in our data are due to the universal problems with [+ strident] segments noted above, and I will discuss the status of the problems with /ke/ and /ge/ in the next section. For now, I conclude that our data show a distinct and significant difficulty for the 29 children to articulate syllables of the form C/i/...or (C)/y/ non-/i/V..., whatever other articulation problems they may have.

Turning now to the types of errors made with the initial segment(s) of syllables of the form C/i/... or (C)/y/ non-/i/V..., our data contain three types of errors: distortions, omissions, and substitutions. As will be seen below, some of the substitutions could also be classified as omissions. In general, the vowels are not distorted in our data.

The most common type of distortion takes the form of a lateral lisp, as described by Carrell (1968, pp. 18-19). Such a distortion occurs in the data for the initial segments of most of the syllables shown in Table III and occurs both bilaterally and unilaterally. Other types of distortion include an inappropriate prolongation of the length of the initial segment of the syllables and the occasional nasalization of initial segments. For example, one child--with an articulation problem for the whole range of syllables beginning with /s/ and /z/, in addition to iotazism--produced a prolonged [s] for /sy/ sequences. What is interesting in this child's articulation is that she substituted [ʃ] and [ʤ] for plain [s] and [z]! Other children also showed the same kind of perplexing interchange, which is one of the possible characteristics of the so-called functional articulation disorders.

Errors of omission occurred most often in the case of syllables of the form (C)/y/ non-/i/V... . Sometimes the intervening glide of such syllables was omitted; at other times the initial consonant was dropped. (When /y/ was initial it was never omitted, although it was occasionally distorted.) For example, the sequences /rya/, /ryu/ and /ryo/ were articulated by one child as [ra], [ru] and [ro], respectively; another child articulated /rya/ and /ryu/ as [ja] and [ju], respectively.

Substitution errors are perhaps less frequent than the lateral distortions noted above but are still quite common in our data. For example, AK (male, age: 6) at one time articulated "hati" ("eight") as [haki], substituting [k] for the affricate [ʧ] which occurs for /t/ before /i/. Another child articulated the sequences /tya/, /tyu/ and /tyo/ as [ka], [ku] and [ko], respectively. Some other examples of substitutions in the data are listed below in Table IV.

Table IV

Some examples of substitution errors among 29 children with iotazism on a test of articulation

Target	Substitution(s)	Target	Substitution
/sy/ [ʃ]	[s]. [t]. [ç]	/gy/ [gj]	[ʤ]
/hy/ [çj]	[ʧ]	/zi/ [ʤi]	[zi]
/ky/ [kj]	[ʧ]	/zy/ [ʤ]	[g]

All of the sequences in Table IV were also articulated by the 29 children in our data with distortions rather than substitutions. Of course, the substitutions of [s] and [z] for /sy/ and /zy/, respectively, shown in Table IV could also be regarded as resulting from an omission of the underlying glide.

The therapists who have been working with the children at Ōmiya Elementary School with articulation disorders--including iotazism--have informed us that iotazism usually improves rather quickly with therapy and disappears completely by adolescence. This is in contrast with the cases reported in Furuya and Fujita (1956).

Some implications

To begin with, language-independent explanations of Japanese iotazism--i.e., explanations based solely on the characteristics of segments without special reference to the sound system of Japanese--are unattractive for three reasons: 1.) If iotazism were the result of simple combinatory difficulties of segments followed by /i/ or /y/ we would expect some of this coarticulation difficulty to result occasionally in distortion of the syllable's vowel. Such distortion does not, however, occur in our data. 2.) If iotazism were the result of a language-independent coarticulation difficulty, we would also expect a greater consistency of error types in place of the varied array of distortions and substitution errors of functional articulation disorders revealed in our data. 3.) Finally--but perhaps most importantly--according to Furuya and Fujita (1956, p. 1013) iotazism is unique to the Japanese language, which we would not expect if it were the result of a simple coarticulation problem since most languages have the segments /i/ and /y/. (I must stress, however, that I am uncertain as to whether or not any disorders resembling iotazism actually occur in other languages.)

In addition, I feel that evidence internal to the system of Japanese segments both affected and unaffected by iotazism argues against an explanation of iotazism on the basis of language-independent coarticulation factors. This will become clear by wading through some of the ebb and flow of the arguments related to claims regarding such coarticulation factors. To begin with, in Japanese, /k/ and /g/--not followed by /y/--are among the earlier consonants correctly articulated by children (see Murata, 1968, pp. 46-50). However, /ki/ and /gi/ are at the top of the errors list in Table III. I do not have any data on the acquisition order of consonant-vowel combinations in Japanese, but Jakobson (1968, pp. 46ff.) has noted that [i] is universally acquired quite early. Now, one might be tempted to claim that the backness of the velar stops in Japanese and the frontness of /i/ somehow combine to cause a coarticulation difficulty. (The trouble 9 of the children in our data have with /ke/ and /ge/, as noted in the preceding section, seems to support this claim.) But this claim is contradicted by the higher incidence of errors for /si/ and /zi/([ʃi] and [ʤi], respectively) shown in Table III than for sequences of /sy/ and /zy/ followed by a non-front vowel--since the frontness of palatalization should, according to the preceding claim, be more difficult to effect with the non-front vowels.

Still, one could claim that the crucial point about the difficulty with back-front sequences (such as /ki/) is the direction of the articulatory movement; in other words, sequences such as /sya/ ([ʃa] at the phonetic level) are not as difficult as /ki/ and /gi/ because it is somehow easier for the articulators to move from front to back.

However, this last dodge still leaves us without any explanation as to why /si/ and /zi/-- as front-front sequences--should be as difficult as /ki/ and /gi/ (again, please see Table III for the relevant error frequencies). At this, the dodger might say, "Ah, ah! But [ʃ] and [ʤ] [from underlying /s/ and /z/, respectively, before /i/] are [+ strident]!" (see p. 8 above). To this, I say that 15 of the children in our data had no particular difficulty with syllables composed of non-/i/ vowels preceded by either [s] or [z]--in spite of the fact that, universally, [s] and [z] are even more difficult for the child to articulate than [ʃ], [ʒ], [ʧ] or [ʤ] (see, for example, Ingram, 1976, pp. 26ff.; Salus and Salus, 1974, p. 155; and the references cited in these two works). In addition, both /ri/ and /ni/ (both front-front sequences) are high on the list of errors in Table III. Admittedly, Japanese /r/ may be difficult for children to articulate; and I do not want to deny that this difficulty specific to /r/ contributes to the fact that none of the 29 children in our data correctly articulated /ri/. However, of the 29 children, all but six could correctly articulate /r/ followed by any of the non-/i/ vowels of Japanese--including /e/! (Of the six who had trouble with /r/ followed by a non-/i/ vowel, only three had consistent problems with all of the /r/ sounds.)

And so it goes... Sticking to language-independent explanations of iotazism restricted to the nature of peripheral articulatory events leads eventually to separate explanations for individual segments which seem to run counter to each other in their basic assumptions. Of course, such a situation also misrepresents the essentially unified nature of the iotazism symptoms. According to the partial analysis of Japanese iotazism to be proposed below, the articulation of syllables of the form C/i/... or (C)/y/ non-/i/V... should be acquired relatively late--but not for purely language-independent reasons based on assumptions about coarticulation difficulties.

It is probably no coincidence that the environments which predict the articulation difficulties in iotazism are the same environments which create the palatalized consonants of Japanese at the phonetic level discussed by Schane (1971) with reference to surface contrast. A while back, McNeill (1966, p. 37) suggested that "specific transformations evolved in order to make acquisition of grammar possible at earlier ages." Although McNeill was referring to syntax, I see no reason why he would object to extending his remark to the evolution of sound systems as well. Making such an extension, we might suggest that one of the general tendencies affecting diachronic changes in the overall sound system of a language is for changes to occur which will facilitate acquisition. But as Martinet (1972) has noted, there is also an opposing tendency operative in the evolution of language: that which operates to increase communicative clarity. These two tendencies are certainly interdependent, since "ease of acquisition" also includes the ease with which the ability to effect communicative clarity is acquired. Now, the surface contrasts in which the palatalized consonants of Japanese are involved--as discussed by Schane--obviously function to maintain communicative clarity since they function to prevent

the neutralization of underlying distinctions at the phonetic level. However, the same surface contrasts also pose a potential source of confusion for the child since they are not isomorphic with the system of underlying contrasts. Thus, Japanese--a language with considerable homophony--retains a system of surface contrasts for the sake of cummunicative clarity but at the expense of language acquisition difficulty.

Now, it appears that iotazism is not a disorder of the underlying competence of the children discussed above since their comprehension performance exhibits no abnormalities. In keeping with the nature of functional articulation disorders, we have to say that the articulation problem in iotazism results from a difficulty in "getting at" the correct knowledge for templating the desired speech behavior. To explain the connection between the facts discussed in Schane (1971) and Japanese iotazism we need make only one, reasonable assumption: namely, that it is more difficult to establish new means of access to knowledge which is more difficult to acquire. (Apparently the means of access to knowledge for comprehension behavior are established in the course of the acquisition of the knowledge of the underlying forms of Japanese words.) With this assumption, Japanese iotazism becomes a piece of supporting evidence for Schane's arguments about the psychological importance of a roughly phonemic level of description in the sound system of a language and his assessment of the importance of this level in preventing the historical depalatalization of Japanese consonants before /i/.

Of course, the segments affected by the articulation difficulties in Japanese iotazism are more than those involved in the surface contrasts discussed by Schane. I feel that the reason for this is the fact that the environments creating palatalized consonants--the right-hand side of the rule(s) in generative phonology--are isomorphic with those predicting articulatory difficutly in iotazism. In other words, the segments which fit the requirements of the structural description (the left-hand side) of the palatalization rule(s), as well as those which do not, have to be learned by the child in the course of language acquisition--as well as the relevant structural changes for those which fit the structural description(s). All of this "negative and "positive" information must be represented in the brain on nearly the same level, which is the level of knowledge which must be accessed for the templating of articulation in the environments relevant to iotazism. In this connection, it is interesting to reconsider Table III. From this table it can be seen that three types of syllables stand out from the rest as causing many fewer articulation errors: those with either /p/, /b/, /m/ or /y/ in syllable initial position. It is very likely significant that these segments are the most easily eliminated from the structural description of the palatalization rule--/p/, /b/ and /m/ because of the "extra-dental" nature of their place of articulation, and /y/ because there is simply no segment before it to apply to the structural description. Again, if the "negative" knowledge that these segments do not meet the structural description for the palatalization rule is easier to acquire, it should be easier to access for articulation than the knowledge about the other segments involved in iotazism.

The fact that some children had difficulty with /ke/ and /ge/--as noted in the previous section--poses some problems for my analysis. It is possible that in the dialect spoken by the children in our data there is a

phonetic high, front glide occurring between instances of /k g/ and /e/. If so, this phonetic fact might make it difficult for some children to arrive at the corresponding underlying representations with no glide. In this case, the representation of the sequences /ke/ and /ge/ would occupy a level of knowledge near those involved in iotazism. In any case, the relatively small number of errors for /ke/ and /ge/ suggests a degree of acquisition difficulty closer to syllables with /p/, /b/, /m/ and /y/ as initial than to the other syllables in the iotazism paradigm.

The discussion above implies a hierarchical representation in the brain of knowledge regarding the sound system of a language which corresponds in some respects to different possible levels of phonological description. These levels of representation would make possible different types of generalizations about the sound structure of a language (cf. Smith, 1973, p. 190). The problem for neurolinguistic models is to provide an explanatory framework for the structure of such a representational system and its principles of operation in language behavior; the data from Japanese iotazism suggest that such levels may have a certain degree of operational independence. (For one such model, see Bisazza (in preparation).)

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