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A hierarchy of difficulties of English consonant clusters for Japanese students

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A HIERARCHY OF DIFFICULTIES OF

ENGLISH CONSONANT CLUSTERS

FOR JAPANESE STUDENTS

A Thesis

Presented to

the Faculty of the Department of Speech

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In Partial Fulfillment

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Master of Arts

by

Tsutomu Saito

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TABLE OF CONTENTS

CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

Among the various types of difficulties that students of a foreign language encounter, the most challenging ones seem to be those related to pronunciation. Phonetic difficulties have been frequently attributed to causes related to factors of non-linguistic nature, such as learning skills, cultural environment, ethnic background, and so forth. All these assumptions, of course, have never surpassed the stage of speculation and are irrelevant for linguistic description as well as for language education.

There is no doubt that the correct use of the sounds of a foreign language depends on the successful acquisition of new habits. The term "habit" in this particular case should be understood as adjustment to new linguistic behavior in order to carry out phonological rules that assign to sentences the correct pronunciation. The problem in the past has been that teachers of foreign languages have devoted too much time and effort to the development of the new habit without giving the student a reference frame other than simple imitation. The instructors, interested in readjusting the behavior of the students to the new linguistic situation, have neglected to explore the phonological structure of languages.

In order to arrive at an inventory of certain pronunciation difficulties that a speaker of Japanese may encounter in learning English, the phonological system of English and Japanese were focused phonotactically, for such an approach has been found by the writer appropriate to observe both phoneme- and sound arrangements, and therefore useful for formulating phonemic as well as phonetic hierarchies of difficulties. Furthermore, the phonotactic approach permits the observation of linguistic habits upon which the accurate pronunciation of a language depends. After several years of experience, the writer believes that endeavors to improve pronunciation should go beyond speculations about linguistic habits, and reach a reference frame, that is to say, a set of phonological rules, the function of which is to guide the student in the acquisition, perhaps also in the elimination, of various forms of linguistic behavior, in order to handle a foreign language as an efficient tool of communication.

I. THE PROBLEM

Statement of the problem. The purpose of this study was (1) the selection of consonant clusters of both English and Japanese; (2) the comparison and analysis of the clusters on the phonemic as well as phonetic level; and (3) the formulation of a hierarchy of difficulties encountered by the Japanese students in learning English consonant clusters.

Importance of the study. Although comparative anal-
ysis of the structures of English and Japanese has been made
both on the phonetic and phonemic levels, a contrastive
analysis on the phonotactic level between the two languages
has not been thoroughly accomplished. Especially, to the
best of this writer's knowledge, the formulation of the
hierarchy of difficulties of English consonant clusters for
the Japanese student has not yet been attempted. One pos-
sible approach to this problem could be from the statistical
standpoint. However, the writer believes that "comparative
phonotactics" between English and Japanese will lead to the
formalization of a theoretical hierarchy of difficulties of
consonant clusters.

II. DEFINITIONS OF TERMS USED

Phonotactics. A branch of phonemics which covers the
structural characteristics of phoneme sequences is called
phonotactics.[1] The term was first introduced in 1954 by
Robert P. Stockwell, who " . . . coined the term by analogy
with the term 'tactics' itself as originally proposed by
Bloomfield to refer to various arrangements at the syntactic

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[1]Archibald A. Hill, Introduction to Linguistic Struc-
tures: From Sound to Sentence in English (New York: Harcourt,
Brace & World, Inc., 1958), p. 68.

level."[2] In this paper the term "phonotactics" was used as the description of arrangement of phonological segments.

Intrasyllabic cluster and Intersyllabic cluster.
An intrasyllabic cluster is a consonant cluster which occurs within a syllable, e.g. [str-] as in street [strit]. An intersyllabic cluster is a cluster which occurs between syllables, e.g. [-s + tr-] as in mouse trap [maʊs + træp].

In spite of distributional differences of components between intrasyllabic and intersyllabic clusters, for practical purposes, it can be accepted that the sound components of these clusters are the result of similar processes of articulation.[3] Therefore, any existing difference of articulatory nature between these two types of clusters was excluded throughout this paper.

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[2]A personal letter from R. P. Stockwell in answering this writer's inquiry, May 16, 1968.

[3]Eugene T. McDonald, Articulation Testing and Treatment: A Sensory-Motor Approach (Pittsburgh: Stanwix House, Inc., 1964), pp. 117-8.

CHAPTER II

REVIEW OF THE LITERATURE

Phonological interference and contrastive structural analysis have been treated by many linguists from various points of view for more than twenty years; however, the following is a brief summary of only those works which are closely related to the present paper.

I. LITERATURE ON THE PHONOLOGICAL INTERFERENCE THEORY

The subject of interference in the process of learning a second language has been discussed in many books on general linguistics, under headings such as "speech mixture," "borrowing," "pidgin languages," "bilingualism," "foreign accents." However, the first book that approaches the subject at full length from the linguist's point of view is Languages in Contact: Findings and Problems, by Uriel Weinreich.[1] According to the author, if two or more languages are used alternately by the same person, those languages are said to be in contact;[2] wherever there is contact, there arise certain problems on various levels of the

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[1]Uriel Weinreich, Languages in Contact: Findings and Problems (New York: Publications of the Linguistic Circle of New York, NO. 1, 1953)

[2]Ibid., p. 1.

structure of a language. These problems are referred to as
interference phenomena by Weinreich.[3] He attempted to out-
line a model for the description of phonological inter-
ference in its various aspects. He defines phenomena of
interference as "those instances of deviation from the norms
of either language which occur in the speech of bilinguals
as a result of their familiarity with more than one language,
i.e. as a result of language contact."[4] According to the
author phonological interference arises when a bilingual
person realizes a phoneme of the secondary system with one
in the primary system, and in reproducing it, subjects it to
the phonetic rules of the primary language.[5] Weinreich con-
cludes that the problem of phonological interference concerns
the manner in which a speaker perceives and reproduces the
sounds of one language in terms of another.[6]

Weinreich draws up a contrastive description of two
languages in contact and shows the differences and similar-
ities between them. Since any difference in the structure
of the languages is a potential source of interference, this
contrastive description should enable the linguist to predict

[3]Ibid.

[4]Ibid.

[5]Ibid., p. 14.

[6]Ibid. p. 14

the linguistic behavior of bilingual persons.[7]

To explain the types of interference in phonemic systems, Weinreich compared the phonological systems of Romansh and Schwyzertütsh,[8] *(dialects of the eastern part of Switzerland)* and succeeded in establishing four different types of interference:

    (1) <u>Under-differentiation</u> of <u>phonemes</u> occurs when two sounds of the secondary system whose counterparts are not distinguished in the primary system are confused.[9]

An example for such a confusion can be observed between English and Japanese: the English phoneme $/z/$[10] and the cluster $/dz/$ are usually expressed by the Japanese speaker as $/z/$. The confusion becomes more prominent if it is taken into account that the Japanese $/z/$ has two allophones, namely, $[z]$ and $[dz]$.

$$\text{LII} \begin{Bmatrix} /z/ \\ /dz/ \end{Bmatrix} \longrightarrow \text{LI} \left\{ /z/ \quad \begin{bmatrix} [z] \\ [dz] \end{bmatrix} \right\}$$

Using actual words, this can be illustrated as follows:

$$\text{E} \begin{Bmatrix} /ka\underline{z}/ \\ /ka\underline{dz}/ \end{Bmatrix} \longrightarrow \text{J} \left\{ /kaze/ \quad \begin{bmatrix} [ka\underline{z}e] \\ [ka\underline{dz}e] \end{bmatrix} \right\}$$

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[7] Einar Haugen, "Review of <u>Languages</u> <u>in</u> <u>Contact:</u> <u>Findings</u> <u>and</u> <u>Problems</u> by Uriel Weinreich," <u>Language</u>, 30:381, 1954.

[8] Romansh and Schwyzertütsh are dialects of the eastern part of Switzerland.

[9] Weinreich, <u>op</u>. <u>cit</u>., p. 18.

[10] For phonetic and phonemic symbols, see Chapter III of this paper; for special symbols, such as / /, see Appendix.

(2) <u>Over-differentiation of phonemes</u> involves the imposition of phonemic distinctions from the primary system on the sounds of the secondary system, where they are not required.[11]

The speaker of English may be prone to establish unneeded differences in Japanese: e.g. in English /ǰ/ and /ž/ are two different phonemes, whereas in Japanese they become allophones of /ǰ/.

$$\text{LII} \left\{ /ǰ/ \begin{bmatrix} [dž] \\ [ž] \end{bmatrix} \right\} \longrightarrow \text{LI} \left\{ \begin{array}{c} /ǰ/ \\ /ž/ \end{array} \right\}$$

Using actual words, this can be illustrated as follows:

$$\text{J} \left\{ /ǰuu/ \begin{bmatrix} [džuu] \\ [žuu] \end{bmatrix} \right\} \longrightarrow \text{E} \left\{ \begin{array}{c} /pleǰə/ \\ /pležə/ \end{array} \right\}$$

(3) <u>Reinterpretation of distinctions</u> occurs when the bilingual distinguishes phonemes of the secondary system by features which in that system are merely concomitant or redundant, but which are relevant in his primary system.[12]

This phenomenon can be observed in Japanese: the Japanese speaking person reinterprets the difference in vowel length which in English is redundant. The minimal pair /hiyt/ vs. /hit/ is interpreted as /hiito/ vs. /hitto/.

E <u>heat</u> /hiyt/ ---→ J /hiito/

E <u>hit</u> /hit/ ---→ J /hitto/

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[11] Ibid.

[12] Ibid.

(4) Actual phone substitution, . . . applies to phonemes that are identically defined in two languages but whose normal pronunciation differs.[13]

This case can be observed in the substitution of the English phoneme /h/--this phoneme is identically defined in English as well as in Japanese--for an allophone [x] which is nonexistent in English; [x] is an allophone of the Japanese phoneme /h/ in the environment of __/i, y/.

LII /h/ --→ LI /h/ = [x] in env. __/i, y/

Using actual words, this can be illustrated as follows:

E /hiyt/ --→ J /hiito/ = [xiito]

It should be noted that Weinreich stressed that this classification was established not from the raw data directly, but from their phoneme analysis.[14] He maintained that the greater the difference between the systems, the greater are the potential areas of interference.

Referring to the same problem, Einar Haugen stressed the importance of information concerning allophones and distribution in a contrastive description. He stated that a list of phonemes is of little value in predicting interference unless it is accompanied by a rather complete

[13]Weinreich, op. cit., p. 19.

[14]Ibid.

statement of their distribution.[15]

Haugen established a general formula for the identification of allophones in the study of interference. A speaker of Spanish may substitute the final [n] of his own language for any of the following English sounds [-m], [-n], [-ŋ]. This particular case can be symbolized as follows:

$$E \left\{ \begin{matrix} -m \\ -n \\ -\eta \end{matrix} \right\} \longrightarrow S \left\{ -n \right\}$$

Haugen proposed the name <u>diaphonic</u> for this relationship, since it transcends the limits of a single linguistic system.[16] He also suggested the name <u>diaphone</u> for the identification of those sounds alien to the phonemic system of the language.[17] According to this formula, the three English sounds listed above would all be diaphones of Spanish /n/ in the final position.[18] Haugen's identification of sounds may be outlined as follows:[19]

(1) <u>Convergent</u> identification—two or more phonemes

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[15]Haugen, <u>op</u>. <u>cit</u>., p. 384.

[16]Einar Haugen, "Language Contact," <u>Proceedings of the VIII International Congress of Linguistics</u> (Oslo, 1958), p. 781.

[17]<u>Ibid</u>.

[18]<u>Ibid</u>.

[19]<u>Ibid</u>.

in one language are identified with one in another.

$$E \begin{Bmatrix} /1/ \\ /r/ \end{Bmatrix} \longrightarrow J \begin{Bmatrix} /r/ \end{Bmatrix} \quad \text{as in} \quad E \begin{Bmatrix} /layt/ \\ /rayt/ \end{Bmatrix} \longrightarrow J \begin{Bmatrix} /raito/ \end{Bmatrix}$$

(2) _Divergent_ identification--one phoneme is realized by more than one phoneme in the other language.

$$J \begin{Bmatrix} /a/ \end{Bmatrix} \longrightarrow E \begin{Bmatrix} /a/ \\ /æ/ \\ /ə/ \end{Bmatrix} \quad \text{as in} \quad J \begin{Bmatrix} /hatto/ \end{Bmatrix} \longrightarrow E \begin{Bmatrix} /hat/ \\ /hæt/ \\ /hət/ \end{Bmatrix}$$

(3) _Simple_ identification--the relation is one-to-one.

E /b/ ---> J /b/ as in E /bəs/ ---> J /basu/

A different approach to the same problem has been proposed by Robert Lado. According to him, procedures for the comparison and analysis of two sound systems may be presented in three steps: (1) linguistic analysis of sound systems, (2) comparison of sound systems, and (3) description of troublesome contrasts.[20]

The first step consists of making a linguistic description of the sound system of the language to be learned and a similar description of the language of the learner.[21]

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[20]Robert Lado, _Linguistics Across Cultures_ (Ann Arbor: The University of Michigan Press, 1957), p. 12.

[21]_Ibid._

The description of the sound systems should include relevant information of the phonetic features of the phonemes and their variants, as well as information of their destribution.[22]

The second step is to compare these descriptions of sound systems in order to see if (1) the native language has a phonetically similar phoneme to one in the language to be learned, (2) the variants of the phonemes are similar in both languages, and (3) the phonemes and their variants are similarly distributed.[23]

Robert Lado thinks that there is a hierarchy of difficulties in learning the sound system of a foreign language. The easiest sounds are those physically similar to those of the native language, structurally similar to them, and similarly distributed.[24] The hardest sounds, according to Lado, are those which do not occur in the native language, or which are structurally different, or which have a different distribution.[25]

William G. Moulton did not neglect the importance of phonetics in establishing a contrastive analysis of two

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[22]Ibid., p. 13.

[23]Ibid., p. 12.

[24]Ibid.

[25]Ibid.

languages.[26] In his contrastive analysis of American English and German, Moulton made a careful and systematic comparison of the sounds of these two languages in order to point out similarities and differences of sounds in both systems, and in this way, to predict the possible errors the student would make in his attempt to learn German. Moulton believes that such a comparison may help the teacher explain why the learner makes those errors, and only when the cause of those mistakes has been discovered will it be possible to design useful corrective exercises.[27]

Moulton grouped the errors made by American students of German in four major categories:[28]

A. Phonemic errors.

Use of the wrong phoneme caused by the phonological habits of his native tongue: e.g.

G /x/ —→ E/k/ as in G /naxt/ —→ E /nakt/

B. Phonetic errors.

Use of the wrong sound caused by the phonetic habits of his native tongue: e.g.

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[26]William G. Moulton, The Sounds of English and German (Chicago: The University of Chicago Press, 1962), p. 5.

[27]William G. Moulton, "Toward a Classification of Pronunciation Errors," Modern Language Journal, 40:101, 1962.

[28]Ibid., pp. 101-2.

G [R] (uvular)---→ E [r] (frictionless continuant)

as in

G [Rain]---→ E [rain]

C. Allophonic errors.

Use of the wrong allophone caused by the habits of selection already established in his native tongue: e.g.

G [-VtV-]---→ E [-VṭV-] (flap) as in

G [fa:tər]---→ E [fa:ṭər]

D. Distributional errors.

Use of the wrong phoneme caused by carrying over distributional habits of English into German: e.g.

G [ts-]---→ E [z-] as in

G [tsu:]---→ E [zu]

Robert P. Stockwell and J. Donald Bowen based the degree of difficulty to which the student of a foreign language is exposed on the phonemic distribution which leads the speaker to select the appropriate allophone.[29] According to Stockwell and Bowen, the principle involved in learning the use of an allophone in a foreign language is the same one on which the general process of learning is based, that is,

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[29]Robert P. Stockwell, and J. Donald Bowen, The Sounds of English and Spanish (Chicago: The University of Chicago Press, 1965), p. 9.

linguistic facts common to two different languages can be
easily transferred from one language to the other. For exam-
ple, the phonemes /m/, /n/, and /t/ in initial position may
precede a vowel both in English and in Spanish, in which case
there is, in Stockwell and Bowen's terminology, a "positive
transfer,"[30] and therefore the difficulty is minimal.

The degree of difficulty may increase when the same
phoneme in similar distribution is represented in the foreign
language by a given allophone which will never occur in the
source language. For example, the phoneme /d/ can be inter-
vocalic both in English and in Spanish, but it is represented
by two different allophones: e.g. the English word meadow
has an intervocalic /d/ which is represented by the allophone
[d]; on the other hand the same phoneme /d/ in the same dis-
tribution in Spanish is represented by the allophone [ð].
This situation is called by Stockwell and Bowen a "negative
transfer,"[31] which offers a greater degree of difficulty.

The maximum degree of difficulty, the "zero transfer"[32]
in the terminology of Stockwell and Bowen, may be observed
in such cases in which the learner has to face a phoneme
completely alien to his own language. The speaker tends to

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[30]Ibid.

[31]Ibid.

[32]Ibid.

select an acoustically similar sound to represent the alien
phoneme. Such is the case of the velar voiceless fricative
/x/ in Spanish. Wherever it occurs, the speaker of English
tends to substitute it with the glottal /h/, which may in
certain cases affect the identification of the word: e.g.
the word S/xamas/ becomes E/hamas/.

To test the accuracy of the predicted hierarchies of
difficulty based solely on theoretical basis, Eugène J.
Brière conducted an experiment using specifically prepared
materials in Arabic, French, and Vietnamese as target "lan-
guage."[33] The purpose of the experiment was to expose the
English speaking persons to a group of phonemes—twenty-four
in all—which would present specific learning difficulties,
and this would lead to formulate a hierarchy of difficulty.

From this study, Brière concluded that (1) phonemes of
the target language closely related to the phonemes of the
language spoken by the learner and represented by closely
related allophones offer a minor degree of difficulty, and
(2) prediction and statements about production of sounds based
exclusively on phonemic analysis is inadequate, because
descriptions and predictions about the acquisition of pro-
nunciation skills require information concerning articulatory

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[33]Eugène J. Brière, "An Investigation of Phonological
Interference," Language, 42:773-4, 1966.

features on the phonetic level.[34]

The foregoing review shows clearly that the analysis of phonological interference exclusively from the theoretical point of view is inadequate. The description and the classification of the degree of difficulty in acquiring linguistic habits require a careful analysis of the phonetic level based on articulatory facts.

In conclusion, the comparison of sound systems in order to formulate a hierarchy of difficulties should be based on the distributional structure of phonemes as well as a set of allophones that represent those phonemes in a given distribution, and finally, the various articulatory adjustments that convert those allophones into sound waves which make up the perceptible level of language.

II. LITERATURE ON COMPARATIVE PHONETICS AND PHONEMICS OF ENGLISH AND JAPANESE

A comparative analysis has been proposed by Masako Isshiki,[35] who based the comparison on (1) variants, i.e.

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[34]Ibid., p. 769.

[35]Masako Isshiki, "A Comparative Analysis of the English and the Japanese Consonant Phonemes," Onsei no Kenkyuu (Study of Sounds), 8:391-416, 1957.

allophones and free variants, (2) features, i.e. the point
and manner of articulation as well as voicing, and finally
(3) the distribution of variants. Although Isshiki's compar-
ative analysis does not offer the clarity expected in such
an endeavor, it at least points out the instances of diffi-
culty for Japanese learners of English, and suggests ways to
select materials which can guide the learners effectively.
In Isshiki's opinion, the comparison of consonant clusters
between Japanese and English requires a special attention
because of the limited consonant clusters in Japanese.

Several characteristic difficulties faced by students
in learning English have been extensively discussed by Franz
Giet, who at the same time has proposed ways to overcome
them.[36] Giet gathered informative materials from more than
1,700 Japanese college students using thirty minute test
interviews for this purpose.

In order to find the characteristic difficulties above
mentioned, Giet performed a careful analysis in four differ-
ent areas; namely, phonemic, allophonic, phonetic, and dis-
tributional. He concluded that a Japanese student would
find difficulties in pronouncing, for example, phonemes /v/,
/f/, /θ/, /ð/, /l/, /r/, because these do not exist in

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[36]Franz Giet, "The Typical Difficulties of a Japanese
Student in Pronouncing Foreign Sounds and How to Overcome
Them," Onsei no Kenkyuu (Study of Sounds), 9:189-203, 1961.

Japanese. He also concluded that the Japanese student would find difficulties in using the English allophone /h/ in the environment __/i, y/, because in this environment the Japanese student uses exclusively the sound [x]. Thirdly, he found modifications of sounds; e.g. English sound [š], which is characterized by lip-rounding, occurs in Japanese but without lip-rounding, which causes a different phonetic effect. Finally, he found that the Japanese student re-adjusts the pronunciation of certain English words by drop-ping a sound in a specific distribution: e.g. /w/ will never occur in the environment __/u/ in Japanese; therefore the English word woman [wumən] becomes [umən]. Giet also exam-ined the consonant clusters [ts], [dz], [tr], [dr], which he calls affricates, and he believes they offer a certain degree of difficulty to Japanese students of English.[37]

Giet did not try to formulate any hierarchy of diffi-culty, but did emphasize that the /n/ in the final position, e.g. in the word pen, or in the environment of /__ + frica-tive/, as in the word sense, is "the most difficult sound for the Japanese student."[38]

The details about various kinds of difficulties that Japanese students of English usually encounter have also been

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[37]Ibid., pp. 193-200.

[38]Ibid., p. 200.

discussed by Tsutomu Akamatsu, who attempted to formulate a hierarchy of difficulty based on the personal data obtained in his teaching English pronunciation to nearly three hundred students at a university in Tokyo.[39]

In Akamatsu's report, the hierarchy of difficulty was determined according to the techniques required to teach the particular consonant as well as the extent of drills required for a student to acquire it. To be more specific, the consonants of what he calls "the first-degree of difficulty" are those the production of which requires the students

> . . . to draw substantially not only on adequate descriptive explanations with the aid of diagrams showing the articulatory organs which participate in the formation of a consonant in question, but also on the tactile sensation in the oral cavity accompanying production of those consonants---the sensation which the students should commit to their tactual memory in such a manner that it may be actualized when subsequently called on to form those consonants.[40]

In treating the consonants of "the second-degree of difficulty," Akamatsu wrote:

> . . . the students' malpronunciation may be rectified through adequate diagrammatical descriptions of the articulation organs for the consonants in question hand in hand through the mimicry method.[41]

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[39]Tsutomu Akamatsu, "Some Observations in the Speech Clinic," Onsei no Kenkyuu (Study of Sounds), 11:31-60, 1965.

[40]Ibid., p. 35.

[41]Ibid.

Akamatsu's "first-degree-difficulty consonants" include [z], [r], [n], [tr], [dr], [dz], ([tr], [dr], and [dz] are treated as affricates); the "second-degree-difficulty consonants" are [p], [t], [k], [θ], [ð], [l].[42] According to Akamatsu [f], [v] and [š] are either nonexistent or obsolescent in present-day Japanese, and cause the students relatively minor trouble.[43] The remaining English consonants, [b], [d], [g], [s], [z], [h], [tš], [dž], [ts], [m], and [ŋ], are presumably fairly easy for the students because approximate counterparts exist in Japanese.

A comparison of the phonological systems of English and Japanese, including segmental and suprasegmental phonemes, has been made by Akira Ota.[44] In regard to segmental phonemes, Ota's opinion is that the comparison of phonemic inventories of the two languages alone is not enough; the distribution of phonemes, phonetic features--not only of distinctive function but also of phonetic nature--of phonemes, allophones and their distribution should also be considered.[45]

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[42]Ibid.

[43]Ibid., p. 34, also p. 37.

[44]Akira Ota, "Nichi-Eigo no Ontaikei no Hikaku (A Comparative Study of the Japanese and English Sound System)," Nichi-Eigo no Hikaku (Comparative Study of Japanese and English) (Tokyo: Kenkyuusha, 1965), pp. 3-40.

[45]Ibid., p. 21.

Ota's contrastive analysis of the phonological systems of English and Japanese shows not only these differences between the two languages, but also the possible problems that may arise in learning English because of the structural differences. For the presentation of the various problems Ota adopted Moulton's system of classification, namely, (A) Phonemic, (B) Phonetic, (C) Allophonic, and (D) Distributional.[46] Here is an illustration of Ota's treatment of some problems:[47]

A. <u>Phonemic</u>.

$$E \begin{Bmatrix} /\eth/ \\ /z/ \end{Bmatrix} \longrightarrow J \begin{Bmatrix} /z/ \end{Bmatrix} \quad \text{as in} \quad E \begin{Bmatrix} /say\eth/ \\ /sayz/ \end{Bmatrix} \longrightarrow J \begin{Bmatrix} /saizu/ \end{Bmatrix}$$

B. <u>Phonetic</u>.

E [n] $\longrightarrow$ J [ɲ] in env. __/i/ as in E [ni] $\longrightarrow$ J [ɲii]

C. <u>Allophonic</u>.

$$E \begin{Bmatrix} /zy/ \\ /\check{z}/ \end{Bmatrix} \longrightarrow J \begin{Bmatrix} [d\check{z}] \end{Bmatrix} \quad \text{in env.} \ \underline{\ \ }/uw/ \ \text{as in}$$

$$E \begin{Bmatrix} /zyuws/ \\ /\check{z}uws/ \end{Bmatrix} \longrightarrow J \begin{Bmatrix} [d\check{z}uus] \end{Bmatrix}$$

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[46] See pp. 13-14.

[47] Ota, <u>op. cit.</u>, pp. 28-32.

D. Distributional.

E /CC/ --→ J ∅ as in E /treyn/ --→ J /toreiN/

From the above outline Ota concludes that phonemically
speaking, there are no clusters in Japanese. This relevant
fact--interesting in comparing Japanese with English--will
be explained later in this paper.

~~Ota mentioned very briefly how difficult or easy the~~
perception and production of new or unfamiliar segments or
combination of them was for the Japanese student of English,
but did not attempt to formulate a hierarchy of difficulties
among them.

The difficulties that the Japanese student of English
usually encounters have been carefully discussed in articles
and books related with language education in Japan. The
structural differences between English and Japanese that
prevent the Japanese student of English from acquiring ac-
ceptable pronunciation have been constantly discussed, not
only by Japanese phoneticians but also by language experts
outside Japan. Although contrastive analysis of English
and Japanese has been performed both on the phonetic and
phonemic levels, no remarkable effort has been made to estab-
lish statistically a hierarchy of difficulties. Further-
more, a contrastive phonotactic analysis of Japanese and

English has not been thoroughly accomplished. It is the opinion of this writer that a contrastive analysis based on phonotactic facts can lead to formulate a logical hierarchy of difficulties which will guide the student in his endeavor to learn an accurate pronunciation of English.

CHAPTER III

SEGMENTAL PHONEMES OF ENGLISH AND JAPANESE

This chapter includes listings of vowel and consonant phonemes of English as well as of Japanese. Each phoneme is listed together with its allophones, with the exception of the vowel phonemes of English. Articulatory features of each allophone are indicated by various diacritical marks or by absence of them. Information related to articulatory features of an allophone is necessary whenever a Japanese student of English has to learn consonant clusters.

The present inventory is by no means exhaustive; several allophones—not pertinent to the present discussion—have been excluded.[1] However, information concerning the listed allophones, their distribution and articulation, necessary for a phonotactic contrast of English and Japanese, and for detecting the causes of difficulties in dealing with phonotactic system of English, are included in the inventory.

I. LIST OF ENGLISH PHONEMES AND ALLOPHONES

A. English Vowels and Vowel Nuclei.

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[1]For further information, see George L. Trager and Henry Lee Smith, *An Outline of English Structure* (Washington: American Council of Learned Societies, 1957), pp. 29-35, also p. 90.

All the English vowels and vowel nuclei needed in the present discussion are shown below. Articulatory features of each vowel which are not relevant to the present discussion have been excluded.

Phonemic symbols	Phonetic symbols	Key words
/iy/	[i]	beat
/i/	[ɪ]	bit
/ey/	[eɪ]	late
/e/	[ɛ]	bet
/æ/	[æ]	bat
/a/	[a]	father
/ɔ/	[ɔ]	bought
/ow/	[ou]	boat
/u/	[ʊ]	foot
/uw/	[u]	boot
/ə/	[ə]	above
/ay/	[aɪ]	bite
/aw/	[aʊ]	bout
/ɔy/	[ɔɪ]	voice

B. English Consonants.

/p/ the class of voiceless bilabial stops:

✓ [pʰ] aspirated /p/: in env. #__V́   pad

✓ [p˺] unreleased /p/: in env. __/p, b,
          t, d, k, g, č, ǰ/   lamppost

  [p̃] nasal plosion: in env. __/n, m/   topmost

✓ [p] unaspirated /p/: in env. /s/__V,
          and elsewhere   V́~V   spot

/b/ the class of voiced bilabial stops:

  [bʱ] aspirated /b/: in env. #__V́   bag

✓ [b˺] unreleased /b/: in env. __/p, b,
          t, d, k, g, č, ǰ/   obtain

  [b̃] nasal plosion: in env. __/n, m/   ribbon

✓ [b̥] devocalized /b/: in env. __#, __C̥   absurd

✓ [b] unaspirated /b/: elsewhere   rubber

/t/ the class of voiceless alveolar stops:

✓ [tʰ] aspirated /t/: in env. #__V́   take

✓ [t˺] unreleased /t/: in env. __/p, b,
          t, d, k, g, č, ǰ/   outpost

  [t̃] nasal plosion: in env. __/n, m/   cotton

  [t̫] lateral plosion: in env. __/l/   little

  [t̪] dental /t/: in env. __/θ, ð/   eighth

  [t̫] bilabialized /t/: in env. __/w/   between

[ṭ]   retracted /t/: in env. __/r/   tree

✓ [ṱ]   voiced /t/: ^(FlᴀP) in env. V́__V   water

✓ [t]   unaspirated /t/: in env. /s/__V,

            and elsewhere   stop

/d/   the class of voiced alveolar stops:

[dʱ]   aspirated /d/: in env. #__V́   day

✓ [d˺]   unreleased /d/: in env. __/p, b,

            t, d, k, g, č, ǰ/   bedtime

✓ [d̃]   nasal plosion: in env. __/n, m/   sudden

✓ [d̠]   lateral plosion: in env. __/l/   middle

✓ [d̪]   dental /d/: in env. __/θ, ð/   width

[d̥]   bilabialized /d/: in env. __/w/   dwell

[d̥]   retracted /d/: in env. __/r/   dry

✓ [d̥]   devocalized /d/: in env. __#, __C̥   road

✓ [d]   unaspirated /d/: elsewhere   leader

/k/   the class of voiceless velar stops:

✓   [kʰ]   aspirated /k/: in env. #__V́   come

✓   [k˺]   unreleased /k/: in env. __/p, b,

            t, d, k, g, č, ǰ/   picture

[k̃]   nasal plosion: in env. __/n, m/   acknowledge

[k̥]   bilabialized /k/: in env. __/w/   queen

✓ [k]   unaspirated /k/: in env. /s/__V,

            and elsewhere   skin

/g/ the class of voiced velar stops:

    [gʰ] aspirated /g/: in env. #__V̌   go

  ✓ [gˀ] unreleased /g/: in env. __/p, b,

        t, d, k, g, č, ǰ/   rugby

    [g̊] nasal plosion: in env. __/n, m/   ignore

    [g̊] bilabialized /g/: in env. __/w/   language

 ✓ [g̊] devocalized /g/: in env. __#, __Ç̥ dog

  ✓ [g] unaspirated /g/: elsewhere   eager

/f/ the class of voiceless labiodental fricatives:

    [f]   feet

/v/ the class of voiced labiodental fricatives:

  ✓ [v̥] devocalized /v/: in env. __#   leave

    [v] elsewhere   veal

/θ/ the class of voiceless interdental fricatives:

    [θ̠] retracted /θ/: in env. __/r/   three

    [θ] elsewhere   thick

/ð/ the class of voiced interdental fricatives:

    [ð̠] retracted /ð/: in env. __/r/   brethren

    [ð̥] devocalized /ð/: in env. __#   with

    [ð] elsewhere   brother

/s/ the class of voiceless alveolar fricatives:

    [s̊] bilabialized /s/: in env. __/w/   swear

  ✓ [s] elsewhere   sit

/z/ the class of voiced alveolar fricatives:

    [z̫]   bilabialized /z/: in env. __/w/   ·   Oswald

  ✓ [z̥]   devocalized /z/: in env. __#   buzz

   ✓[z]   elsewhere   easy

/š/ the class of voiceless alveopalatal fricatives:

  ✓ [š]   ·   sheet

/ž/ the class of voiced alveopalatal fricatives:

    [ž̥]   devocalized /ž/: in env. __#   rouge

  ✓ [ž]   elsewhere   pleasure

/h/ the class of voiceless glottal fricatives:

  ✓ [ɦ]   voiced glottal fricative: in env.

        V__V   behind

    [x]   prevelar fricative: in env. __/y/   human

  ✓ [h]   elsewhere   hen

/č/ the class of voiceless alveopalatal affricates:

  ✓ [tš] *Aspirated*   cheese

/ǰ/ the class of voiced alveopalatal affricates:

    [dž̥]   devocalized /ǰ/: in env. __#   judge

  ✓ [dž]   elsewhere   jest

/m/ the class of voiced bilabial nasals:

    [ɱ]   labio-dental /m/: in env. __/f, v/   comfort

  ✓[m̩]   syllabic /m/:·   rhythm

✓	[m̥]	devocalized /m/: in env. C̥__	smoke
✓	[m]	elsewhere	meal

/n/ the class of voiced alveolar nasals:

[n̪]	lateral plosion: in env. __/l/	tunnel
[n̪]	bilabialized /n/: in env. __/w/	unwanted
[n̪]	retracted /n/: in env. __/r/	Henry
✓ [n̩]	syllabic /n/:	cotton
[ɲ]	palatalized /n/: in env. __/y/	news
✓ [n̥]	devocalized /n/: in env. C̥__	snow
✓ [n]	elsewhere	net

/ŋ/ the class of voiced velar nasals:

[ŋ̩]	syllabic /ŋ/:	bacon
[ŋ̊]	devocalized /ŋ/: in env. __#, __C̥	distinct
✓ [ŋ]	elsewhere	singer

/l/ the class of voiced alveolar laterals:

[l̪]	bilabialized /l/: in env. __/w/	always
✓ [ɫ]	dark /l/: in env. __#, __C	full
✓ [l̩]	syllabic /l/:	middle
✓ [l̥]	devocalized /l/: in env. C̥__	plea
✓ [l]	elsewhere	late

/r/ the class of voiced frictionless continuant:

[ɹ]	fricative /r/: in env. /t, d/__	dress
[ɾ]	flapped /r/: in env. V__V	very

    [r̥]   devocalized /r/: in env. C̥___   <u>cream</u>

    [r]   elsewhere   <u>road</u>

/w/ the class of voiced bilabial semivowels:

    [w̥]   devocalized /w/: in env. C̥___   <u>queen</u>

    [w]   elsewhere   <u>wet</u>

(labial more imp. than velar)

/y/ the class of voiced alveopalatal semivowels:

    [y̥]   devocalized /y/: in env. C̥___   <u>cue</u>

    [y]   elsewhere   <u>yard</u>

/#/ the class of pauses:

    [#]   before all phonemes except /ŋ, ž/

II. LIST OF JAPANESE PHONEMES AND ALLOPHONES

A. Japanese Vowels.

/i/ the class of high front vowels:

    [I]   devocalized /i/: after /p, k, š, h, č/ and

           before /p, t, k, s, š, h, č/, in free variation with

           [i]. e.g. <u>kita</u> [kIta] 'north'

    [ĩ]   nasalized /i/: before or after /N/. e.g.

           <u>jishin</u> [džišĩɲ] 'earthquake'

    [i]   elsewhere. e.g. <u>ie</u> [ie] 'house'

/e/ the class of mid-front vowels:

[E]   devocalized /e/: in rapid speech, before /p, t, k/ and after /p, t, k/, in free variation with [e]. e.g. <u>tetenashigo</u> [tEtenašiŋo] 'orphan'

[ẽ]   nasalized /e/: before or after /N/. e.g. <u>enpitsu</u> [ẽm̥pIcu] 'pencil'

[e]   elsewhere. e.g. <u>e</u> [e] 'picture'

/a/ the class of low vowels:

[A]   devocalized /a/: in rapid speech, before /p, t, k/ and after /p, t, k/, in free variation with [a]. e.g. <u>takai</u> [tAkai] 'high'

[ã]   nasalized /a/: before or after /N/. e.g. <u>hanbun</u> [hãm̥bũn̥] 'half'

[a]   elsewhere. e.g. <u>asa</u> [asa] 'morning'

/o/ the class of mid-back vowels:

[O]   devocalized /o/: in rapid speech, before /p, t, k/ and after /p, t, k/, in free variation with [o]. e.g. <u>kokoro</u> [kOkoř o] 'heart'

[õ]   nasalized /o/: before or after /N/. e.g. <u>hon</u> [hõn̥] 'book'

[o]   elsewhere. e.g. <u>oka</u> [oka] 'hill'

/u/ the class of high back vowels:

[U]   devocalized /u/: after /p, t, k, s, š, h, č/ and before /p, t, k, s, š, h, č/, in free

variation with [u]. e.g. <u>kusa</u> [kUsa] 'grass'

[ũ]   nasalized /u/: before or after /N/. e.g.

      <u>bunka</u> [bũŋka] 'culture'

[u]   elsewhere. e.g. <u>ue</u> [ue] 'up'

B. Japanese Consonants.

/p/ the class of voiceless bilabial stops:

  [p̚]   unreleased syllabic /p/: before /p/. e.g.

       <u>ippai</u> [ip̚pai] 'one cup'

  [p]   before /i, e, a, o, u, y/. e.g. <u>pen</u> [pẽŋ]

      'pen'

/b/ the class of voiced bilabial stops:

  [b]   before /i, e, a, o, u, y/. e.g. <u>bin</u> [bĩŋ]

      'bottle'

/t/ the class of voiceless dental stops, or voiceless

  dental or denti-alveolar affricates:

  [t̪]   voiceless dental stop: before /e, a, o/. e.g.

      <u>te</u> [t̪e] 'hand'

  [t̪̚]   unreleased syllabic /t/: before [t̪]. e.g.

      <u>ittoo</u> [it̪̚t̪oo] 'one horse'

  [c]   voiceless dental or denti-alveolar affricate:

      before /u/. e.g. <u>tsuri</u> [cuři] 'fishing'

  [ç̚]   syllabic /t/: before [c]. e.g. <u>ittsuu</u>

      [iç̚cuu] 'one letter'

/d/   the class of voiced dental stops:

    [d]   before /e, a, o/. e.g. doko [dokɔ] 'where'

/k/   the class of voiceless velar stops:

    [k̚]   unreleased syllabic /k/: before /k/. e.g.

        kekka [kek̚ka] 'result'

    [k]   before /i, e, a, o, ʊ, y/. e.g. ki [ki]

        'tree'

/g/   the class of voiced velar stops:

    [g]   before /i, e, a, o, u, y/. e.g. gikei [gikee]

        'brother-in-law'

/s/   the class of voiceless fricatives:

    [ş]   syllabic /s/: before pause and /s/. e.g.

        issatsu [iṣsacu] 'one book'

    [s]   before vowels except /i/. e.g. san [sãŋ]

        'three'

/z/   the class of voiced alveolar fricatives:

    [z]   before vowels except /i/. e.g. kaze [kaze]

        'wind'

    [dz] alveolar affricate: before vowels except /i/,

        in free variation with [z]. e.g. kaze [kadze]

        'wind'

/š/   the class of voiceless alveopalatal fricatives:

[ş̩] syllabic /š/: before pause and /š/. e.g.

   zásshi [zaş̩ši] 'magazine'

[š] before vowels. e.g. shashin [šašĩɲ] 'picture'

/h/ the class of voiceless glottals, or bilabial fricatives, or prevelar fricatives:

   [ɦ] voiced glottal: between vowels. e.g. ohayoo

   [oɦayoo] 'good morning'

   [Φ] bilabial fricative: before /u/, in free variation with [h]. e.g. hurui [Φur̥ui] 'old'

   [x] prevelar fricative: before /i, y/. e.g. hi [xi] 'fire'

   [h] voiceless glottal: before /e, a, o, u/. e.g. henka [hẽŋka] 'change'

/č/ the class of voiceless alveopalatal affricates:

   [tš̩˺] unreleased syllabic /č/: before /č/. e.g. icchi [itš̩˺tši] 'agreement'

   [tš] before vowels. e.g. kuchi [kUtši] 'mouth'

/ǰ/ the class of voiced alveopalatal affricates or voiced prepalatal fricatives:

   [dž] voiced alveopalatal affricates: before vowels. e.g. jishin [džišĩɲ] 'earthquake'

   [ž] voiced alveopalatal fricative: before vowels, in free variation with [dž]. e.g. jishin [žišĩɲ] 'earthquake'

/m/ the class of bilabial nasals:

[m] before /i, e, a, o, u, y/. e.g. mimi [mimi]

'ear'

/n/ the class of dental nasals:

[n̪] before /e, a, o, u/. e.g. nashi˙ [na ši]

'pear'

[ɲ] voiced palatal nasal: before /i, y/. e.g.

gyuunyuu [gyuuɲuu] 'milk'

/ŋ/ the class of voiced velar nasals:

[ŋ] before /i, e, a, o, u, y/. e.g. kaigi [kaiŋi]

'conference'

/N/ the class of syllabic nasals:

[m̩] voiced bilabial syllabic /N/: before /p, b, m/.

e.g. konban [kõm̩bãɳ̩] 'this evening'

[n̪̩] voiced dental syllabic nasals: before /t, d, r,

z, n, č, ǰ/. e.g. minna [minna] 'everybody'

[ŋ̩] voiced velar syllabic nasal: before /k, g, ŋ/.

e.g. bunka [bũŋka] 'culture'

[ɴ̩] voiced velar half-nasal: before /e, a, i, o, u,

s, š, h, w, y/, and /#/. e.g. san [sãɴ̩]

'three'

/r/ the class of voiced flaps:

[ř] before /i, e, a, o, u, y/. e.g. roku [řoku]

'six'

/w/   the class of non-syllabic high back semivowels:

   [w]   after vowels, /N/, and /#/ and before /a/.

      e.g. wakai [wakai] 'young'

/y/   the class of non-syllabic high front semivowels:

   [y]   after vowels, and /p, b, k, g, h, m, n, ŋ, N, r/

      and before /a, o, u/. e.g. heya [heya] 'room'

/#/   the class of pauses:

   [#]   before all phonemes except /ŋ/, and after /i, e,

      a, o, u, N/. e.g. isu [#isu#] 'chair'

CHAPTER IV

THE STRUCTURE OF THE SYLLABLE IN
ENGLISH AND JAPANESE

Learners of a foreign language seem to have the tendency of transferring their habit of syllabic division of their own language into a foreign one, perhaps because in some languages the syllabic structure conditions the phonetic shape of the sentence, or perhaps because the concept of syllable varies from language to language. For example, when a Japanese speaks English, he divides the sentence into the segments that reflect the syllabic structure of his own language, but do not match the syllabic division of the English utterance. It is therefore necessary for comparative purposes to establish the differences of syllabic structures between English and Japanese.

The central part of an English syllable is a vocalic nucleus, simple or followed by a glide, sometimes linked to a consonant environment or sometimes not, as it can be observed in the following examples:

	Linked to consonant	Not linked to consonant
Vowel nucleus + glide	<u>bait</u> /beyt/	<u>I</u> /ay/
Vowel nucleus – glide	<u>bet</u> /bet/	<u>a</u> /ə/

In Japanese, on the other hand, the syllable must be defined in terms of relative duration: e.g. the words <u>Nippon</u> and <u>sayonara</u>, which present a noticeable difference between their segmental length, are uttered in the same amount of time.

In English, the consonant environment to which the vowel nucleus of a syllable is linked is a phonotactic arrangement, which prevents the Japanese student from interpreting properly the syllable sequence in English utterances.

I.   SYLLABIC COMPONENTS OF ENGLISH

A.   Vocalic Nucleus and Consonant Environment.

As it was stated in the preceding section, the present paper is not concerned with the components of the vocalic nucleus but with the consonant environment, that is, the phonotactic arrangements of consonant phonemes to which the nucleus is linked.

The following is a chart of the various phonotactic arrangements of consonant phonemes which constitute the environment of the syllable nucleus.

Examples

/C/ (rare)	/n̩/	'n' (as in <u>bread</u> 'n' <u>butter</u>)
/V/	/ə/	<u>a</u>
/CV/	/ðə/	<u>the</u>

$/C^cV/$	/stey/	stay
/VC/	/in/	in
$/VC^c/$	/iŋk/	ink
/CVC/	/ðæt/	that
$/C^cVC/$	/step/	step
$/CVC^c/$	/miks/	mix
$/C^cVC^c/$	/glimpst/	glimpsed

B.   English Consonant Clusters.

The inventory of the possible consonant cluster in English can not be exhausted because of the constant increase of English vocabulary and the marked divergencies of pronunciation due, among others, to cultural factors.

From the practical and educational point of view, a listing of clusters should be established according to the frequency of occurrence in actual utterances. Therefore, a listing should give priority of selection to /st/ instead of /sθ/, for /st/ occurs 699 times in a 72,210-phoneme utterance, whereas /sθ/ occurs only once.[1]

This paper presents fifty consonant clusters selected on the basis of their high frequency of occurrence in the

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[1]P. B. Denes, "On the Statistics of Spoken English," The Journal of the Acoustic Society of America, 35:892-904, 1963.

language,[2] and they are shown in Table I. This table in-cludes only two member clusters. Clusters of three members $C_1 C_2 C_3$ were separated into $C_1 C_2$ and $C_2 C_3$ and counted separately. A four member cluster $C_1 C_2 C_3 C_4$ was considered as $C_1 C_2 + C_2 C_3 + C_3 C_4$, and each two member cluster was counted respectively; and so forth.

The segmentation of longer clusters into two member ones coincides with the actual teaching situation of English clusters, because longer clusters can best be taught by expanding shorter ones: e.g. rang - rank - rankle - rankles ([ræŋ] - [ræŋk] - [ræŋkl] - [ræŋklz]). Since every conso-nant sound is the result of a single set of adjustments of the speech mechanism, it is natural for a student to encoun-ter some difficulty when two consonants come together and form an unfamiliar cluster, especially when one of the conso-nants is a new challenging sound for the student.[3] Diffi-culties may increase when three or four or even five conso-nants come together to form a cluster.

Discussion concerning distribution of consonant clus-ters within a word seems to be irrelevant at this point and will be taken into consideration in Chapter V. Rules of

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[2] Ibid.

[3] Halvor P. Hansen, and Lulu Hayes Pierce, Speak to Learn (Stockton: University of the Pacific Press, 1966), p. 23.

TABLE I

FREQUENCY OF OCCURRENCE OF CONSONANT CLUSTERS IN ENGLISH

Order	Conso-nant clusters	Occur-rence fre-quency	Percen-tage	--Cumulative--Occur-rence fre-quency	Percen-tage
1	nt	804	10.63	___	___
2	nd	760	10.05	1564	20.68
3	st	699	9.24	2263	29.92
4	ns	260	3.44	2523	33.36
5	ks	238	3.14	2761	36.50
6	tr	171	2.26	2932	38.76
7	pr	160	2.11	3092	40.87
8	pl	155	2.05	3247	42.92
9	tl	150	1.98	3397	44.90
10	kt	148	1.95	3545	46.85
11	ts	145	1.92	3690	48.77
12	bl	139	1.84	3829	50.61
13	ŋk	137	1.81	3966	52.42
14	fr	124	1.64	4090	54.06
15	dn	114	1.51	4202	55.57
16	kw	110	1.45	4314	57.02
17	šn	110	1.45	4424	58.47
18	sp	103	1.36	4527	59.83

TABLE I (continued)

Order	Consonant clusters	Occurrence frequency	Percentage	--Cumulative-- Occurrence frequency	Percentage
19	kl	103	1.36	4630	61.19
20	zn	96	1.27	4726	62.46
21	ld	92	1.22	4818	63.68
22	gr	89	1.18	4907	64.86
23	nl	87	1.15	4994	66.01
24	sk	87	1.15	5081	67.16
25	dz	82	1.08	5163	68.24
26	nz	79	1.04	5242	69.28
27	mp	75	1.00	5317	70.28
28	ft	68	0.90	5385	71.18
29	br	66	0.87	5451	72.05
30	vn	62	0.82	5513	72.87
31	mz	60	0.79	5573	73.66
32	dy	58	0.77	5631	74.43
33	fl	55	0.73	5686	75.16
34	sn	49	0.65	5735	75.81
35	tn	48	0.63	5783	76.44
36	mb	47	0.62	5830	77.06
37	sl	46	0.61	5876	77.67
38	lf	45	0.60	5921	78.27

TABLE I (continued)

Order	Consonant clusters	Occurrence frequency	Percentage	--Cumulative--	
				Occurrence frequency	Percentage
39	lt	42	0.56	5963	78.83
40	lm	42	0.56	6005	79.39
41	θr	42	0.56	6047	79.97
42	dr	41	0.54	6088	80.49
43	pt	41	0.54	6129	81.03
44	ny	40	0.53	6169	81.56
45	ps	40	0.53	6209	82.09
46	ŋz	40	0.53	6249	82.62
47	sm	37	0.49	6286	83.11
48	šl	37	0.49	6323	83.60
49	dl	36	0.48	6359	84.08
50	ky	35	0.46	6394	84.54
51 ≀ 206	others	1170	15.46	7564	100.00

consonant patterning--phonotactic laws--are not in the scope of this study. This section is concerned only with the types of consonant clusters which actually occur frequently in English.

The fifty consonant clusters to be handled in this paper represent about eighty-five per cent of the 7,564 occurrences of the consonant clusters in a 72,210-phoneme utterance. For educational purposes, it seems sufficient to limit the number of clusters to the above mentioned percentage (84.54 per cent).

II. SYLLABIC COMPONENTS OF JAPANESE

It was stated previously that the main concern of this paper is the consonant clusters that accompany the vowel nucleus. If a syllabic pattern similar to the English one shown on page 40 is proposed for Japanese, the following type of phonemic syllables can be established. It is important to notice that in the chart below, item (1) is a syllabic consonant, similar to English 'n' as in bread 'n' butter, item (2) is a single vowel, similar to English a /ə/, item (3) is a consonant + a vowel, similar to English the /ðə/, and finally item (4) is a consonant + a semivowel + a vowel, similar to English cue /kyuw/. As it can be observed the consonant environments are not in themselves clusters of a

length comparable to that of glimpsed /gl + i + mpst/.

   (1) /C/   e.g.   /N/

                       (un /NN/ [ŋŋ] 'yes')

   (2) /V/   e.g.   /i/, /e/, /a/, /o/, /u/

                       (i /i/ [i] 'stomach')

   (3) /CV/   e.g.   /ki/, /ke/, /ka/, /ko/, /ku/

                       (ki /ki/ [ki] 'tree')

   (4) /CyV/   e.g.   /kya/, /kyo/, /kyu/

                       (kyaku /kyaku/ [kyaku] 'guest')

A. Japanese Consonant Clusters.

     The preceding statements do not mean that Japanese is a language devoided of consonant clusters. As a matter of fact, clusters may be observed intersyllabically distributed on the phonemic level: e.g. ando /a-N-do/ 'relief'. To understand this fact it is necessary to explain the nature of the Japanese syllable and the possible occurrence of sequences of syllables.

     Japanese syllables are all open syllables except when the syllabic phoneme /N/ occurs, or when syllabic allophones of voiceless consonant phonemes occur; e.g. [ik̚koo] /i-k-ko-o/ 'a party'. The syllabic lengthening takes place in the first half of the geminated consonants when two identical consonants occur in the intervocalic positions. The

total distribution of the geminate consonant in Japanese is
as follows:

/-(C)V-p-pV-/	e.g.	ippai	[ip̚ˈpai]	'one cup'
/-(C)V-t-tV-/		ittoo	[it̚ˈtoo]	'one horse'
/-(C)V-t-tu-/		ittsuu	[iç̚ˈcuu]	'one letter'
/-(C)V-k-kV-/		kekka	[kek̚ˈka]	'result'
/-(C)V-s-sV-/		issatsu	[issacu]	'one book'
/-(C)V-š-šV-/		zasshi	[zaššị]	'magazine'
/-(C)V-č-čV-/		icchi	[itš̚ˈtši]	'agreement'

As the chart of geminate consonants of Japanese shows,
/CCV/ is counted as two syllables; the first /C/ forms one
syllable, and /CV/ forms another. The main difference of the
consonant clustering between Japanese and English is that in
the first language, the clustering is intersyllabic, and in
the second intrasyllabic.[4]

Syllabic type /CyV/ (Consonant-Semivowel-Vowel)
presents a peculiar distribution in Japanese. The distribu-
tion of /__yV/ type syllable can be formulated as follows:

---

[4]Cf. p. 4 of this paper.

			Examples	
∅				
/p/			/ya-ma/	'mountain'
/b/			/ha-p-pya-ku/	'eight hundred'
/k/			/byo-o-i-N/	'hospital'
/g/	/y/	/a/	/kyu-u/	'nine'
/h/		/o/	/hyo-o/	'list'
/m/		/u/	/mya-ku/	'pulse'
/n/			/gyu-u-nyu-u/	'milk'
/ŋ/			/saN-ŋyo-o/	'industry'
/r/			/šo-o-rya-ku/	'omission'

Returning to the syllable structure, it should be noted that in Japanese, non-syllabic consonants are always followed by a vowel, since they do not occur in the final position. Consonants which can stand alone include the syllabic phoneme /N/, and seven syllabic allophones of voiceless consonants whose distributions have been already described in this chapter.[5] These facts show clearly that there can be no true intrasyllabic consonant cluster in Japanese, when those four types of syllable are distributed one after another.

However, since all four syllabic types can occur in initial, medial, and final position, the following combinations which produce many intersyllabic consonant clusters

---

[5]cf. p. 48.

are possible.

A. /-N-CV-/

  1. /-N-pV-/   sanpo   /saNpo/   [sãm̥po]   'walking'

  2. /-N-bV-/   shinbun   /šiNbuN/   [šĩmbũņ]   'newspaper'

  3. /-N-tV-/   hontoo   /hoNtoo/   [hõntoo]   'really'

 3' /-N-tu-/   santsuu   /saNtuu/   [sãņcuu]   'three letters'

  4. /-N-dV-/   kondo   /koNdo/   [kõndo]   'this time'

  5. /-N-kV-/   bunka   /buNka/   [bũŋka]   'culture'

  6. /-N-gV-/   bangohan /baNgohaN/   [bãŋgohãņ]'supper'

  7. /-N-sV-/   sensoo   /seNsoo/   [sẽņsoo]   'war'

  8. /-N-zV-/   anzu   /aNzu/   [ãndzu]   'apricot'

  9. /-N-šV-/   konshuu   /koNšuu/   [kõņšuu]   'this week'

10. /-N-hV-/   hanhan   /haNhaN/   [hãɸhãņ]   'half and half'

11. /-N-čV-/   banchi   /baNči/   [bãņtši]   'house number'

12. /-N-ǰV-/   sanjuu   /saNǰuu/   [sãndžuu]   'thirty'

13. /-N-mV-/   sanman   /saNmaN/   [sãmmãņ]   'thirty thousand'

14. /-N-nV-/   minna   /miNna/   [mĩņnã]   'everybody'

15. /-N-ŋV-/   sangatsu /saNŋatu/   [sãŋŋãcu]   'March'

16. /-N-rV-/   shinrai   /šiNrai/   [šĩņřai]   'reliance'

17. /-N-wV-/   shinwa   /šiNwa/   [šĩņwa]   'mythology'

18. /-N-yV-/   konyaku   /koNyaku/   [kõņyaku] 'engagement'

B. /-N-CyV-/

1. /-N-pyV-/ nanpyooyoo /naNpyooyoo/ [nãm̥pyooyoo] 'Antarctic
                                                               Ocean'

2. /-N-byV-/   sanbyaku   /saNbyaku/   [sãmbyaku]   'three hundred'

3. /-N-kyV-/   kankyaku   /kaNkyaku/   [kãŋkyaku]   'audience'

4. /-N-gyV-/   (This sequence does not occur.)

5. /-N-hyV-/   jikanhyoo   /JikaNhyoo/   [džikãɲhyoo]   'timetable'

6. /-N-myV-/   sanmyaku   /saNmyaku/   [sãmmyaku]   'mountain chain'

7. /-N-nyV-/   hunnyuu   /huNnyuu/   [ɸũɲɲyuu]   'powdered milk'

8. /-N-ŋyV-/   sangyoo   /saNŋyoo/   [sãŋɲyoo]   'industry'

9. /-N-ryV-/   shinryaku   /šiNryaku/   [šĩnʳyaku]   'invasion'

Only these forty-three intersyllabic clusters can occur in Japanese on the phonemic level.

B.   Vowel Devocalization and Consonant Rearrangement.

During the production of a devocalized vowel, the glottis is not closed.[6] This articulatory fact causes the vowel in question to lose its vocal quality; e.g. /suteru/ ---→ [sUteru] ---→ [steru].

The devocalization originates a new arrangement of segments. The sequence of segments [sut-] by devocalization is rearranged into [st-]. It is important to note that in spite of the devocalization, the syllable boundary /su-te-ru/ is maintained as [s-te-ru]. This fact permits the

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[6]Mieko Shimizu Han, "Unvoicing of Vowels in Japanese," Onsei no Kenkyuu (Study of Sounds), 10:82-3, 1962.

establishment of a new set of intersyllabic clusters which
needs careful explanation.

Under certain circumstances, the Japanese voiced
vowels [i], [e], [a], [o] and [u] are replaced by the corre-
sponding devocalized (voiceless) allophones [I], [E], [A],
[O], and [U]. The study of this phenomenon in relation to
the phonological structure of Japanese is of importance, since
the different interpretation of devocalization of vowels
causes a difference in the analysis of the total phonological
system of Japanese.[7] The phenomenon has been noted by many
linguists and interpreted in various ways. Samuel E. Martin,
for instance, treated these devocalized vowels as separate
phonemes.[8] Bernard Bloch did not consider the devocalized
vowels as separate phonemes, but as allophones.[9] Since
devocalized vowels do not contrast with voiced counterparts
and they can be accounted for in terms of environment, it
can be said that devocalized vowels are allophones of the
corresponding vowel phonemes.

The phenomenon of the devocalization has been

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[7]Ibid., p. 81.

[8]Samuel E. Martin, "Morphophonemics of Standard Collo-
quial Japanese," Language (Supplement, Language Dissertation
No. 47), 28:12, 1952.

[9]Bernard Bloch, "Studies in Colloquial Japanese IV:
Phonemics," Language, 26:86-125, 1950.

described in detail by Mieko Shimizu Han, who believes that
the following factors are involved in this phenomenon:[10]   (1)
the duration of vowels, (2) tempo, (3) pitch-accent, and (4)
neighboring sounds. According to Han, when the other condi-
tions are the same, the ratio of duration among the five
Japanese vowels is as follows:[11]

/u/   1.00

/i/   1.17

/o/   1.26

/e/   1.37

/a/   1.44

Of these vowels, the two shortest vowels /u/ and /i/ are de-
vocalized in the same environment and at the same tempo more
readily than the other vowels /a/, /e/, /o/. Of the two
vowels /i/ and /u/, the vowel /u/ is more readily devocal-
ized than /i/. The other vowels /a/, /e/, and /o/ are not
devocalized at normal tempo.[12]

According to Han, "the tempo of speech played an
important part in the phenomenon of unvoicing. If the tempo
is rapid, the vowels /i/ and /u/ are more readily unvoiced;

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[10]Han, op. cit., p. 81.

[11]Mieko Shimizu Han, "The Feature of Duration in Japa-
nese," Onsei no Kenkyuu (Study of Sounds), 10:67, 1962.

[12]Mieko Shimizu Han, "Unvoicing of Vowels in Japanese,"
p. 84.

naturally in the slow tempo unvoicing is less frequent."[13]

As to the effect of pitch-accent on the devocaliza-
tion of vowels, Han found that "/i/ and /u/ between voice-
less consonants are unvoiced in general, when they occur
anywhere except in a high pitched syllable." e.g.

/kikukoto/   k̄Ikukoto   'to listen'

kikŪkoto   'with Kikuko'[14]

Devocalization does not occur in the following environ-
ments:

(a) $\left\{\begin{matrix} /\underset{\circ}{C}/ \\ /\#/ \end{matrix}\right\} — \left\{\begin{matrix} /\underset{\smallsmile}{C}/ \\ /V/ \end{matrix}\right\}$ (b) $\left\{\begin{matrix} /\underset{\smallsmile}{C}/ \\ /V/ \end{matrix}\right\} — \left\{\begin{matrix} /\underset{\circ}{C}/ \\ /\#/ \end{matrix}\right\}$

Examples: /C̥__C̬/   [suberu]   'slide'

/C̥__V/   [šio]   'salt'

/#__C̥/   [#ude]   'arm'

/#__V/   [#uo]   'fish'

/C̬__C̥/   [buta]   'pig'

/C̬__#/   [hanabi#]   'firework'

/V__C̥/   [kaiko]   'silkworm'

/V__#/   [naŋai#]   'long'

Devocalization occurs only when both neighboring

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[13]Ibid., p. 85.

[14]Ibid., pp. 85-6.

sounds are voiceless consonants, i.e. in the environment of
Ç__Ç. Voiceless consonants in Japanese are [p], [t], [k],
[s], [š], [h], [Φ], [x], [c] (=[ts]), and [tš], and the
possibility of the occurrence of these consonants with [I]
and [U] are limited to the following combinations:

$$
\begin{Bmatrix} /p/ \\ /t/ \\ /k/ \\ /s/ \\ /š/ \\ /h/ \\ /ž/ \end{Bmatrix} + \begin{Bmatrix} [I] \\ [U] \end{Bmatrix} + \begin{Bmatrix} /p/ \\ /t/ \\ /k/ \\ /s/ \\ /š/ \\ /h/ \\ /ž/ \end{Bmatrix}
$$

As illustrated in the inventory of allophones in the
previous chapter (pp. 34-38), /t/ becomes [c] (=[ts]) in the
environment __/u/; /t/ does not occur in the environment
__/i/; /s/ does not occur in the environment __/i/; /h/
becomes [Φ] in the environment __/u/, [x] in the environment
__/i/. This distribution can be formulated as follows:

$$
/i/, /u/ \longrightarrow [I], [U] \text{ in env. } \begin{Bmatrix} [x] \quad + \quad /i/ \\ \begin{Bmatrix} [c] \\ [s] \\ [Φ] \end{Bmatrix} + /u/ \\ \begin{Bmatrix} [p] \\ [k] \\ [š] \\ [tš] \end{Bmatrix} + \begin{Bmatrix} /i/ \\ /u/ \end{Bmatrix} \end{Bmatrix} + \begin{Bmatrix} [x] \\ [h] \\ [c] \\ [s] \\ [Φ] \\ [t] \\ [p] \\ [k] \\ [š] \\ [tš] \end{Bmatrix}
$$

Examples:

hihan	/hihaN/	[xIhã̞ŋ]	'criticism'
sanpuku	/saNpuku/	[sãmpUku]	'hillside'
kishi	/kiši/	[kIši]	'shore'
kushi	/kuši/	[kUši]	'comb'
shita	/šita/	[šIta]	'below'
chikaku	/čikaku/	[tšIkaku]	'near'
tsuchi	/tuči/	[cUtši]	'soil'
supootsu	/supootu/	[sUpoocu]	'sport'
hutsuka	/hutuka/	[ɸUcuka]	'two days'

C. Vowel Elision.

The phenomenon of vowel elision is preceded by the phenomenon of vowel devocalization. The elision of a vowel is conditioned by the following factors: (1) tempo, (2) pitch-accent, and (3) some consonant environment, e.g. fricative + /u/ + stop.

(1) Tempo.

In rapid speech, the difference between [ṣs] as in issatsu [iṣsacu] 'one book' and [sUs] as in susumu [sUsumu] 'advance' is sometimes not clear.

(2) Pitch-accent.

A low pitched /su/-syllable in the final position is usually heard as [ṣ] even at normal tempo. For instance, the

endings of such words as gasu /gasu/ 'gas' and dasu /dasu/ 'take out' are heard as [gas̩] or [das̩] respectively.

In the instances explained in (1) and (2) above, the duration of the vowel /u/ is reduced to such an extent that an untrained ear may perceive it as elided. However, there are some sequences of /CVC/ where even a trained ear can not detect the existence of the devocalized vowel, as is explained in the following paragraphs.

(3) Some consonant environment.

One of Japan's leading linguists, Shiro Hattori, stated that in the Tokyo dialect, the natural pronunciation of suteru /suteru/ 'abandon' and shiteru /šiteru/ 'be doing' are [steru] and [šteru] respectively, and that between the voiceless consonants, there is not any devocalized vowel, but complete elision of vowel sound.[15]

According to Akira Ota, in rapid speech /u/ and /i/ of the first syllables of suki 'like' and shiki 'ceremony' are sometimes elided.[16]

Samuel E. Martin made the following remarks:[17]

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[15]Shiro Hattori, Gengogaku no Hoohoo (General Linguistics) (Tokyo: Iwanami Shoten, 1960), p. 316.

[16]Akira Ota, "Nichi-Eigo no Ontaikei no Hikaku (A Comparative Study of the Japanese and English Sound Systems)," Nichi-Eigo no Hikaku (Comparative Study of Japanese and English) (Tokyo: Kenkyuusha, 1965), p. 19.

[17]Martin, op. cit., p. 14.

Instead of the replacement by a corresponding un-
voiced vowel, the vowel /i/ and /u/ are sometimes re-
placed by zero, ...
This zero replacement is especially common with
various forms of the polite verb -masu and the polite
copula desu. Examples: /iides/ 'it is good,'
/anatadeska/ 'is it you?,' /inudešta/ 'it was a dog.'
Replacement between /s/ or /š/ and /t/ is almost uni-
versal: . . . .[18]

Generally speaking, when one of the surrounding

voiceless consonants is a stop, e.g. /t/, or an affricate,

e.g. /č/, and the other is a fricative, e.g. /s/, the vowel

between them is more likely to be elided, especially when the

vowel is /u/; and thus there appear some consonant sequences

as shown below:

arupusu	/arupusu/	[ařupsu]	'Alps'
kushi	/kuši/	[kši]	'comb'
shutai	/šutai/	[štai]	'subject'
shukaku	/šukaku/	[škaku]	'nominative case'
supai	/supai/	[spai]	'spy'
suki	/suki/	[ski]	'like'
suteru	/suteru/	[steřu]	'abandon'
hutatsu	/hutatu/	[ɸtacu]	'two'

The above sequences and others of the /CVC/ pattern,

in which an untrained ear, or in some cases even a trained

one can not perceive the existence of vowels, are considered

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[18]In this quotation the bars / /, and underlines are not
in the original.

intersyllabic consonant clusters which occur only on the phonetic level of Japanese. The existence of these "phonemic" as well as "phonetic" consonant clusters in Japanese is worth recognizing in the preparation of efficient teaching materials for English consonant clusters.

CHAPTER V

FORMULATION OF HIERARCHY
OF DIFFICULTIES

In order to formulate a hierarchy of difficulties in learning English consonant clusters, it is necessary to know the type and the degree of difference and similarity between the consonant clusters of the two languages. For this purpose, fifty English consonant clusters[1] and their Japanese counterparts[2] are listed for comparison in this chapter (Figure 1 and 2). These parallel listings exhibit structural as well as articulatory differences and similarities between English and Japanese consonant clusters, and are expected to make possible the prediction of phonological interference as well as degree of difficulty. In order to determine the exact articulatory differences between the two languages, examples of consonant clusters are also transcribed in terms of allophones.

Information regarding the distribution of clusters (initial, medial, final) does not appear in the listings, because the distribution of Japanese consonant clusters can

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[1]These clusters were chosen on the basis of the frequency of occurrence. Cf. p. 46.

[2]These Japanese clusters were obtained by structural analysis of the Japanese syllable. Cf. Chapter IV of this paper.

FIGURE 1

LIST OF ENGLISH AND JAPANESE CONSONANT CLUSTERS (I)

No.	Cluster	Examples English		Japanese	
1	pt	[æpꜗt]	apt	–	
2	ps	[æɫps]	Alps	[aɾupsu]	'Alps'
3	pl	[pl̥eɪ]	play	–	
4	pr	[pr̥eɪ]	pray	–	
5	bl	[bleɪm]	blame	–	
6	br	[brɛd]	bread	–	
7	ts	[kʰæts]	cats	[kacu]=[katsu]	'to win'
8	tn	[bə̂tn̩]	button	–	
9	tl	[batɫ̩]	bottle	–	
10	tr	[t̥ru]	true	–	
11	dz	[kʰadz]	cards	[dzeŋ]	'Zen'
12	dn	[sə́dn̩]	sudden	–	
13	dl	[mɪdɫ̩]	middle	–	
14	dr	[d̥raɪ]	dry	–	
15	dy	[dyu]	dew	*[adyuu]	'good-bye'
16	kt	[æk̚t]	act	–.	
17	ks	[tʰæks]	tax	[ksuɾi]	'medicine'
18	kl	[kl̥u]	clue	–	
19	kw	[kw̥in]	queen	–	
20	ky	[ky̥u]	cue	[kyuu]	'nine'

FIGURE 1 (continued)

No.	Cluster	Examples English		Japanese	
21	gr	[grin]	green	-	
22	ft	[æftə]	after	-	
23	fl	[fleɪm]	flame	-	
24	fr	[fri]	free	-	
25	vn	[ɨvn̩]	even	-	
26	θr	[θr̥i]	three	-	
27	sp	[spun]	spoon	[spuuŋ]	'spoon'
28	st	[stɛp]	step	[steřu]	'abandon'
29	sk	[ski]	ski	[skii]	'ski'
30	sm	[sm̥oɫ]	small	-	
31	sn	[sn̥oʊ]	snow	-	
32	sl	[sl̥ip]	sleep	-	
33	zn	[pr̥ɪzn̩]	prison	-	
34	šn	[košn]	caution	-	
35	šl	[spɛšɫ]	special	-	
36	mp	[pʰə́mp]	pump	[pompu]	'pump'
37	mb	[kəmbaɪn]	combine	[šimbuŋ]	'newspaper'
38	mz	[tʰɛmz]	Thames	-	
39	nt	[tʰɛnt]	tent	[sentoo]	'battle'
40	nd	[ænd]	and	[ando]	'relief'
41	ns	[sɛns]	sense	-	

FIGURE 1 (continued)

No.	Cluster	Examples English		Japanese	
42	nz	[branz]	bronze	**[andzu]	'apricot'
43	nl	[tə́nɫ]	tunnel	–	
44	ny	[nyuz]	news	–	
45	ŋk	[bæŋk]	bank	[buŋka]	'culture'
46	ŋz	[rɪŋz]	rings	–	
47	lt	[hoɫt]	halt	–	
48	ld	[oʊɫd]	old	–	
49	lf	[sɛɫf]	self	–	
50	lm	[fɪɫm]	film	–	

* In Japanese [dy] occurs only in loan words.

** In Japanese /z/ becomes [dz] in the environment of [n]__; in English, in rapid speech [nz] and [ndz] are often difficult to differentiate. Therefore the Japanese [ndz] is considered to be the counterpart of English [nz].

be generalized as follows:

1. Japanese clusters never occur in the final position, because all of them are intersyllabic clusters except /consonant + semivowel/ sequence, e.g. /ky-/, /by-/, and /ny-/ which can not occur in the final position either. Therefore any English cluster in the final position is presumably equally difficult for the Japanese learners of English.

2. Whenever there is a Japanese counterpart for an English cluster, the Japanese counterpart always occurs wherever the English cluster occurs, except in the final position. What matters, then, as far as the initial and medial positions are concerned, is whether a Japanese counterpart for an English cluster exists or not.

The following factors should be taken into consideration in formulating a hierarchy of difficulties: (I) the existence or nonexistence of Japanese counterparts of English consonant clusters, (II) articulatory features which are unfamiliar to the Japanese student.

I.   HIERARCHY OF DIFFICULTIES BASED ON PHONEMIC
     DIFFERENCES BETWEEN THE TWO LANGUAGES

The relationship between English and Japanese consonant clusters can be classified into the following five types:

Type 1.   The English consonant cluster consists of two
         components either of which does not exist in Japa-
         nese: e.g.

         E [-CC-] ---→ J ØØ as in [flæg], [self]

Type 2.   One of the components of the English consonant
         cluster does not exist in Japanese: e.g.

         E [-CC-] ---→ J [-CØ-] or [-ØC-] as in

         E [hɔlt], [pleɪ], [ivn̩]

Type 3.   Both components of the English consonant clus-
         ter do exist in Japanese, but their phonotactic
         behavior in English differs from that in Japanese.
         Type 3 has three subtypes in Japanese.

 a) There occurs a vowel between the consonant compo-
     nents: e.g.

         E [-CC-] ---→ J [-CVC-] as in

         E [preɪ] ---→ J [puřei]

 b) There occurs a devocalized vowel between the conso-
     nants: e.g.

         E [-CC-] ---→ J [-CVC-] as in

         E [æpˀt] ---→ J [apUto-]

     In this subtype, in the English cluster there is an
     incomplete plosion, i.e. [-pˀt-], whereas the Japa-
     nese sequence is of an open transition, that is,

there is a weak devocalized vowel between the two
voiceless consonants,[3] e.g. [-pUt-].

c)   A particular allophone used in an English cluster
     is different from the one used in the Japanese
     counterpart: e.g.

    E [-ns-] ---→ J [-ɳs]   as in

    E [sɛns] ---→ J [seɳsu]

Type 4.   The English cluster has a similar Japanese
          counterpart: e.g.

    E [-CC-] ---→ J [-CC-]   as in

    E [stɛp] ---→ J [steᵡu]

Type 5.   An English cluster corresponds to a Japanese
          affricate: e.g.

    E [-CC-] ---→ J [-C-]   as in

    E [kæts] ---→ J [kaçu] = [katsu]

The fifty English consonant clusters are classified
as follows on the basis of the preceding phonemic information,
that is, on the basis of presence or absence of one or two
phonemic components of the cluster on the part of Japanese.

Type 1.   (two clusters)

    [fl], [lf]

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[3]Kenneth L. Pike, _Phonemics_ (Ann Arbor: The University
of Michigan Press, 1947), p. 252.

Type 2. (fifteen clusters)

[ft], [fr]; [lt], [lm]; [pl], [bl], [tl], [dl]; [ld], [nl], [kl], [sl], [šl]; [vn]; [θr]

Type 3. (eighteen clusters)

a) [pt], [kt]

b) [pr], [br], [tr], [dr], [gr]; [tn], [dn], [sn], [zn], [šn]; [sm]; [mz]; [ŋz]; [kw]

c) [ny]; [ns]

Type 4. (thirteen clusters)

[ps], [ks]; [dy], [ky]; [sp], [st], [sk]; [mp], [mb]; [nt], [nd]; [ŋk]; [dz]

Type 5. (two clusters)

[ts] (=[c]); [nz] (=[ndz])

If other factors are not taken into consideration, the degree of difficulties of these five types of clusters can be established as follows:

1. The clusters of Type 1 are the most difficult for the Japanese learners of English, because both of its members are entirely new to the students, and therefore there is no "transfer" that can facilitate the learning process.

2. The clusters of Type 2 are less difficult than Type 1, because only one of the components of the cluster is a phoneme which is unfamiliar to the student, and the other

is a sound which exists in Japanese.

3.   The clusters of Type 3 are easier than Type 2, because the phonemic components of English consonant clusters of Type 3 all exist in Japanese.   None the less, clusters of this type require furthur adjustments of articulatory nature as well as a selection of appropriate allophones.

4.   The clusters of Type 4 and of Type 5 are the easiest to acquire, because they have similar counterparts.[4]

The above hierarchy, formulated according to phonemic factors, may be of theoretical significance as well as applicable in teaching beginners who have not yet been introduced systematically to the intricacies of the phonemic system of English.

II.   HIERARCHY OF DIFFICULTIES BASED ON ARTICULATORY
        DIFFERENCES BETWEEN THE TWO LANGUAGES

The hierarchy of difficulties formulated from the standpoint of phonemic data is of course different from that formulated from the standpoint of articulatory features. In this case, the differences and similarities in articulatory features between English and Japanese are taken into consideration.   In other words, those articulatory features

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[4]These fifteen clusters of Types 4 and 5 represent 44.80 per cent of 7,564 consonant clusters.   See pp. 43-46.

which are unfamiliar to the Japanese students of English will naturally be difficult for them to acquire; consequently, any English consonant cluster which needs such an unfamiliar articulatory adjustment in its pronunciation should be more difficult for the student than the one which does not need such an adjustment, even if the student is able to pronounce those phonemic components of English in isolation correctly. Therefore, in the following discussion, it is assumed that the student who is able to pronounce English consonants in isolation reasonably well is not necessarily able to pronounce the same consonants when they appear in clusters.

If the previous assumption is accepted, the thirty-five consonant clusters of English, the counterparts of which do not exist in Japanese, can be rearranged as indicated in Figure 2.

As can be inferred from the list (Figure 2), there is a marked difference between the English pronunciation of the consonant clusters and that of the Japanese counterparts. English consonants form a close transition[5] in a cluster, i.e. there is no vowel sound between them; whereas in Japanese they form, in most cases, an open transition. This is due mainly to the difference between English syllable structure and that of Japanese.

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[5]Pike, loc. cit.

FIGURE 2

LIST OF ENGLISH AND JAPANESE CONSONANT CLUSTERS (II)

No.	Cluster	Examples	English pronunciation	Japanese approximate pronunciation
1	pt	apt	[æp˺t]	[æpUt(ə)]
2	pl	play	[pʰl̥eɪ]	[pələɪ]
3	pr	pray	[pʰɹ̥eɪ]	[pəreɪ]
4	bl	blame	[bleɪm]	[bəleɪm(ə)]
5	br	bread	[brɛd]	[bərɛd(ə)]
6	tn	button	[bə́tn̩]	[bə́tən]
7	tl	bottle	[batl̩]	[batəl]
8	tr	true	[tɹ̥u]	[təru]
9	dn	sudden	[sə́dn̩]	[sədən]
10	dl	middle	[mɪdl̩]	[mɪdəl]
11	dr	dry	[d̥ɹaɪ]	[dəraɪ]
12	kt	act	[æk˺t]	[ækUt(ə)]
13	kl	clue	[kʰl̥u]	[kəlu]
14	kw	queen	[k̫ʰw̥in]	[kəwiɲ]
15	gr	green	[grin]	[gəriɲ]
16	ft	after	[æftə]	[æftə]
17	fl	flame	[fleɪm]	[fələɪm]
18	fr	free	[fri]	[fəri]
19	vn	even	[ivn̩]	[ivəɲ]
20	θr	three	[θɹ̥i]	[θəri]

FIGURE 2 (continued)

No.	Cluster	Examples	English pronunciation	Japanese approximate pronunciation
21	sm	small	[smɔɬ]	[səmɔl]
22	sn	snow	[snoʊ]	[sənoʊ]
23	sl	sleep	[sl̥ip]	[səlip(ə)]
24	zn	prisoner	[pʰrɪznə]	[pərizənə]
25	šn	caution	[kʰɔšn̥]	[košən]
26	šl	special	[spɛšɬ]	[spɛšəl]
27	mz	Thames	[tɛmz]	[tɛməz(ʊ)]
28	ns	sense	[sɛns]	[sɛns]
29	nl	tunnel	[tʰə́n̩ɬ]	[tə́nəl]
30	ny	news	[nyuz]*	[ɲuz(ə)]
31	ŋz	rings	[rɪŋz̩]	[rɪŋəz(ə)]
32	lt	halt	[hɔɬt]	[hɔɬt(ə)]
33	ld	old	[oʊɬd]	[oʊɬd(ə)]
34	lf	self	[sɛɬf]	[sɛl(ə)f(ə)]
35	lm	film	[fɪɬm]	[fɪl(ə)m(ə)]

* If the student is expected to pronounce [ɲuz] or [nuz] for news, they are not treated as a cluster any more.

English clusters can be classified in seven groups according to articulatory characteristics:

1. Inaudible release of stops preceding other stops or affricates.

In a cluster of two stops, e.g. /p/ + /t/, or a stop and an affricate, e.g. /t/ + /ǰ/, either within a word or at word boundaries, the first stop has no audible release:[6] e.g.

apt   [pˈ] + [t]

act   [kˈ] + [t]

great joke   [tˈ] + [dž]

This feature is not too difficult for the Japanese student to acquire, because the same kind of release is found in his native tongue, namely the incomplete plosion of geminate consonants,[7] e.g. [pˈp] as in ippai 'one cup,' where the release of the first stop is delayed until the release of the second.

2. Nasal release of stops followed by a homorganic nasal, especially /t, d/ + /n/.

When a stop is followed by the homorganic nasal conso-nant, the release of air is normally effected not by a

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[6]A. C. Gimson, An Introduction to the Pronunciation of English (London: Edward Arnold Publishers Ltd., 1962), p. 151.

[7]See p. 48.

removal of the oral closure, which is retained, but by the escape of the compressed air through the nasal passage, opened by the lowering of the soft palate for the nasal consonant:[8] e.g.

    button   [t̩] + [n̩]

    sudden   [d̩] + [n̩]

This quick lowering action of the soft palate may be significant for linguistic communication, or simply be a consequence of biological needs, namely the necessity of clearing the naso-pharyngeal passage for breathing in case of a cold. When this very movement of the velum is fully recognized by the student objectively and with the tactual sensation, the acquisition of the nasal plosion in clusters such as [-t̩n-] or [-d̩n-] will not be too difficult.

    3. Lateral release of /t, d/ + /l/.

In the homorganic sequences /t/ + /l/ and /d/ + /l/, /t/ and /d/ are normally released laterally, i.e. one or both sides of the tongue are lowered to allow the air to escape. The tongue-tip contact persists:[9] e.g.

    bottle   [t̪] + [l]

    middle   [d̪] + [l]

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[8]Gimson, op. cit., p. 152.

[9]Ibid., p. 153.

The cluster [-nl-] as in tunnel, does not have the same plosion as in [-t̪l-] or [-d̪l-]. However, the point of articulation and the transition from one consonant to the other in [-n̪l-] is so similar to those in [-t̪l-] or [-d̪l-] that they could be regarded as members of the same category. Lateral plosion as explained above does not exist in Japanese, ~~therefore it presents a great difficulty in learning how to~~ produce it.

4. Devocalization of a voiced consonant, as in play [pʰ] + [l̥].

In the consonant sequence /voiceless + voiced/ as in the word snow [snoʊ], the voiced consonant [n] seems to lose --at least partially--its vocal quality, in contact with the preceding voiceless sound [s]. The devocalized [n̥] regains its original quality as the transition to the next vowel occurs. This process could be transcribed as follows: [sn̥noʊ] or [sn̥oʊ]. There are eight clusters of this type in the list (Figure 2): e.g.

play	[pʰl̥eɪ]
pray	[pʰɹ̥eɪ]
true	[t̪ɹ̥u]
clue	[kʰl̥u]
queen	[kʰ̫w̥in]
small	[sm̥ɔl]
snow	[sn̥oʊ]
sleep	[sl̥ip]

In the preceding list, there is a [-k̹ẘ-] cluster in which not only the devocalized /w/ is used, but also a lip-rounded variant of /k/ is used under the influence of /w/. Since the lip-rounding of the semivowel /w/ in Japanese is not as marked as in English, and /w/ only occurs before /a/ in Japanese, this protrusion of lips in the articulation of /k/ is very effective in enforcing the proper lip-rounding of English /w/, especially when /w/ precedes vowels other than /a/, as in queen [k̹ʰẘin], queer [k̹ʰẘɪə], quote [k̹ʰẘoʊt], and so forth.

To master this kind of transition is a fairly difficult task for the Japanese student, because such a transition does not exist in his native language. However, it is useful to teach students to use partly devocalized consonants, because the successful use of those consonants prevents the students from inserting an unnecessary vowel between the two consonants in a cluster, e.g. [pʰḻleɪ] instead of [pəleɪ] for play, or [ṭɹ̥ɹu] instead of [təřu] for true.

5. Modification of the point of articulation of sounds in sequence.

In clusters such as /tr/, /dr/ and /θr/, as in the words true, dry, and three respectively, the phonemes /t/, /d/ and /θ/ under the influence of the subsequent component of the cluster--/r/ in this particular case--are expressed by retracted variants, as in:

true   [t̪ɹ̥u]

dry   [d̪ɹaɪ]

three   [θɾ̥i]

Clusters [-t̪ɹ̥-] and [-d̪ɹ-] are difficult for the Japanese student, because (1) the Japanese /t/ and /d/ are usually pronounced with dental articulation, whereas in [t̪ɹ̥] or [d̪ɹ], /t/ and /d/ are post-alveolar under the influence of /r/ which has post-alveolar articulation; (2) the allophone of /r/ used in these clusters is a voiced fricative [ɹ], or voiceless fricative [ɹ̥], the counterpart of which in Japanese is a flap [ɾ̥]. Only after the above differences have been clearly perceived is the student able to acquire an acceptable pronunciation of these clusters.

Finally, [θɾ̥] presents a situation a little different. Since the Japanese student can use his own [ɾ̥] (flap) sound in the cluster, his main concern is to avoid the insertion of a vowel between the consonants.

6. Different allophones in similar distribution.

Allophones used in particular consonant clusters of English are different from those used in similar clusters of Japanese: e.g.

sense   E [sɛns] ⟶ J [sɛn̪s]

new   E [nyu] ⟶ J [ɲy̆u]

These and other similar clusters are extremely difficult for the Japanese student, because the correct

pronunciation of clusters such as [ns] and [ny] requires the
acquisition of a new phonetic habit, namely the use of the
allophone [n] before /s/ and /y/ respectively, in order to
avoid pronunciations such as [seɲs] and [ɲyu] (=[ɲu]).

7. Segment adjoining clusters.

Segment adjoining clusters should be understood as
those phonotactic arrangements which do not generate any
articulatory modification.

a) The cluster [ft], as in after, does not present a
major difficulty of pronunciation, because a similar phono-
tactic arrangement occurs in Japanese as the result of the
[U] elision,[10] e.g. [ɸUt] ---→ [ɸt]. It is of course clear
that the labio-dental feature is not present in [ɸt], but
the replacement of [ɸ] for [f] works almost automatically,
probably because of a related articulation process.

b) The correct phonetic production of adjoining
segments such as any of the stops /p/, /b/, /k/, /g/, and the
lateral /l/ or the frictionless continuant /r/ requires a
rather simple adjustment, namely the avoidance of an unnec-
essary vowel segment the Japanese student is prone to insert
between the two consonants involved in these types of clus-
ters.

An effective technique for the correct pronunciation

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[10]See pp. 56-58.

of the English clusters above mentioned has been proposed,

among others, by L. A. Hill:

> " . . . , one can get the students to try putting
> their tongues and lips in the position for the next
> element in the cluster while they are holding the stop
> for the plosive, or even before they make the stop.
> Thus, when they release the plosive, their organs of
> speech will already be in the position for the next part
> of the cluster, and an intrusive /ə/ can be avoided."[11]

c) Clusters [ɫt] as in ha<u>lt</u>, and [ɫd] as in <u>old</u>,
will be easy to acquire because of their homorganic compo-
nents.

d) In treating clusters [vn̩] as in <u>even</u>, [šn̩] as in
<u>caution</u>, and [šl̩] as in <u>special</u>, the student can use the
alternate pronunciation of those clusters which have an
intrusive /ə/ between the two consonants, e.g.

[ivən]   instead of [ivn̩]

[kɔšən]   instead of [kɔšn̩]

[spɛšəl] instead of [spɛšl̩]

However, if the student is expected to pronounce
these clusters without inserting a vowel between the two
consonants, the difficulties involved in such pronunciations
are similar to those treated in the following section.

e) The five clusters listed below, together with an
illustrative example, do not offer the student any special

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[11]L. A. Hill, "Final Clusters in English," <u>English
Language Teaching</u>, 17:171, 1963.

difficulty.

      [mz]   <u>Thames</u>

      [ŋz]   <u>rings</u>

      [fl]   <u>flag</u>

      [ɫf]   <u>self</u>

      [ɫm]   <u>film</u>

In the preceding clusters, there is not any particular feature to be learned. Nevertheless, the student must get used to faster transition from consonant to consonant to prevent his inserting a vowel between them.

The hierarchy of difficulties--the subject matter of this chapter--is formulated in terms of articulation, distribution and allophones (Figure 3).

An objection may arise concerning the classification of [ns] and [ny] as the most difficult clusters in English, because it seems difficult to decide which process of adjustment is easier for learners, to learn a completely new set of articulatory features, or to eliminate phonetic habits of the student's native tongue. Although a definite answer has not been given to this question, the experience of this writer acquired in the correction of the English pronunciation of a few thousand college students in several universities in Tokyo, has demonstrated that the English cluster [ns] and similar ones of the type /n/ + fricative, are the most difficult phonotactic arrangements for the Japanese

FIGURE 3

HIERARCHY OF DIFFICULTY
OF ENGLISH CONSONANT CLUSTERS

Difficulty		Articulatory features	Clusters
Magnitude	Order	Articulatory features	Clusters
	1	Allophone difference	ns ny
I	2	Lateral release	ţl ḍl ņl
	3	Modification of point of articulation	ţɹ ḍɹ
	4	Nasal release	ţn dn
	5	Devocalization	pl̥ pr̥ kl̥ kw̥ sm̥ sn̥ sl̥
II	6	Inaudible release	pᒧt kᒧt
	7	Different transition	bl br gr fr vn šn šl fl ɬf fm mz ŋz θr zn
	8	Homorganic articulation	ɬt ɬd
III	9	Positive transfer of phonetic habit	ft
	10	(Common clusters)	dz nz dy mp mb nt nd ŋk ps ks ky sp st sk ts

student of English. Further, the experience of the writer has found confirmation in reports published by Akamatsu[12] and Giet.[13] Both linguists agree that the phonetic habit the Japanese speaking person develops in English can be attributed to the persistent use of Japanese allophones.

The cluster [dz] needs a more detailed explanation. The English cluster [dz] occurs only in the final position, as in cards, whereas the Japanese affricate [dz] never occurs in the final position. Due to this distributional difference, the cluster [dz] presents a certain degree of difficulty to the Japanese speakers of English. Nevertheless, this degree of difficulty is not exclusive to this particular cluster, because there are other clusters which do not occur in the final position, and therefore are difficult.[14] This means that as far as the degree of difficulty is concerned, the cluster [dz] should be handled in the same manner as any other clusters regardless of their distribution.

As was pointed out before, any English clusters in the final position are presumably equally difficult for the Japanese learners of English. However, English clusters [ks], [ps], and [ts], the counterparts of which exist in Japanese,

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[12]Tsutomu Akamatsu, "Some Observations in the Speech Clinic," Onsei no Kenkyuu (Study of Sounds), 11:44, 1965.

[13]Cf. p. 19 of this paper.

[14]Cf. p. 64 of this paper.

seem to be exceptions, because the vowel sound in the Japanese syllable /su/ in final position is likely to be elided when the /su/ syllable is not high-pitched. Thus, the Japanese student of English will have less difficulty in pronouncing clusters such as [ks] as in box, [ps] as in Alps, [ts] as in cats, than other consonant clusters.

The hierarchy of difficulties of English consonant clusters for the speakers of Japanese, formulated in terms of the differences of articulation, distribution, and allophones in the two languages, is applicable to those students who have mastered English segmental phonemes in isolation, and whose ideal is the acquisition of an almost-native pronunciation. Tests based on this hierarchy of difficulties should reveal the audiolingual proficiency in English of Japanese speakers.

CHAPTER VI

SUMMARY AND CONCLUSION

I. SUMMARY

The hierarchies of difficulties of English consonant clusters formulated in this paper were based on a contrastive analysis of the phonotactic systems of English and Japanese.

The fifty English consonant clusters, selected on the basis of their high frequency of occurrence, were compared with their Japanese counterparts, which were obtained by structural analysis of the syllable. The hierarchy of difficulties on the phonemic level was formulated according to the presence or absence of phonemic components of English clusters in the Japanese phonemic system. On the other hand, the hierarchy of difficulties on the phonetic level was formulated on the basis of differences and similarities of allophones, distribution, and articulatory features between the two languages.

II. CONCLUSION

The following two kinds of hierarchy of difficulties of English consonant clusters have been formulated:

A. A Hierarchy of Difficulties based on the Phonemic
Difference between the Two Languages.

Order of difficulty	Clusters
1.	fl lf
2.	ft fr lt ld lm pl bl tl dl nl kl sl šl vn θr
3.	pt kt pr br tr dr gr tn dn sn zn šn sm ŋz kw ny ns
4.	ps ks dy ky sp st sk mp mb nt nd ŋk dz ts nz

B. A Hierarchy of Difficulties based on the Articulatory Difference between the Two Languages.

Difficulty		Clusters
Magnitude	Order	
	1.	ns ny
I	2.	tl dl nl
	3.	tr dr
	4.	tn dn
	5.	pl pr kl kw sm sn sl
	6.	pt kt
II	7.	bl br gr fr vn šn šl
		fl lf fm mz ŋz θr zn
	8.	lt ld
	9.	ft
III	10.	dz nz dy mp mb nt nd
		ŋk ps ks ky sp st sk
		ts

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A P P E N D I X

SPECIAL SYMBOLS

/ /	Symbols within / / represent phonemes.
[ ]	Symbols within [ ] represent allophones.
LI	means "the language of the learner" or "the source language."
LII	means "the language to be learned" or "the target language."
E [x], J /y/, etc.:	Capital letters immediately preceding phonemic or allophonic descriptions represent various languages: e.g. E = English, G = German, J = Japanese, and S = Spanish.
--->	is read as "becomes."
in env.	means "in the environment of."

$$\begin{Bmatrix} X \\ Y \end{Bmatrix}$$ indicates a choice between X and Y.

$$\begin{bmatrix} X \\ Y \end{bmatrix}$$ indicates that X and Y are allophones of a phoneme.

V	means vowel.
V̥	means devocalized vowel.
C	means consonant.
C̬	means voiced consonant.
C̥	means voiceless consonant.
C^c	means consonant cluster.
C̩	means syllabic consonant.
Ø	means "the corresponding segment is missing in the structure of the language."