SPECULATIONS INTO THE DISTRIBUTIVE FUNCTION OF CONSONANTS AND VOWELS IN ENGLISH AND JAPANESE*

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ABSTRACT

It is proposed in this paper that the air pressure involved in producing the speech sounds of English is much stronger than that required in Japanese. Some analyses of the composition of English and Japanese words in terms of the ratio of consonant to vowel sounds in a syllable are presented to prove the point. Through this discussion, some peculiarities in the composition of English words are revealed in support of the theory of stronger air pressure being necessary in the production of English speech sounds. The proposition is further elucidated through the examination of phenomena peculiar to English.

This paper concludes that the differing levels of air pressure involved in the production of speech sounds in English and Japanese should be studied much more carefully than has hitherto been done.

This paper is an attempt to show what the most striking difference in the production of speech sounds between the English speaker and the Japanese speaker is, making use of somewhat subjective observations about the phenomena in English that might be considered as accidental coincidences unless concerned care is focused upon them.

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There may be many phonological differences between English and Japanese. There does not seem, however, to be any more conspicuous difference between the two languages than the ways in which both of the languages distribute consonantal sounds and vocalic ones in their vocabulary. When we closely examine what this difference could mean to both languages, it becomes possible to speculate that the way the English language distributes its consonants among vowels shows a preference toward strong air pressure in pronunciation, whereas Japanese structures its vowels between consonants so frequently and regularly that it may be said to show a reverse inclination.

First, let's consider English consonants and their distributions. Even a casual analysis of the number of English consonants used per vowel seems to point to the clear difference between the two languages. For example, take the following English words and see the ratio of consonants in the syllables:

S C R I P T   S T R O N G   S T R U G G L E
1 2 3   4 5   1 2 3   4 5   1 2 3   4   5

The number of consonants used per vowel is five to one. Although such a combination is not the only one, English has many words of this ratio, while such a combination would be impossible in the way in which Japanese arranges consonants against vowels. The most one can expect in Japanese as a ratio of consonants to vowels is two to one in words such as:

MINNA (everybody) KITTA (cut, past form)
GAKKO (shool)

Although English consonants can cluster around a vowel in numbers of more than three, such combinations of consonants can never, in any circumstances, occur in Japanese. This unmistakably clear difference of consonantal vowel ratio should not pass unnoticed as the carrier of an important phonological difference between the two languages.

Consonants, however, are not the only English speech sounds that behave so dramatically differently from those in Japanese. The vowels in the two languages do have a marked difference in their manners of appearance. For example, a combination of three or four straight vowels constituting a word, without a single consonant in it, can be found in Japanese in various forms as follows:

Examples of three vowels constituting a word:

AOI (blue, adj.) AOU (Let's meet.) IAI (a skill in Japanese swordplay) IEI (a poem by the deceased) EII (a position of honor) OOI (many) OUI (the throne) IEE (no) IOU (sulfur)

Examples of four vowels constituting a word:

AIOI (be born together, or grow together)
IIAU (argue) OIOI (gradually)

Such generous combinations of straight vowels do not exist in English. Therefore, some possibilities of vowel combinations may be unthinkable to the English speaker as; (1) a Japanese word can contain three or four identical vowels in a consecutive series; (2) an utterance in Japanese can collect 13 consecutive vowels in a straight series. Some examples are:

OOOKU (the inner palace)

OOOJI (granduncle)

OOOTOKO (a giantic man; an extremely big man)

OOBA (grandaunt)

KARERA WASONO HITO NO

O	O	I	A	O	I	I	E	O	A	U	I	E	NI
1	2	3	4	5	6	7	8	9	10	11	12	13	

SURU KOTO NI KIMETA.

(A translation can be: they decided on the blue house with many people as a meeting place.)

The possibility or permissibility of such a great number of straight vowels in Japanese is significant, as will be made clear in the latter section of this paper.

Differences between English and Japanese consonants and vowels in the manner of their appearance, as dicussed above, may not seem to reveal anything further than different combinations both peoples employ in arranging speech sounds. However, what Ladefoged tells us about the production of consonant sounds (Ladefoged, 1975) reveals a property of English consonants which has become a source of many speculations related to the theme of this paper.

"In order to form consonants, the airstream through the vocal tract must be obstructed in some way."[1] If, as Ladefoged says, the production of consonant sounds entails some obstruction of the airstream, English words such as "script, strong, struggle," having many more consonants around a vowel than any word in Japanese can have, should result in a much greater obstruction of air in their production. If so, the process also requires much stronger air pressure. Figure 1 depicts the passage of air in the cases of both a consonant and a vowel.

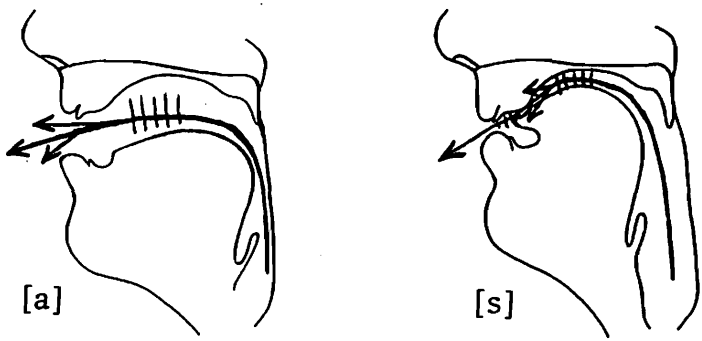

Figure 1

The two illustrations in Figure 1 are meant to show that the vowel [a] has an unobstructed airstream, whereas the consonant [s] has its airstream obstructed in two places, one at the area of the alvelar ridge and another at the raised tip of the tongue. What can be speculated from these observations is that air obstructed against a wall of solid substance, as in the case of the pronunciation of [s], can easily build up more air pressure than air pushing against a wall of air as the atomosphere enveloping the speaker's face, as in the production of a vowel sound such as [a]. Moreover, [s] has the opening gradually narrowed for the release of the compressed pulmonic air output from the oral cavity and this is also instrumental to make the air pressure in the oral cavity greater than for the vowel sound [a], which has a greater opening vailable for the release of the same output. For these reasons it can be surmised that the areas with diagonally crossed lines close to the lips should have different air pressure in the pronunciation of the two sounds, and in the case of the consonant [s] the air pressure should be stronger.

One can conduct a simple experiment to test this. While pronouncing the vowel [a], raise the tongue to the exact articulatory position of [s] and then stop voicing while maintaining equal pulmonic air output. The consonant [s] cannot be produced in this way unless there is an increase of air pressure by running the air faster within the oral cavity to make a strong hissing sound required for a correctly pronounced [s].

Similar experiments with all the other English consonants seem to prove that, concerning increased air pressure, the same can be said of almost all the English consonants. These consonants are:

[p, b, t, d, k, g, f, v, θ, ð, s, z, ʃ, ʒ].

Some exceptions seem to be:

[m, n, r, j, w, l.].

However, even with these consonants, an effort to increase air pressure in pronouncing them makes for clear pronunciation.

If the above point is granted, it becomes possible to say that each addition of a consonant sound around a vowel or in a word can result in the accumulation of air pressure in its pronunciation. If so, a generalization is now possible that because many English words have more consonants around a vowel or in a word than those in Japanese do, much more air pressure is inherently required in their pronunciation.

This simple generalization has a still greater implication when the distribution of English vowels is examined and it is proved that they, too, are arranged in such a manner as to assist the pressure of air in the oral cavity to be as high as possible. This observation leads to the ultimate conclusion of this paper; that the native speaker of English is extremely conscious of air pressure in the production of his speech sounds, whereas the native speaker of Japanese has little air pressure consciousness in his production of both Japanese and English speech sounds. An awareness of air pressure differences may deserve to be brought to the attention of the Japanese learner of English as a second language.

In order to develop this awareness, it may be best to start with a brief discussion of the manner in which the air pressure in the oral tract can be raised to its highest point in the production of a vocalic speech sound in English. If an equal amount of air, with equal pressure, were pushed out of the lungs and reached the lips, just about to pass through between them, the air pressure by then would be highest if the oral cavity and tract were narrowed to make the area of the air passage the smallest. One way in which a person can realize this effect is to lift the blade and the tip of the tongue to the height that almost reaches the alvelar ridge, and the result is the creation of a higher air pressure than the oral tract creates when the tongue is in a rest position. The resulting vowel, when phonated, is of course, the speech sound named a high front vowel, and this is the first sound in a word such as "eat".

It is important to notice that the highest air pressure among the English vowels, produced in the manner explained above, creates this sound [i], because [i] is the most frequently used vowel sound (although sometimes unstressed) in the English vocabulary. One way to prove this point seems to lie in the actual count of vowel distribution in utterances of some length by a native speaker of English. To find the vowel distribution of the Japanese version of the very same text in English, the choice of the passages tested for this study was made on the ground that a reliable translation of the original English was available. For this reason, the first couple of paragraphs from the bilingual edition of

Somerset Maugham-4 with translation and annotation by Yagi, Tsuyoshi and Goto, Mitsuyasu were chosen.[2] The paragraphs were first transcribed into broad phonetic transcription and then all the vowels in the passage were counted according to the following 8 groups of vowels. The numbers on the right side of the table are the result of the vowel count from the passage.

(1) High front vowels	[i , ɩ]	283	29%	of the total vowels
(2) Mid front vowels	[e , ɛ]	103	11%	" "
(3) Low front vowels	[æ]	71	7%	" "
(4) Mid central vowel	[ə]	265	27%	" "
(5) Low central vowel	[ʌ]	33	3%	" "
(6) High back vowels	[u , ɷ]	64	7%	" "
(7) Mid back vowels	[o , ɔ]	77	8%	" "
(8) Low back vowels	[a , ɑ]	70	7%	" "

According to the count, the high front vowels proved to be the most numerous vowels, and the second largest percentage the mid-central unaccented vowel (schwa). It is of some interest to note that [ə] can be pronounced either with the tip of the tongue raised higher than the high front vowels [i, ɩ] or lower than these. In the former case, the air pressure in the oral cavity can be maintained higher than the high front vowels. When the occurences of high front vowels and schwa are added together, they make up 56 percent of the entire vowels, which is more than half of the total vowel sounds in the passage.

When the consonants from the same passage are counted they number 1,462, and this number divided by the total of the vowels, 966, yields 1.51. This means that the consonant-vowel ratio is 1 to 1.5. As we do not have half a sound, we may form the structure CVC as the basic structure of a monosyllabic word in English. This count and its consequent form of CVC, though gathered from very small data, conform to the basic structure of monosyllabic words in the Germanic languages, as V. Y. Plotkin states in his *Dynamics of the English Phonological System*; "CVC is the cononic shape of the Germanic monosyllable."[3]

If this is the case, the frequency of the presence of the high front vowel can be mathematically calculated. As three of the vowels, when put together, constitute more than a half of the entire vowel distribution, one of them will appear in every other syllable. In other words, when a disyllabic word consists of CVCCVC, either one or the other V in that structure has to be one of the following [i, ɩ, ə]. As these vowels can keep the air pressure nearly as high as that of the consonants between the vowels, and considering the effect of coarticulation, the structure CVCCVC may, in some cases, depending upon the environments which surround the vowels, be even closer in the maintained air pressure to the form of either CCCCVC or CVCCCC. This arrangement of vowels seems to support the theory of high air pressure in the oral cavity, as no other vowels in English are allowed to appear with the same degree of frequency.

In the matter of vowel distribution, the count from the Japanese text shows quite a different result. However, a word about the transcription system employed for the purposes of this paper should be added before the data is studied. That is, the transcription is not that of phonetics but a direct replacing of what appears in a Japanese hiragana rendering of the text into romaji; or, Roman letters. The reason for this is that in Japanese, while some letters or sounds are devoiced in some cases, their actual mora duration is present in the speech. The devoiced sounds are, however, clearly present in writing, showing the combination of a consonant and its accompanying vowel which is left out in speech. Therefore, all the vowels that are present in Japanese hiragana writing are counted, without exception. However, this does not alter the results significantly, because the numbers of devoiced sounds are not large enough.

The vowel count from the Japanese text are shown in the figures opposite.

The most significant difference that emerges out of the study of the ways in which both Japanese and English speakers distribute their vowel sounds in their languages (as show in the data opposite) is that the acoustic properties of the most frequently appearing vowels in the two languages

A	348	26%	of the total vowels	
I	409	24%	”	”
U	283	17%	”	”
E	162	10%	”	”
O	396	23%	”	”
	1688			

are diametrically opposed: One is high and front and the other is low and back. This leads to a natural speculation that in English, due to the three frequently appearing vowels [ɪ ɩ, ə], and even more numerous apperances of consonants, the oral cavity tends to maintain its narrow volume. On the other hand, Japanese offers an exactly reversed picture; that is, the most frequently appearing vowel sound, [a], necessitates a great number of wide openings of the mouth, and the vowels in Japanese are surrounded by a small number of consonants. Therefore, the consequence is that a large volume of air is kept in the oral cavity with frequent wide openings of the mouth.

If the greater mouth opening in production of speech sounds is the rule of thumb for Japanese, it would be extremely difficult for the Japanese to speak their language with as much air pressure as the English speakers apply in their speaking. If a Japanese wants to apply the same pressure in speaking Japanese, it would require maintenance of greater pulmonic air pressure, because, at one end of the oral tract sits a great opening constantly releasing the coming airstream with generosity. This is quite inconceivable for other reasons, too, which are not only phonological or linguistic but also sociological and psychological. For example, a Japanese would find a speaker who used an unemotional, even tone and reserved manner of speech more polite, judicious, and pleasing than a speaker with an untrameled manner of speech, using great intonational variety and loud stress.

This discussion concerning the vowel count and its results shows the great presence of high front vowels in English vocabulary. There are many other ways to support the results of the count, and they are included in the following section of the paper.

A simple and quick way to see the overriding frequency of the high front vowels in English is to look at the English alphabet and the names of the letters in it. The way the English speaking people have arranged their speech sounds and decided on their pronunciations for the purpose of either convenience or euphony is shown in the names of the letters.

Figure 2 shows each letter of the English alphabet in order, with respective pronunciations, after which is presented a close look at the vowel constituents of each.

A	B	C	D	E	F
[eɪ]	[bi]	[si]	[di]	[i]	[ef]
G	H	I	J	K	L
[dʒi]	[eɪtʃ]	[aɪ]	[dʒeɪ]	[keɪ]	[el]
M	N	O	P	Q	R
[em]	[en]	[oʊ]	[pi]	[kju]	[ar]
S	T	U	V	W	
[es]	[ti]	[ju]	[vi]	[dəblju]	
X	Y	Z			
[eks]	[wai]	[zi]			

Figure 2

Out of twenth-six sounds represented in the alaphabet of English, 14 of them are pronounced with a high front vowel. Therefore, the percentage of high front vowels present in the pronunciation of the letters in the alphabet is 54%. The frequency of the high front vowels in quite consistent with the finding from the vowel count: the high front vowels are the most frequently appearing vowels among the vowels in English.

The much-favored high front vowels in English do not seem to receive the same favorable treatment in Japanese: a high front vowel [i] and a high back vowel [u] are the only two vocalic sounds that are entirely excluded from the standard Japanese vocabulary when they are combined with certain limited consonants. A study of the syllabary of Japanese may be necessary to see this difference clearly:

A	KA	SA	TA	NA	HA	MA	YA	RA	WA	N
I	KI	SHI	CHI	NI	HI	MI	I	RI	I	
U	KU	SU	TSU	NU	HU	MU	YU	RU	U	
E	KE	SE	TE	NE	HE	ME	E	RE	E	
O	KO	SO	TO	NO	HO	MO	YO	RO	O	

The fourth column in the syllabary shows that [ti] and [tu] are not found in the set; this is because these two sounds are not used today in standard Japanese. The substitutes for these two missing sounds are, as represented in the preceding set, "CHI" and "TSU". There is a voiced set of the consonants for "K, S, T, H." in Japanese, which are "G, Z, D, B.", but the voiced counterpart of "T" also receives the same exclusion. That is, [di] and [du] are not used in the vocabulary in standard Japanese. These four excluded speech sounds, [ti, tu, di, du.], can only find their presence in borrowed words of mostly Western origin, or in some dialects one can find in the prefecture of Okinawa.

The preceeding discussion again shows that the high front vowels are the most favored vocalic speech sounds in English. As for Japanese, according to the syllabary, it may be said that the high front vowel and high back vowel are the least favored vocalic speech sounds. One reason for this differing treatment of the vowel sounds [i] or [u] may lie in the different attitude the two language groups have in terms of the air pressure needed in the oral cavity to pronounce the sounds. In order to see what the above hypothesis means, some knowledge of the property of the vowels [i, u] should be helpful. Peter Ladefoged refers to the degree of sonority of the front vowels [i, u] as follows:[4]

> The sonority of a sound is its loudness relative to that of other sounds with the same length, stress and pitch. Try saying just the vowels [i, e, a, o, u.]. You can probably hear that the vowel [a] has greater sonority (due, largely, to its being pronounced with a greater mouth opening). You can verify this fact by asking a friend to stand some distance away from you and say these vowels in a random order. You will find that it is much easier to hear the low vowel than the high vowels [i, u.].

The same author gives estimates of the acoustic intensity of a group of sounds on comparable pitches with comparable degree of length and stress by the bar graph in Figure 3:[5]

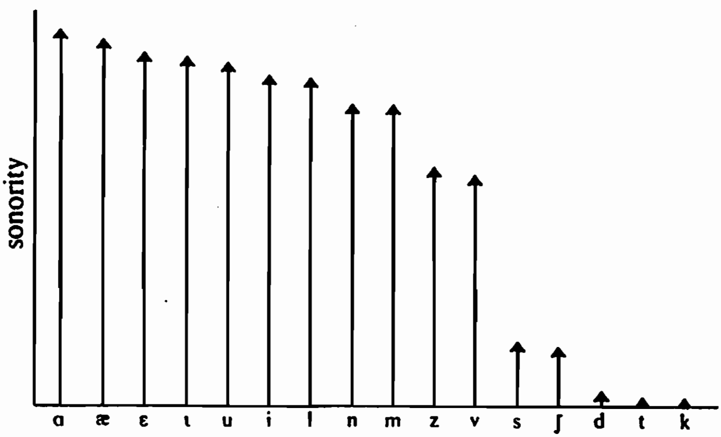

Figure 3

According to the bar graph, the high front vowel is the vowel with least sonority. It may mean that greater energy has to be applied in order to pronounce the vowel to be heard as clearly as others that have greater sonority. This fact may account for the Japanese exclusion of the vowel in some combinations, whereas English capitalizes on the very same quality of the sound. This hypothesis gains a little more ground when the consonants that have little or almost zero sonority on the graph are checked. These consonants are (d, t.] and [k]. Out of the three, two of the least sonorous consonants, [d] and [t], are excluded from Japanese in combination with the vowels which have least sonority, that is, [i] and [u]. Unlike the other two consonants [k] is not excluded, and this can also be understood from the degree of air pressure it builds up in the oral cavity. Unlike [d] and [t], [k] allows greater opening of the mouth; and, therefore, its sonority becomes higher than the two without the air pressure high in the oral cavity. Therefore, out of the three least sonorous consonants [d, t] and [k], that might be avoided in combination with the least sonorous vocalic sounds [i] and [u], only [k] is being used in combinations with [i] and [u] in Japanese.

We have observed the frequent appearances of the high front vowels in the pronunciation of the English Alphabet, and the same result can be obtained by a simply devised chart using all the English consonants and all the English vowels to examine all the monosyllabic English words having an initial consonant and an open syllable in them.

	[i, ɪ]	[ʌ]	[u, ʊ]	[e, ɛ]	[o, ɔ]	[æ]	[ə]	[a]
[m]	me							ma
[n]	knee		new					
[ŋ]								
[p]	pea, "P"				paw			pa
[b]	be, bee, "B"		boo					baa
[t]	tea, tee, "T"		to, too, two				to	
[d]	"D"		do					
[k]	Key		coo					
[g]	ghee		goo					
[f]	fee						for	
[v]	"V"							
[θ]					thaw			
[ð]	thee						the	
[s]	sea, see		sue		saw			
[z]	"Z"		zoo					

	[i, ɪ]	[ʌ]	[u, ʊ]	[e,]	[o, ɔ]	[æ]	[ɚ]	[a]
[ʃ]	she		shoe					
[ʒ]			Jew					
[w]	we		woo					
[r]			rue		raw			
[j]	ye		you, "U"					
[l]	lee		lieu					
[h]	he		who					
[tʃ]			chew					
[dʒ]	"G", gee				jaw			

The table shows that there are 26 words with high front vowels, the most frequently occuring vowels in English. Excepting [u], which are also high vowels, no other vowels can even come close in number of meaningful combinations to the high front vowels. The rest of the vowels are seen in only half a dozen words at best, [o, ɔ] and zero in some cases: [ʌ, e, ɛ , æ].

Even such a simple test using arbitary combinations of English consonants and vowels shows very clearly that the high front vowels are the most frequently occuring vowels. Consequently, we can assume that in proportion to the frequency of high front vowels in English, the speaker's need of high air pressure to pronounce words containing them should increase. From this point of view, let us make some further observations concerning the ways in which the high front vowels appear in English words.

The discussion has only dealt, so far, with words that are mostly monosyllabic, yet the frequency with which the high front vowels appear in polysyllable words in English is also unique. In the following discussion, attempts are made to point to the possibility that it may be only high front vowels that can occur in three consecutive series to make up English words. Such a combination with other vowels is either nonexistent or, if ever, extremely rare. However, with the high front vowels the case is different.

As an initial example, it is interesting to note the number of [i] s found in the following word:

"indivisibility ˈindiˌviziˈbiliti [-zəˈb-,-lət-]"

The pronunciation is taken from the way it is listed in *An English Pronouncing Dictionary.*[6]

There are seven straight [i]s in the word without any other vowels found in the same word. Such a word with a persistent usage of 7 identical vowels to the exclusion of all the other vowels is very hard to find in English. In fact, with other vowels, such a combination simply doesn't exist. (Note: various English language dictionaries list different readings of the word, such as [ində-vizə-bilə-ti].)

A word with seven identical vowel sounds in succession alternating with other consonants is not easily found in English, yet three or even four high front vowels in a straight cluster in a word without any other vowels are easy to find. Schwas in some of the following words should probably be considered, judging from orthography, as high front vowels in origin. A few words should suffice as examples to prove the point:

easy- - - -easily	repeat- - -repeated- - -repeatedly
busy- - - -busily	infinite- - -infinitive- - -infinitely
insist- -insisting	increase- - -increasing- - -increasingly
desist- -desisting	decrease- - -decreasing- - -decreasingly

The list of the words with three or four high front vowels without any other vowel sounds in the word may be counted by hundreds and may even go up to thousands, yet such a combination utilizing other than high front vowels in a word is so scarce that it almost looks as if the combination is totally absent from the English vocabulary.

The discussion so far has not shown conclusively that the high front vowels are systematically employed in English on a consistently more frequent basis than other vowel sounds. As the words studied in the preceeding discussion were collected arbitrarily, this point needs further clarification. In order to do this in a brief manner, a simple set of personal pronouns are listed and studied in terms of the presence of the high front vowels.

I HE SHE WE THEY YOU

The pronunciation of all the personal pronouns given here except "you" end with a high front vowel. Although "you" looks like one exception, there is historical evidence that "you" also utilized a high front vowel before it came to be in its present form. The archaic form of the second person pronoun was "ye", and the pronunciation was; [ji]. This pronunciation is very close to the third person pronoun "he", yet evidently "ye" and "he" must have been used contemporaneously in the past. The similarity of pronunciation of these two pronouns may have caused confusion, resulting in "ye" being gradually replaced by "you".

In addition, the second person pronoun "you" used to have other forms: "thou, thy, thee." There might also have been a confusion between the forms "thou, they, thee" and "they, their, theirs."

The high front vowels are the only vowels used in the set of personal pronouns, although there are in English many other vowels available to make the last syllables of words. When the possibility that other vowels could have been brought into the personal pronoun set is considered, a point can be made that dominant usage of the high front vowels is apparent, without regard for clarity of communication.

Finally, it would be interesting to see how the high front vowel sounds [i, ɪ] appear in sentences. All the previous discussions show that [i, ɪ] are the most frequently occurring vowel sounds in English, and as such, one can easily find an utterance or a sentence in English that collects a dozen [i, ɪ]s without any other intervening vowels:

He didn't see these three people eating tinned fish
1 2 3 4 5 6 7 8 9 10

here with me in the evening
11 12 13 14 15 16 17

She, the evil green witch, feels ease in killing sweet
1 2 3 4 5 6 7 8 9 10 11

little people with these six thin spears, which is
12 13 14 15 16 17 18 18 19

indeed weird.
21 22 23

No other vowels in English, besides the high front vowels, seem to allow such a construction. In a Japanese sentence, such a consecutive appearance of a vowel sound can only be found with two back vowels; [a] and [o]. Three of the other vowels appearing in Japanese, [i, u, e], do not seem to allow such a combination with the same degree of easiness as the other two. A couple of sentences, as examples, are:

ANATAGATA DAKARA
1 2 3 4 5 6 7 8

W A K A R A N A K A T T A N DESU
9 10 11 12 13 14

Meaning:You did not understand because you were what you were or (because of your situation.)

DAREKA GA GAKE KARA SONO OTOKO
1 2 3 4 5

TO KODOMO O OTOSO TO KOKOROMITA
6 7 8 9 10 11 12 13 14 15 16 17

Meaning: Someone tried to push the man and the child off the cliff.

The discussion up to this point has attempted to show that in the spoken English language, there is an uncommonly favored distribution of high front vowels. One reason for this is ascribed to the consciousness of high air pressure in production of speech sounds among English speakers. In Order to further examine this point, some attempts are presented in the following section of this paper.

In the preceeding discussion, the overriding frequency in occurrence of the high front vowels in the English langauge has been utilized as a possible proof of the English speaker's air pressure consciousness. The above assumption pertains to a method of inclusion or addition, for the critical question depends on how often or how many high front vowels are included in the English vocabulary. If a method of inclusion or addition to satisfy some property of a language, such as the overriding usage of a given vowel found in English, is used, it will be a highly feasible assumption that a method of exclusion to maintain exactly the same property of the language wanted is also systematically employed in that language. For this reason, the following discussions attempt to show that it is possible to look at some aspects of English using the method of exclusion, on the grounds that these phenomena received hierarchical imposition by virtue of the existence of a property of the language which has a high priority.

Before proceeding to a further discussion of the phenomena being studied, it may be of some help to depict all the sounds of English in graph form. This would make it easier to study how many parameters are available and how many are excluded from the possible combinations in terms of conditions and environments. In the following are figures for the English consonants and vowels given by Ladefoged.[7]

The two figures 4 and 5 give 13 vowels and 23 consonants (including [h, tʃ, dʒ] added in the explanation below the Figure 4) that are available for the possible combinations of speech sounds in English. If no restriction in particular is placed in the choice of speech sounds to be combined in order to compose words in the language, equal distribution of these sounds in every environment would seem to be the natural outcome. Further, ease in communication would be more efficiently attained by the equal participation of all available sounds in every available environment. However, this is not the case for the English language: out of twelve vowels (excluding a rarely used [ɒ] five of them are always excluded from appearing at the end of English words. These vowels are [ɪ , ɛ , æ , ʊ , ʌ]; the set of vowels classified as lax vowels. This exclusion of lax vowels from the English

Manner of articulation \ Place of articulation	bilabial	labio-dental	dental	alveolar	palato-alveolar	palatal	velar
nasal	m			n			ŋ
stop	p b			t d			k g
fricative		f v	θ ð	s z	ʃ ʒ		
(central) approximant	(w)			r		j	w
lateral (approximant)				l			

Figure 4

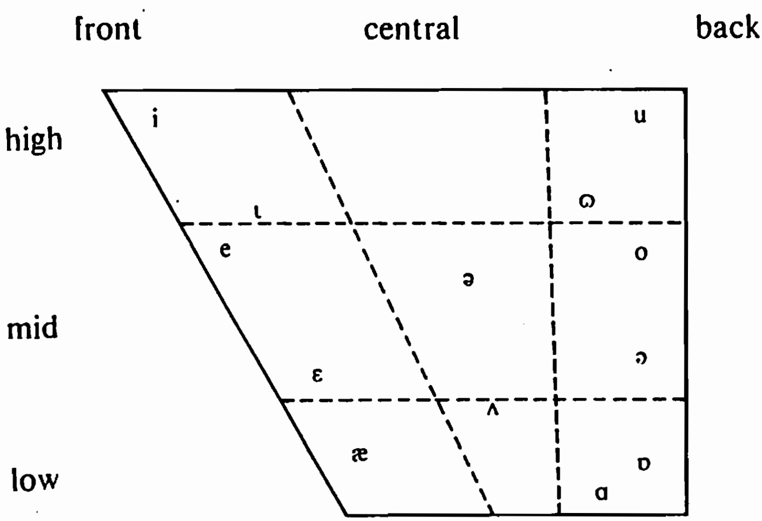

Figure 5

vocabulary in forming open syllables at the end of words results in the cutting almost in half of the possible number of open syllables in this position in English. This restriction, "numerically neutral" so to speak, is quite a heavy exclusion and selection.

Ladefoged refers to the three sets of vowels in pairs of a tense and lax vowel, [i, ɪ], (eɪ, ɛ] and [u, ʊ]: "In each of these pairs the lax vowel is shorter, lower, and slightly more centralized than the corresponding tense vowel."[8] The quality of the tongue position being lower and slightly centralized in pronouncing these vowels can be viewed in terms of air pressure as follows: When the tongue is lower and more centralized, the air pressure in the oral cavity is also low. The exclusion of [ʌ] and [æ], also, may be attributed to this effect of lowering the air pressure in the oral cavity. By the same token, [ə] is not excluded from the vowels that can form open syllables, because a schwa can be pronounced with the tip of the tongue higher than any other vowels, thus never decreasing the air pressure as drastically as other lower vowels. Therefore, the schwa has an ability to maintain the air pressure in the oral cavity and it is allowed to form open syllables, whereas the lax vowels tend to decrease the air pressure in the oral cavity and therefore are excluded as not being desirable in forming open syllables at the end of words.

Ladefoged also mentions that lax vowels are shorter than tense vowels, and this seems to stand to reason if the pronunciation of them is considered from the point of air pressure in the oral cavity. If these lax vowels do not create enough air pressure in pronouncing them, shorter duration in pronouncing them will work better toward the preservation of the air pressure in the oral cavity that might be weakened by longer duration in pronunciation, which may make the preservation of air pressure, or the creation of it after the weakened air pressure, slightly more difficult.

If exlcusion, as explained above, is reflected in the manner in which the vowels at the end of the words are arranged, it seems to be a reasonable assumption that any sound that comes at the end of the word and decreases the air pressure in the oral cavity should be prevented from occurring at the end of the word. This should be applied to the consonants of English as well. Examination of the distribution of the English consonants proves this to be the case.

However, most of the English consonants require some obstruction of air; therefore, they meet the requirement of air pressure consciousness of the speaker. There is one consonant, though, that does not require a closing of the lips, nor a raising of the tongue to seriously obstruct the coming airstream from the vocal tract. This rare consonant is [h]. The search for the [h] in a final position shows zero distribution in this place. Therefore, this seems to be best explained as the phenomenon of air pressure consciousness at work among English speakers.

If such strong consciousness of air pressure in speech sound production is reflected in the manner in which English words end, it is again quite reasonable to assume that the same reflection should also be found in the manner in which English words deal with the initial sound or sounds of a word. This prediction is not entirely without support, and the point may be best explained by a brief discussion of the ways in which English consonants and vowels are produced.

Consonants are produced by some obstruction of the airstream in the oral cavity. As consonsants constitute the majority of the English speech sounds, many more words start with consonants than with vowels. A word with a consonant at the beginning of it does not cause any trouble as regards the pressure of the air in its pronunciation. In case of a vowel in the initial position of a word, the matter is somewhat different, because no lip closing occurs and the air in the oral tract flows out of the oral cavity with least obstruction. When one's breath runs out of the oral cavity without any obstruction, it becomes very difficult to maintain high air pressure in the oral cavity. When two vowels appear in a consecutive series in conversation, the amount of the air that flows out of the oral cavity and subsequent lowering of the air pressure in the oral cavity can be quite strong. Therefore, if the speaker considers the preservation of air pressure in the oral cavity as some property of linguistically high priority, the generous airflow in pronouncing two vowels in a consecutive series has to be prevented one way or another. Here, some device can be found in the manner the English speaking people follow some linguistic rule. In the following is a set of English nouns with grammatically correct articles placed in front of them.

(1) a tree, a flower, a river, a cat, a pig, a monkey, a girl.
(2) an egg, an apple, an organge, an eagle, an American.

What this grammatical mandate forbids is such a comination as

(3) a egg, a apple, a orange, a eagle, a American

One reason for this may be found in the degree of priority the English speaker feels in maintaining high air pressure in the oral cavity: combinations of vowels in such words as "a apple, a orange, etc." require the pronunciation of two consecutive vowels and unobstructed air flow of some duration equal to the length of the two vowels combined. The result would be a drastic decrease of the air pressure in the oral cavity.

As "an" came from "one" in Old English, the presence of [n] here may not be a conscious selection, yet as the form, "an tree, an pig, etc." is not the final reduction from "one tree, one pig, etc." some reason must have interfered in the simplification of "one" into two distinct forms of the indefinite article; that is, into "an" or into "a". In a natural situation simplicity may be preferred provided that function sees no damage in simplification. Therefore, if, although only if, simplicity was the highest priority among the reasons for the reduction of "one" to "an" and "a", either one of the forms given below might have been the most natural result of the reduction:

(1) a tree, a egg, a flower, a apple, a cat, a orange, a American
or
(2) an tree, an egg, an flower, an apple, an cat, an Englishman.

As this is not the case, the present forms can be said to be a complication of the old form that utilized a single pattern: "one tree, one apple, one pig, one orange, etc.".

All the nouns listed above can take the definite article "the", yet the pronunciation of this article differs according to the quality of the sound immediately following. When followed by a consonant, it is [ðə] and when a vowel it is [ði]. The raising of the tongue before the vowel sound in producing [ði] seems to be consistent with the high consciousness of air pressure in the oral cavity. As with [n] in "an", [i] pronounced before a vowel instead of a relaxed schwa [ə] seems to work better to sustain air pressure by narrowing the space in the oral cavity by its lifted tongue position.

If two consecutive vowels are banned from the desired combination of English speech sounds by one facet of grammatical inhibitions, it will be of some value to see if this phonological exclusion has cast any restriction on this vocalic combination in some additional environments available in the English language. English, unlike Japanese that allows double or even triple or greater vocalic combinations, does not favor the combination of two vowels in consecutive series within a word. What comes close to this combination can be found in what is classified as diphthongs in English. An examination of one quality of dipthongs can provide some additional insight into the manner in which a combination of vowels (which might be a double vocalic construction in other languages) is treated in English.

Ladefoged cites six dipthongs and explains them.[9] These six dipthongs are; [aɪ, eɪ, ɔɪ, aʊ, oʊ, ju]. As the dipthongs involve a change in quality within one vowel, and the change can be described as a movement from one vowel to another, the direction of the movement can be graphed as in Figure 6.

A reordering of the six dipthongs from the order Ladefoged cites according to the proximity of the last vowel can show the direction of the movement within the vowel: that is, [aɪ, eɪ, ɔɪ, aʊ, oʊ, ju]. All the last vowels in these six dipthongs are high vowels which are equally distributed in a set of three between the front and back vowels. Therefore, all the arrows showing the direction of the movement in figure 6 except one, are upward, which means narrowing

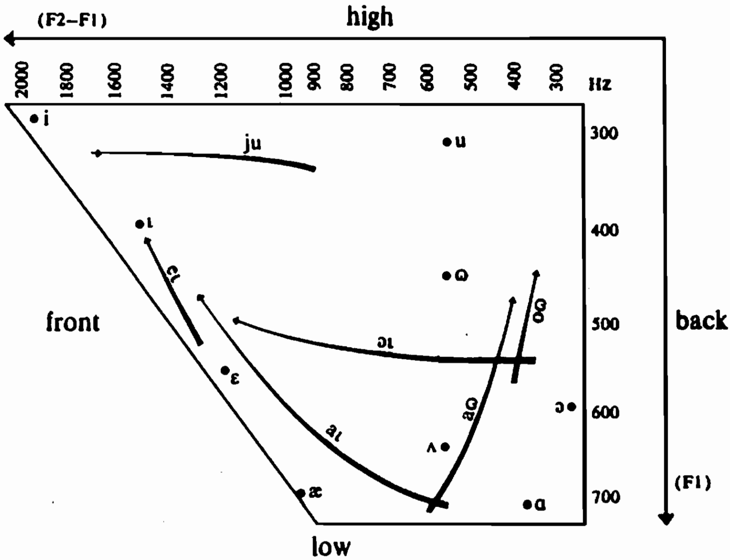

Figure 6 The relative auditory qualities of some of the vowels of American English

the space of the oral cavity. Consequently, the pronunciation of any of these diphthongs builds up pressure toward the end of the sound. One exception seems to be [ju], for the arrow seems to show a downward direction. In pronouncing [ju], however, one can find the direction of the movement from [i] to [u] tends to build more pressure than the reverse movement; that is from [u] to [i]. One reason for this may be found in a possibility that the oral cavity is more narrowed and constricted toward the last vowel in the former case.

This quality of diphthongs in English is one of the signs of air pressure consciousness because diphthongs are composed in such a manner as to preserve some air pressure toward the end of the sounds. By the same token, a possible support can be derived from the fact that a diphtongal construction that results in the reverse movement of the vowels is not found as such. In other words, there are no English diphthongs whose movements of the arrows in the graph can be downward, which would be described as [ɩa , ɩe , ɩɔ , ɷa, ɷo , uj]. These diphthongs, if they existed, would necessitate a greater opening of the mouth toward the end of the sound, thus decreasing the air pressure in the oral cavity. Such a quality of diphthongs should go against the intuitive perception and requirement of sustained air pressure in the oral cavity among the English speaking people.

In discussing the movement of the vocalic sounds and diphthongs, it should be noted that the present English vowels have not always been in the English words as they are today. Regarding the history of the vocalic movements known as the Great Vowel Shift, Albert C. Baugh has the following explanation to give as quoted in Figure 7.[10]

The diagram given by the author shows that the direction of the changes of the long vowels is only upward. If this is the case, all the changes found in the Great Vowel Shift only increase the air pressure in pronouncing the words containing them. If so, the English speaking people have been trying to lift their vowels toward the high vowels and the efforts have been continued generation after generation, covering many centuries.

The discussion in this paper is presented to point out that those learning English as a second language should realize that there is among English speaking people such a phenomenon as air pressure consciousness in the production of speech sounds. A similar consciousness is not seen in Japanese to any comparable degree. Therefore, in the future, study and research should be more vigorously conducted in comparing the two languages, English and Japanese, in terms of the air pressure involved in the production of their respective speech sounds.

The Great Vowel Shift. The situation is very different when we consider the long vowels. In Chaucer's pronunciation these had still their so-called 'continental' value,—i.e., *a* was pronounced like the *a* in *father* and not as in *name*, *e* was pronounced either like the *e* in *there* or the *a* in *mate*, but not like the *ee* in *meet*, and so with the other vowels. But in the fifteenth century a great change is seen to be under way. All the long vowels gradually came to be pronounced with a greater elevation of the tongue and closing of the mouth, so that those that could be raised (*a*, *ę*, *ẹ*, *ǫ*, *ọ*) were raised, and those that could not without becoming consonantal (*i*, *u*) became diphthongs. The change may be visualized in the following diagram:

Such a diagram must be taken as only a very rough indication of what happened, especially in the breaking of *i* and *u* into the diphthongs *ai* and *au*. Nor must the changes indicated by the arrows be thought of as taking place successively, but rather as all part of a general movement with slight differences in the speed with which the results were accomplished (or the date at which evidence for them can be found).

Figure 7

NOTES

[1] Peter Ladefoged, *A Course in Phonetics* (New York: Harcourt, 1975), p. 6.

[2] Tsuyoshi Yagi and Mitsuyasu Goto, *Somerset Maugham-4* (Tokyo: Nanundo, 1959), p. 1-6.

[3] V. Y. Plotkin, *The Dynamics of the English Phonological System* (The Hague: Mouton, 1972), p. 74.

[4] Ladefoged. p. 219.

[5] Ladefoged. p. 220.

[6] Daniel Jones, *An English Pronouncing Dictionary* (New York: E. P. Dutton, 1943), p. 224.

[7] Ladefoged. p. 33–4.

[8] Ladefoged, p. 74.

[9] Ladefoged. p. 70–1.

[10] Albert C. Baugh, *A History of the English Language* (Englewood Cliffs, N.J.: Prentice-Hall, 1978), p. 238.

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