Preface

Some psychologists and philosophers draw a distinction between sensation and perception. Sensation is said to have a raw, unprocessed quality, while perception is said to have the interpreted meaning of sensory activities. But the distinction between sensation and perception is difficult to justify on the basis of what we now know about how sensory receptors and their combined brain areas can work. At each stage of sensory receptors themselves, the particular and selective characteristics of the nerve cells impose expectation and order on sensory signals. The discrimination of stimuli and their cognitive interpretation is inextricably linked even within our sensory systems.

When we see a tree, we keep its feature as perceptive symbol in our brains. See figure 1. The feature is much like the tree but is quite different in materials. Moreover even if we don't see the tree directly in front of us, the image of the tree is preserved in our memories. Our mental operation cannot go without the mediation of image. Image varies at various level of abstraction. There is image from the one close to perceptive symbols to the schematic one. Image is formed by the selective extraction of necessary information for mental operation from perceptive symbols. Image has the status as symbolic representation as long as it is a semiotic tool with which we recall and think what is perceived. Some philosophers name the image combined with conception an idea. The hierarchy of layers of image give rise to structural meaning, conceptional sound, and conceptional rhythm.
In psychology the reproduction of perceptive symbols are all classified into image. We have not only visual image, auditory image, the palate image, the olfactory image, the sense of pain image, muscular motion image, and motion image, but also joint image combined with other image. Among the image which relates to language are phonetic image (auditory image), letter image (visual image), sign language image (visual image), braille image (sensation pressure image), and so on.

This treatise intentionally refers to visual spatial image. Animals are gifted with a marvelous command of visual spatial image in order to compensate for lack of verbal communication. It is by this visual spatial image that every human child develops a deep understanding of his or her mother tongue. Language itself is meaningless without common understanding of image among those taking part in conversation. Revisiting visual spatial image provides us with the ability of instant recall which leads to the habitual use and understanding of language.

I Analogy and abacus

Philosophers, scientists and lawyers have studied and discussed analogy since classical antiquity. The last few decades have shown a renewed interest in analogy which is most notable in cognitive science. In ancient Greek the word analogia originally meant proportionality in the mathematical sense, and it was translated into Latin as proportio. Ever since analogy was understood as identity of relation between any two ordered pairs, whether they are of mathematical nature or not. Contemporary cognitive scientists consider analogy to be both the cognitive process of transferring from a particular subject (the source) to another particular subject (the target) and a linguistic expression corresponding to such a process. According to their view, analogy depends on the mapping or alignment of the elements of source and target. The mapping takes place not only between objects, but also between relations of relations between objects.

Abacus has reflected the external world. There must be similarity between abacus and the external world. In other words there must be a kind of correspondence, similar structural conformity between the structure of the external world and the one reflected on abacus. Abacus is supposed to have evolved historically in order to make a corresponding relation to the external world.

II A brief history of abacus

A brief history of abacus makes clear the seven principles of abacus calculation. Both mental abacus and mental English abacus are based on the same principles of abacus calculation. Mental calculation is the practice of
doing mathematical calculation using the human brain with no help from any computing device. Mental abacus is an abacus-derived visual spatial memory device for digits. Mental English abacus is an abacus-derived visual spatial memory device for learning English.

The spiral evolution of abacus can be divided into four ages: the prehistoric ages, ancient ages, the middle ages and modern times.

In the prehistoric ages the earliest counting boards consisted of a tray made of sun dried clay or wood. A thin layer of sand would be spread alike on the surface, and symbols would be drawn in the sand with a stick or a finger. To start a calculation anew, one would shake the tray or level the sand by hand.

Ancient times is the period from about 300 B.C. to about 500 A.D. We have the Salamis Tablet, the Roman calculi and the Hand-abacus.

Gradually the use of sand gave place to the use of pebbles and they were placed in parallel grooves carved into stone counting boards. The oldest counting board that survives is the Salamis Tablet used by the Babylonians about 300 B.C. During Greek and Roman times, surviving counting boards like the Roman hand-abacus are constructed from stone and metal. The Romans developed their hand-abacus as the first calculating device for engineers, merchants and tax collectors. It reduced the labor of the basic operations of Roman arithmetic with Roman numerals. The late Roman abacus shown below has seven longer and seven shorter grooves for whole number counting. The rightmost two grooves was used for fractional counting. In the bead arrangement Roman abacus has one bead in the shorter upper grooves and four
beads in the longer lower grooves. Some people believe that Roman abacus which predates Chinese abacus suan-pan was introduced into China early in the Christian era by trading merchants.

Roman abacus

![Roman abacus diagram]

The middle ages is the period from the end of 500 A.D. to about 1400 A.D. We have the Apices, the Coin-board and the Line-board in Europe. Wood is the primary material of which counting boards were manufactured. The orientation of the beads switched from vertical to horizontal. In the latter part of the middle ages the use of abacus began to cease since arithmetic using written numbers became popular.

![Apices, Coin-board, and Line-board diagrams]

In the Mayan civilization, the Aztec abacus has been dated back to the 10th century. The counting beads were made of maize strung along parallel wire or strings within a frame of wood. There was a bar across the frame that separated the counters into 3 above the bar and 4 below the bar. This was consistent with the vigesimal system used in ancient Aztec civilization as well as the Basques in Europe.

Modern times is the period from about 1200 A.D. to the present. We have the Chinese Suan-pan, the Japanese Soroban and the Russian Schoty.
The 2/5 abacus called suan-pan appeared in China in about 1200 A.D. The abacus had two beads on each rod on the upper deck and five on the lower deck. The 2/5 style survived unchanged until the 1/5 abacus appeared. The Japanese began to use and evolve the 2/5 abacus via Korea in about 1600. Around 1880 it was modified to have only one bead above the reckoning bar while maintaining the five beads below. The 1/4 abacus appeared in about 1930 and it is a style preferred and manufactured in Japan today. The Russian devised their own abacus and called it schoty. The schoty has ten beads per rod and no reckoning bar. Each bead is one unit counter. The fifth and sixth beads usually have a contrasting color to help a calculation.

Mental abacus is a rapid, accurate, and automatic mental system for representing numbers. The acoustic strategy of common people has to access a number of many figures from a larger figure in listening order, while the visual spatial strategy of advanced abacus operators makes it possible to be accessible directly to every part of a number of many figures. This system is being propagated in China, Singapore, South Korea, Thailand, Malaysia, and Japan.

III The seven principles of abacus calculation

We inherit our genes from our ancestors. So we can see in us not only ourselves, but also our ancestors. We can show you the seven principles of abacus calculation to make use of the 1/4 standard abacus in light of abacus history.

The seven principles of abacus calculation are:

1. change of materials
2. orientation of the beads
3. bead values
4. unit rod
5. always work from left to right
6. a state of preparedness
7. two digits technique
The 1/4 standard abacus comes in various sizes and is constructed of various types of hardwood. The change of materials from sand to visual spatial image is a source of the innovation of calculation. Discussions have focused upon whether the visually handicapped could develop an equivalent tactile spatial mental abacus as they do practice; in other words, whether representational changes in digit memory would be observed among the handicapped. The answer is Yes! This is the principle of change of materials.

The frame of the 1/4 standard abacus has a series of vertical rods on which a number of beads are allowed to slide freely. In this type of abacus how to set and remove numbers is vertical, but how to read the resultant number is horizontal. This is the principle of orientation of the beads. See table 1.

<table>
<thead>
<tr>
<th>Ancient Times</th>
<th>Salamis</th>
<th>Calculi</th>
<th>Hand-abacus</th>
</tr>
</thead>
<tbody>
<tr>
<td>INPUT</td>
<td>vertical</td>
<td>vertical</td>
<td>vertical</td>
</tr>
<tr>
<td>RESULTANT</td>
<td>horizontal</td>
<td>horizontal</td>
<td>horizontal</td>
</tr>
<tr>
<td>The Middle Ages</td>
<td>Apices</td>
<td>Coin-board</td>
<td>Line-board</td>
</tr>
<tr>
<td>INPUT</td>
<td>horizontal</td>
<td>horizontal, vertical</td>
<td>horizontal</td>
</tr>
<tr>
<td>RESULTANT</td>
<td>horizontal</td>
<td>vertical</td>
<td>vertical</td>
</tr>
<tr>
<td>Modern Times</td>
<td>Suan-pan</td>
<td>Soroban</td>
<td>Schoty</td>
</tr>
<tr>
<td>INPUT</td>
<td>vertical</td>
<td>vertical</td>
<td>horizontal</td>
</tr>
<tr>
<td>RESULTANT</td>
<td>horizontal</td>
<td>horizontal</td>
<td>vertical</td>
</tr>
</tbody>
</table>

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A horizontal beam separates the frame into two sections. Each bead in the upper deck has a value of 5; each bead in the lower deck has a value of 1. There is identity of bead value relation between any 5-unit counter and 1-unit counter. This is a relation of master to servant. We call it principle of bead values.

You will notice that a dot is marked on every third rod along the length of the beam. These specially marked rods are called unit rods because any one of them are designated to carry the unit number. The soroban operator makes a rapid decision on whose rod they should select to carry the unit number. To carry the unit number means to put a number into the next raw to the left when you are adding the numbers together. It is common practice to choose a unit rod just to the right of center on the soroban. The dots also serve as markers by which larger numbers can be quickly and efficiently recognized. The rods ensure us that all subsequent numbers can be set on their correct rods. This is the principle of unit rod and it is also called the principle of unit window when we regard several rods as one unit. This is, as it were, the principle of the horizontal relation of master to servant.

Fundamental is to soroban technique is the rule always work from left to right. This is the biggest advantage of soroban. It enables us to calculate at speed, because numbers are added and subtracted in the same way as we read and hear them. To have a good understanding, take the addition example $337 + 241 = 578$. According to the principle of always work from left to right, set 337 onto soroban. Then add 2 to the hundreds rod, 4 to the tens rod and finish by adding 1 to the units rod leaving 578. It is the same for subtraction. Take the example $185 - 123 = 62$. According to the same principle, set 185 onto soroban. Then subtract 1 from the hundreds rod, 2 from the tens rod and 3 from the units rod leaving 62.

The principle of always work from left to right

![fig.8](image)
Calculation normally begin with an cleared soroban. You can do this by slanting your abacus toward you and gravity pulls all the beads down. This state of preparedness is called shimoyose in Japanese. Next place soroban flat on the table, then tilt the frame up away from you. Gravity pulls all the beads up. This state of preparedness is called uwayose in Japanese. Start form shomoyose state of preparedness and then move up all the 5-unit beads by running the forefinger of your right hand between the 5-unit beads and the bar from left to right. You can get nakaake state of preparedness. Start form shomoyose state of preparedness and then move up all the 1-unit beads by running the forefinger of your right hand between the 1-unit beads and the lower frame from left to right. You can get nakayose state of preparedness. They are the elements of abacus calculation.

Use only the thumb and index finger to manipulate beads on soroban. The thumb moves the earth beads up toward the beam. The index finger moves everything else. This is the principle of two digits technique.
IV English abacus

English abacus consists of four windows, that is to say, the rhythm pattern window, the phoneme system window, the sentence pattern window, and the paragraph pattern window. You will notice that four windows are placed on a logical hierarchy along the length of abacus. These specially arranged windows are called unit windows, because any one of them are designated to carry a unit window. To carry a unit window means to put a window into the next window to the right when you are listening, speaking, reading, and writing English. The soroban operator makes a rapid decision on whose window they should select to carry the unit window. It is common practice to choose the sentence pattern window just to the left of the paragraph pattern window or the rhythm pattern window just to the left of the phoneme system window on abacus.
The paragraph pattern window is the most universal, regulative and narrative from the content's viewpoint. It defines all the other windows. The sentence pattern window is defined by the paragraph pattern window and defines the phoneme system window. The rhythm pattern window is defined not only by the phoneme system window, but also by all the rest windows.

V The paragraph pattern window

Each rod represents a meaning paragraph which is divided not formally in print, but interpretatively in contents. Number 1, 2, 3, 4, 5 beads are all called a topic sentence of each paragraph. The number of the topic sentence varies in the statement size. Number 1 bead becomes a whole topic sentence when it means some broad statement that indicates the general nature of not only the first paragraph but also all the paragraphs. Number 5 sentence becomes a concluding sentence when it means some concluding statement of not only the last paragraph but also all the preceding paragraphs. All the beads in the lower deck are called supporting sentences of each paragraph. Any supporting sentence tries to unite and exemplify the paragraph which they belong to.
We have the five paragraph patterns in English. They are named from the first pattern paragraph to the fifth pattern paragraph. The figure 14 below shows a formal practice of the five paragraph patterns by abacus. When a teacher utters rhythmically “the first paragraph pattern”, students input onto abacus the beads according to the ordinal number shown in the abacus beads. The sequence of the number in the bead corresponds with the sentence order in which students listen to English. Clear abacus by running the forefinger of your right hand between the 5-unit beads and the bar from left to right.

**The first paragraph pattern**

This type describes a scene or events step by step. Theme (topic) is not always expressed. But it does not follow that this type lacks unity. Where is the theme of this type? The theme is implied in the collection of sentences in which the different items of description are conveyed.

**The second paragraph pattern**

This type cognitively fragments things and describes them in mutually fragmentary sentences. These sentences seem to be unrelated but have unity at the bottom.

**The third paragraph pattern**

This method of stating the theme in the opening sentence has been widely practiced by the best writers. All that follow in the same paragraph exemplifies this general statement.

**The fourth paragraph pattern**

This type makes a gradual approach to the conclusion from the outskirts. The concluding sentence is made to have some brief comment on what has gone before or a summing-up of the whole paragraph or something that will make reader feel that the paragraph is closed.
The fifth paragraph pattern

This type is a combination of the third and the fourth paragraph pattern. The opening sentence is the most natural position for the theme and what is stated in the opening sentence is reassured in other words in the concluding sentence.

Fig. 14

Next we can show four examples of practice of the paragraph patterns including supporting sentences. See figure 15. An input technique for pinching together the heaven beads and the earth beads makes the principle of always work from left to right very intelligible. To clear abacus use only your forefinger.

The first paragraph pattern, under three topic sentences, two supporting sentences each.

The third paragraph pattern, under the whole topic sentence, two supporting sentences.

The fourth paragraph pattern, under the concluding sentence, two supporting sentences each.

The fifth paragraph pattern, under three topic sentences, two supporting sentences each.

Fig. 15
VI Image of a conceptual model of general actions

In a typical action an agent does an act with an instrument which affects a patient (the movable object of the act) and as a result, the location or the state of the patient is changed. This conceptual model of general actions covers not only a concrete action of daily life but also a physiological action and abstract thinking. We do not always use an instrument but an instrument is indispensable for the model because our parts of bodies work as a kind of instrument. For example our foot functions as an instrument to kick a patient though it is not called an instrument. An English speaker seems to verbalize an action on this conceptual model of general actions. We can verbalize the same scene in another way. It is because we can include a speaker's angle in a conceptual model of general actions. The speaker's angle is a source of the five sentence patterns. In the first sentence pattern and the second sentence pattern an agent does an act with an instrument which affects himself.

![Conceptual model diagram](image)

fig.16

![Sentence patterns](image)

fig.17
VII The five sentence patterns window

![Diagram of sentence patterns]

**fig.18**


Each rod in the upper deck represents four fundamental elements of sentence which are called S, V, O and C. An element M is in the rod of the lower deck. The four fundamental elements and their modifiers bear relation of master to servant. Any modifier tries to clarify, define and specify the elements which they belong to. See "a man wearing glasses" of figure 19.

Japanese explains first the parts or states of affairs of the whole.

![Japanese example]

English explains first the whole and gradually brings into focus.

![English example]

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We have the five sentence patterns in English. They are named from the first sentence pattern to the fifth sentence pattern. The figure 20 below shows a formal practice of the five sentence patterns by abacus. When a teacher utters rhythmically “the first sentence pattern”, students input onto abacus the beads called S, V, O, and C. The sequence of the number in the bead corresponds with the syntactic order in which students speak or listen to or write or read English. To clear abacus by running the forefinger of your right hand between the 5-unit beads and the bar from left to right.

The first sentence pattern

The second sentence pattern

The third sentence pattern

The fourth sentence pattern

In a real practice of the five sentence patterns on the soroban, we must provide one and the same sentence pattern with various kinds of English sentences. The five sentence patterns must be learned step by step.

VIII The phoneme system window

Phoneme is the smallest unit of speech which is capable of conveying a distinction in meaning, as the m of mat and the b of the bat in English. Some linguists restrict the term to vowels and consonants, and others use it including differences of pitch, stress, and rhythm.

A phoneme has variants called allophones which differ phonetically without affecting meaning. It is the theoretical representation of a sound. Therefore it is a conception of a sound. Phonemes can be recorded with the International phonetic Alphabet.

A phoneme is a sound without reference to its position in a word or phrase. Each phoneme in a speech acquires its identity by contrast with other phonemes.
IX The rhythm pattern window

Rhythm is timing patterns among syllables. Stress-timed and syllable-timed are two opposite type of rhythm. Stress-timed rhythm is determined by feet. One foot covers from a stressed syllable to directly before the next stressed syllable. It occurs at regular intervals of time having an uneven and changing number of unstressed syllables. Syllable-timed rhythm is determined by grouping syllables since each syllable takes almost the same amount of time. The table 2 below shows how different stressed syllables and unstressed ones are from each other in three special features: loudness, length, and pitch. Stressed syllables are not only louder but also longer and higher-pitched than unstressed syllables. Vowels in unstressed syllables are reduced when we try to pronounce them smooth and fast.

The table 2

<table>
<thead>
<tr>
<th></th>
<th>loudness</th>
<th>length</th>
<th>pitch</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>vowel length</td>
<td>vowel clarity</td>
<td></td>
</tr>
<tr>
<td><strong>Stressed syllables</strong></td>
<td>loud</td>
<td>long</td>
<td>full</td>
</tr>
<tr>
<td><strong>Unstressed syllables</strong></td>
<td>quiet</td>
<td>short</td>
<td>reduced</td>
</tr>
</tbody>
</table>

Gilbert (1987) has stated that the base line in English is a basic emphasis pattern. The following table 3 introduces the basic emphasis pattern of English. Content words are usually emphasized (stressed), while structure words are usually reduced and de-emphasized (unstressed). Content words carry the basic meaning of a sentence such as the noun “cup” or the verb “walk.” Structure words represent grammatical relationships such as the pronoun “she” and preposition “of.” See table 3.

Table 3

The “basic” emphasis pattern of English

<table>
<thead>
<tr>
<th>Content Words</th>
<th>nouns</th>
<th>main verbs</th>
<th>adverbs</th>
<th>adjectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>(emphasized)</td>
<td>(cat)</td>
<td>(runs)</td>
<td>(quickly)</td>
<td>(happy)</td>
</tr>
<tr>
<td>question words</td>
<td>who, what, where, when, why, how</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>demonstrative pronouns</td>
<td>(this, that, these, those)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Structure Words</th>
<th>pronouns</th>
<th>prepositions</th>
<th>articles</th>
<th>“to be” verbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>(de-emphasized)</td>
<td>(he, she)</td>
<td>(of, to, at)</td>
<td>(a, an, the)</td>
<td>(is, was)</td>
</tr>
<tr>
<td>“to have” verbs</td>
<td>conjunctions</td>
<td>auxiliary verbs</td>
<td>(has, have, had)</td>
<td>(and, but)</td>
</tr>
</tbody>
</table>

(adopted and modified from Gilbert, 1993, p.72)
The concept of the phoneme is of a great significance to structuralism, because it substantiates that meanings depend on an abstract system of differences. See figure 21. The 5-unit counters represent eight English vowels on the beam. We can do practice of eight English vowels from nakaake state of preparedness. In case of consonants The 5-unit counters represent eight English consonants which are called the first consonant pattern. They are voiceless sounds. The second consonant pattern has three nasal sounds. The third consonant pattern has three semivowels. The fourth consonant pattern has consonant “L”, voiced alveolar lateral sound. The fifth consonant pattern consists of the voiced sounds of the first consonant pattern.

The vertical line of the consonants on the same rods has some agreement in pronunciation. We can do practice of twenty two English consonants from shimoyose state of preparedness. Use “heaven beads up and earth beads up” technique vertically along the rod or horizontally along the beam. See figure 21.

![Figure 21](image_url)
We have the basic seven rhythm patterns for students' regular practice. Start from nakaake state of preparedness of the rhythm window and input beads vertically on one rod after another. You can get figure 22.

The basic seven rhythm patterns

1. リズムパターン 1 [●・]
   habit/picture/like it/see you

2. リズムパターン 1 [●●]
   okay/hello/let's go/how nice

3. リズムパターン 2 [●●●]
   Some coffee?/I like it./I'll see you./Goodbye, now.

4. リズムパターン 3 [●●●]
   Here's your book./Stop the noise./Send some help. /How's the job?/Pretty good./glad to hear

5. リズムパターン 5 [●●●]
   Can I help?/Is she here?/In her room?/What a day!/I forgot.

6. リズムパターン 4 [●●●●]
   Where did she go?/This is my wife./How do you do?

7. リズムパターン 6 [●●●●]
   Can I help you?/Should I leave now?/That's a nice one./He's my brother.

fig.22
Image abstracts rhythm patterns. We can see the abstraction of image in the nursery rhyme “Jack and Jill.”

Jack and Jill went up the hill,

\[
\begin{array}{cccc}
\cdot & \cdot & \cdot & \cdot \\
\cdot & \cdot & \cdot & \cdot \\
\end{array}
\]

To fetch a pail of water.

\[
\begin{array}{cccc}
\cdot & \cdot & \cdot & \cdot \\
\cdot & \cdot & \cdot & \cdot \\
\end{array}
\]

Jack fell down and broke his crown,

\[
\begin{array}{cccc}
\cdot & \cdot & \cdot & \cdot \\
\cdot & \cdot & \cdot & \cdot \\
\end{array}
\]

And Jill came tumbling after.

\[
\begin{array}{cccc}
\cdot & \cdot & \cdot & \cdot \\
\cdot & \cdot & \cdot & \cdot \\
\end{array}
\]

Jack and Jill has four stressed syllables in the first and third line and three stressed syllables in the second and the fourth line. We can sing this nursery rhyme two stressed syllables each line. This is because image selectively abstracts itself and the hierarchy of layers of image give rise to structural meaning, conceptional sound, and conceptional rhythm.

Jack and Jill went up the hill,

\[
\begin{array}{cccc}
\cdot & \cdot & \cdot & \cdot \\
\cdot & \cdot & \cdot & \cdot \\
\end{array}
\]

To fetch a pail of water.

\[
\begin{array}{cccc}
\cdot & \cdot & \cdot & \cdot \\
\cdot & \cdot & \cdot & \cdot \\
\end{array}
\]

Jack fell down and broke his crown,

\[
\begin{array}{cccc}
\cdot & \cdot & \cdot & \cdot \\
\cdot & \cdot & \cdot & \cdot \\
\end{array}
\]

And Jill came tumbling after.

\[
\begin{array}{cccc}
\cdot & \cdot & \cdot & \cdot \\
\cdot & \cdot & \cdot & \cdot \\
\end{array}
\]

X I Conclusion

“Nor do they put new wine into old wineskins,

or else the wineskins break,

the wine is spilled,

and the wineskins are ruined.

But they put new wine into new wineskins,

and both are preserved.”

(The Gospel by Mathew the 9th chapter, the 17th paragraph)
Quotations

1. fig.1 養老 猛 著 「形を読む」 培風館 1993 p.102
2. fig.3, fig.5, fig.6 A Brief History of the Abacus
   http://www. ee.ryerson.ca.8080/~elf/abacus/history.html p.3,4
   Roman abacus p.1
4. fig.7 THE JAPAN CHABER OF COMMERCE & INDUSTRY
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5. fig.17 大澤 瑞夫 著 「ONE－WAY ENGLISH～英語を語順どおりに理解させるための指導」平成17年11月19日第55回
   全国英語教育研究大会 岐阜大学にて配本 p.24
6. fig.19 ________ p.14
7. The table 2 Chi-Fen, Chuen-Yn Fan, and Hsiang-Pao Lin
   A New Perspective Teaching English Pronunciation: Rhythm
   嘉南榮學專科學校 2007 p.6
8. Table 3 __________ P.19
9. fig.22 アルク地球人ムック「入門から初級まで これならできる！
   はじめてのヒアリング」アルク 1993 p.36
   「別冊 The English Journal20 カラダが覚える英語ヒアリング
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   phoneme