Latent Ability to Manipulate Phonemes by Japanese Preliterates in Roman Alphabet

Takashi Otake and Yoko Sakamoto

Department of English and Graduate School of Foreign Languages
Dokkyo University
otake@dokkyo.ac.jp and g2679005@dokkyo.ac.jp

Abstract

Recent studies in spoken word recognition show that Japanese listeners with or without alphabetic knowledge are accessible to phonemes during word activation. This suggests that even mora-based language users can recognize a submoraic unit. The present study investigates a possibility of latent ability to manipulate phonemes to search and to construct new words by Japanese preliterates in Roman alphabet. Three experiments were conducted. In Experiment 1 it was tested whether they could search embedded words by deleting word initial consonants. In Experiments 2 and 3 it was tested whether they could construct new words by manipulating consonants and vowels at word initial and medial positions. The results show that they could successfully manage these tasks with high accuracy. These results suggests that they are likely to have latent ability to manipulate phonemes to search and to construct new words.

1. Introduction

Recent models in spoken word recognition assume a universal word activation device which is based upon phonemes rather than other phonological units [1]. According to this proposal, spoken input automatically activates possible word candidates on the basis of phonemes. If this proposal is correct, this activation should be observed in any language users. Recent study on Japanese, which is called a mora-based language, has confirmed that Japanese language users are likely to activate word candidates on the basis of phonemes [2]. Further study on Japanese children without knowledge of Roman alphabet has also demonstrated that they could manage to activate word candidates on the basis of phonemes [3].

The findings in spoken word recognition in Japanese seem to imply that Japanese listeners are accessible to phonemes as well as morae in the process of phonological awareness. It is well recognized that speakers of different languages show phonological awareness at various levels. For example, a study conducted by Lieberman and her colleagues examined the phonemic and syllabic awareness by English speaking children [4]. A series of intensive experiments carried out by Treiman and her colleagues investigated onset-rime awareness by American children [5]. Mann investigated phonemic awareness by Japanese school children [6]. The main issue in these studies was to discover which phonological unit was recognized by different language speakers and how much literacy knowledge was involved with phonological awareness. Although all these studies seem to suggest that speakers of different languages are aware of particular phonological units, such as syllables, phonemes, morae or onset-rime, it may simply reflect upon the fact that they direct their attention to a particular level of phonological structure within words.

If Japanese children without knowledge of Roman alphabet may activate possible word candidates on the basis of phonemes, this fact may imply that they can direct their attention to the phonemic level and that they may have latent ability to manipulate phonemes in their mental lexicon. Thus, the present study attempted to examine whether Japanese preliterates in Roman alphabet could actually search embedded words and construct new words by manipulating phonemes. Three kinds of experiments were conducted with both real words in order to test whether they could search embedded words and construct words by manipulation of phonemes, both consonants and vowels. In Experiment 1 it was tested whether they could find an embedded word after deletion of a word initial consonant. In Experiment 2 it was tested whether they could construct a new word by manipulating word initial consonants. In Experiment 3, it was tested whether they could construct a new word by manipulating word medial vowels.

2. Experiment 1

Experiment 1 aimed at examining whether Japanese preliterates in Roman alphabet could search embedded real and non words within real words if word initial consonants were deleted.

2.1. Method

2.1.1. Materials

Ten 2 mora Japanese real words, each of which contained VCV real words and five 2 mora Japanese words which contained non words were chosen as experimental words. They were chosen in such a way that embedded real and non words emerged if word initial consonants were removed. For example, *geki* 'drama' and *eki* 'station' are real Japanese words. If the initial consonant from *geki* is removed, *eki* emerges. On the other hand, in the case of *yagi* 'goat,' no real word emerges if the initial consonant is removed. Real word type words were *kine, geki, tori, kame, mago, tsume, kasa, shimo, yuzu, mush*i. Non word type words were *natsu, hina, kega, mizo, yagi*.

2.1.2. Subjects

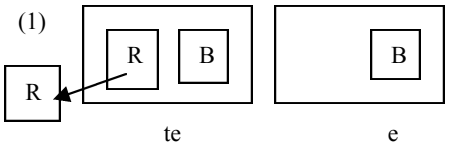
Fourteen Japanese children recruited from local elementary schools in Hiroshima and Saitama who were native speakers of Japanese with no reported hearing impairment took part in this experiment. None had lived abroad nor learned foreign

languages including English. 8 subjects were fourth graders and 6 subjects were fifth graders. None could recognize Roman alphabet.

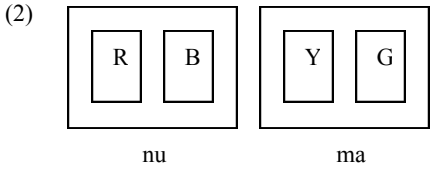
2.1.3. Procedure

In this experiment, color blocks were used as an apparatus in order to give the concept that a word could be embedded within another word if a phoneme was deleted. The following three steps were given to each subject.

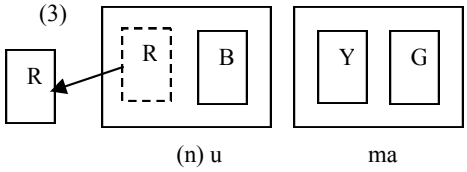
Step 1: Two color blocks R (red) and B (blue) and another color block B (blue) were placed separately on two 10 cm x 20 cm plastic boxes in front of a subject, as shown in (1). The subjects were told that each box was designated as a monomoraic word and that two words, *te* 'a hand' and *e* 'a picture' were presented orally with two picture cards to the subject. The experimenter told the subjects that if the block R on the left box was taken away, the rest became *e*, which is the same as the one on the right box. The instruction was given to the subject until he or she could fully understand, using three separate monomoraic words.



Step 2: Two color blocks were placed on the two plastic boxes (the blocks R and B on the left and Y and G on the right), presenting a two CVCV real word *numa* 'a pond', orally, as shown in (2).



Then, the experimenter removed the leftmost block R and asked the subject what would be a new word, as shown in (3).



In this case, a new word *uma* 'a horse' emerges. The experimenter showed them a correct picture card simultaneously. This practice was given to the subjects with four separate words. If they could understand the procedure fully, the experimental session started.

Step 3: After the experiment, the subjects took part in both reading and writing test. They were asked to read and write 5 words in Roman letters to make sure if they could not recognize Roman letters.

2.2. Results

The distribution of correct and miss responses for both word types are shown in Table 1.

Word type	Correct response	Miss response
Real word	139 (99%)	1 (1%)
Non word	70 (100%)	0 (0%)

Table 1 Correct and miss responses for two types of words.

As can be seen from the table, thy could successfully find embedded words after deleting the initial consonant (Real word ($z = -3.64$, $p<0.001$) and Non word ($z = -3.74$, $p<0.001$). There was no significant difference between both word types. The result suggests they could find embedded words regardless of word types if the word initial consonants were deleted.

3. Experiment 2

Experiment 2 examined whether Japanese preliterate children could construct new words by manipulating consonants taken from two separate words at the word initial positions.

3.1. Method

3.1.1. Materials

Real word type words were ten pairs of 2 mora Japanese real words which were chosen in such a way that after deleting the first consonant in the second word, the first consonant in the first word was moved onto the trace of the initial consonant. By doing so, a new word could be constructed.

Let us take an example of *mugi* 'wheat' and *yado* 'an inn.' When the first consonant of the second word *yado* is deleted, it becomes *ado,* which is a non word. The first consonant (m) of the first word is moved onto the initial empty position of *ado*. Then, it becomes *mado*, which means a window. Non word type words were 5 pairs of Japanese real words which were also made up of two morae. All these words were chosen in such a way that their meaning was lost if the same process was applied. Real word type pair words were *mugi* + *yado*, *mochi* + *taru*, *kutsu* + *nawa*, *goma* + *take*, *heso* + *kana*, *semi* + *niwa*, *kamo* + *soto*, *soba* + *haru*, *mise* + *hachi*, *kushi* + *nami* and non word type of pair words were *nori* + *mimi*, *sori* + *tako*, *nashi* + *shima*, *bara* + *sode*, *mori* + *sara*.

3.1.2. Subjects

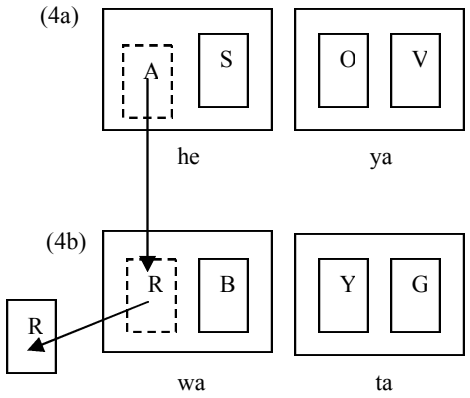
Thirteen Japanese children recruited from local elementary schools in Hiroshima and Saitama who were native speakers of Japanese with no reported hearing impairment took part in the experiment. None had taken part in Experiment 1. None had lived abroad nor learned foreign languages including English. 8 subjects were fourth graders and 5 subjects were fifth graders. None could recognize Roman alphabet.

3.1.3. Procedure

In this experiment, color blocks were also used as an apparatus in order to give the concept that a new word could be constructed by deleting and adding consonants. The following

steps were given to each subject. The first and the third steps were the same as the ones in Experiment 1. Thus, these steps were omitted here.

Step 2: Two color blocks were placed on each of the two pair of two plastic boxes (blocks R and B on the left and Y and G on the right in (4b) and A and S on the left and C and V on the right in (4a)), presenting two 2 mora real words *heya* 'a room' and *wata* 'cotton' orally.



Then, the experimenter removed the leftmost block R in *wata* in (4b) and moved the leftmost block A in *heya* in (4a) to the trace in (4b). The subject was asked what it was. In this case, the newly constructed word is *hata* 'a flag.' The experimenter showed the subject a correct picture card to confirm the answer. This practice was given with four separate words. If they could understand the procedure fully, the experimental session started.

3.2. Results

The distribution of correct and miss responses for the two types of words are shown in Table 2.

Word type	Correct response	Miss response
Real word	110 (85%)	20 (15%)
Non word	47 (72%)	18 (28%)

Table 2 Correct and miss responses for two types of words

As can be seen from this table, they could manipulate the initial consonants in the two types of words and construct the expected words correctly (Real word: $z = -3.24$, $p<0.001$; Non-word; $z = -2.34$, $p<0.05$). There was significant difference between the two word types ($\chi^2=4.18$, df=1, $p<0.05$). These results suggest that although the subjects responded to the experimental words in a different way, they could construct new words successfully.

4. Experiment 3

Experiment 3 examined whether Japanese preliterate children could construct new words taken from two separate words by manipulating vowels at the word medial positions.

4.1. Method

4.1.1. Materials

Real word type words were ten pairs of 2 mora Japanese real words which were chosen in such a way that after deleting the first vowel in the second word, the first vowel in the first word was moved onto the trace of the second word. By doing so, a new word could be constructed.

Let us take an example of *yuka* 'a floor' and *kani* 'a crab.' When the first vowel of the second word *kani* is deleted, it becomes '*kni*' which is a non word. The first vowel (u) of the first word was taken away, and inserted into the trace of the non word '*kni*,' it became *kuni*, 'country'. Non word type words were five pairs of Japanese real words which were also made up of two morae. All these words were chosen in such a way that their meaning was lost if the same process was applied. Real word type pair words were *basu* + *mitsu*, *hebi* + *momo*, *kusa* + *sashi*, *kiba* + *nasu*, *tsuru* + *kamo*, *gake* + *yuri*, *gumi* + *kaji*, *negi* + *biru*, *tora* + *hashi*, *sasa* + *kubi*. and non word type of pair words were *sumi* + *mame*, *kata* + *neko*, *koma* + *hamu*, *kuki* + *yama*, *kuchi* + *same*.

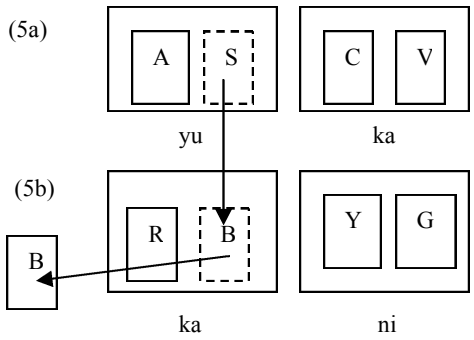
4.1.2. Subjects

Subjects were the same as the ones as in Experiment 2.

4.1.3. Procedure

The basic procedure was the same as the one in Experiment 2 except Step 2. Thus, step 1 and 3 were omitted here.

Step 2: Two color blocks were placed on each of the two pair of two plastic boxes (blocks R and B on the left and Y and G on the right as shown in (5b) and A and S on the left and C and V on the right as shown in (5a)), presenting two 2 mora real words *yuka* 'a floor' and *kani* 'a crab' orally.



Then, the experimenter removed the second block R in *kani* in (5b) and moved the second block S in *yuka* in (5a) to the trace in (5b). The subject was asked what it was. In this case, the newly constructed word is *kuni* 'a country.' The experimenter showed the subject a correct picture card to confirm the answer. This practice was given with four separate words. . If they could understand the procedure fully, the experimental session started.

4.2. Results

The distribution of correct and miss responses for the two types of words are shown in Table 3.

Word type	Correct response	Miss response
Real word	116 (89%)	14 (11%)
Non word	50 (77%)	15 (23%)

Table 3 Correct and miss responses for two types of words

As can be seen from this table, they could successfully manipulate the word medial vowels and construct the new words correctly (Real word: $z = -3.22$, $p<0.001$; Non word: $z = -3.05$, $p<0.001$). There was significant difference between the two types of words ($\chi^2=5.18$, $df=1$, $p<0.05$). These results suggest that although the subjects responded to the experimental words in a different way, they could construct new words successfully. These results suggest that although the subjects responded to the experimental words in a different way, they could construct new words successfully.

5. Discussion and Conclusions

As we have seen above in the three experiments, the results have clearly shown that Japanese elementary school children without alphabetic knowledge can search embedded words and construct new words by manipulating both consonants and vowels successfully provided that they are given a short training which discloses that a single mora includes submoraic units. These results indicate some important implications not only in phonemic awareness but also in spoken word recognition.

The task employed in the present study provided the Japanese school preliterates in Roman letters with the explicit information regarding submoraic structure using color blocks. In other words, it could be said that the present task directed them to be aware of the phonemic level intentionally without using orthographic information. Thus, the results in the present study may be interpreted in the following two ways. The first interpretation is that because of the nature of the task, the Japanese children may have been simply conditioned by the task, so that they may not be able to access to the phonemic level unless they are given this information again. The second interpretation is that they could manage the task because they have the phonemic representations in their mental lexicon and they know them unconsciously. In the literature of phonemic awareness, there has been a debate on this problem. Some researchers claim that literacy knowledge is essential to become aware of phonemes by Japanese children [7], while literacy knowledge is irrelevant to phonemic awareness [6]. Since Japanese has long been called as a mora-based language, it is generally believed that Japanese speakers recognize morae as an indivisible unit. However, it does not necessarily mean that they cannot access to other phonological units.

In fact, our earlier study which employed a more explicit task using a plastic toy that morae could be divisible, Japanese school children without Roman alphabet could find embedded words with amazing accuracy as well [8]. Given the fact that they could manipulate phonemes to search or construct words with high accuracy, it may be more appropriate to say that Japanese children should be endowed with the phonemic unit in their mental lexicon at much earlier stage. In other words, they should possess both morae and phonemes in their mental lexicon, although their default level is the moraic level. Unless they are directed to shift, they remain at the mora level.

If this interpretation is correct, a further new question has arisen. Our recent study shows that both Japanese adults and school children who were preliterate in Roman letters could reconstruct original words from partially distorted words [3], just like Japanese adults [2]. In other words, if phonemic information remains, then, Japanese children seem to be able to employ the information. What this suggests is that Japanese children without Roman letters should be able to play a word game called *dajare* which is equivalent to a pun in English, just like Japanese adults [9] and that word activation should occur on the basis of phonemes.

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