無意味語の音韻処理における反復母音効果　-「もぐら叩き」現象

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(要旨) 母音反復が，無意味語の音韻処理にどう影響するかを考察した．子音と母音の組み合わせの２拍(CVCV)から４拍(CVCVCVCV)の無意味語の命名課題において,抑制効果が観察された．音韻的な組み立て(phonological assemble)の過程における影響ではないかと思われる．本研究では，「もぐら叩き」現象(‘whack-a-mole’ phenomenon)として，これを説明した．

Key Words: **Vowel Repetition, Phonological Processing, 'Whack-a-mole' Phenomenon**

The Obligatory Contour Principle (OCP) refers to a linguistic constraint on similar or same phonological elements or features from being repeated (e.g., Itô & Mester, 1986; Kubozono, 1999). Kubozono and Ôta (1998) suggested the possibility that vowel dissimilation in Japanese may be a result of the OCP. For example, the two Japanese morphemes /nana/ meaning 'seven' and /ka/ meaning 'day' combine to form the compound word /nanoka/ meaning 'the seventh day' instead of /nanaka/, which would seem to be the likely combination. This process of vowel dissimilation occurs so as to avoid vowel repetition of /a/ in sequence within the three mora CVCVCV word structure (C referring to 'consonant' and V referring to 'vowel'). Thus, it would be expected that naming visually-presented Japanese words and nonwords violating the OCP (i.e., same vowel repetition in a series of CV strings) would result in slower processing speeds and higher error rates. To test this hypothesis, the present study examined OCP effects in naming nonwords with and without identical vowel repetition.

EXPERIMENT

Method

Subjects: Twenty-two female and twenty male students (42 in total) participated in the experiment. The average age was 21 years for females and 21 years and 6 months for males. All participants were native speakers of Japanese.

Stimuli: Nonwords constructed from two to four morae were used as stimuli. They were divided into sets according to their number of morae and placed under three conditions. Each set, therefore, contained three nonwords under three different conditions. All nonwords in each set had the same initial mora. The first condition was nonwords with same vowel repetition as in /ko ho mo/. The second condition was nonwords without identical vowel repetition but containing the same consonants as the nonwords with identical vowel repetition. For example, the stimulus nonword of /ko ha mi/ was constructed using the three consonants of /k/, /h/ and /m/ taken from the aforementioned nonword of /ko ho mo/ where the vowel /o/ was repeated. The vowel /o/ of the first mora was kept and the second and the third vowels were replaced by /a/ and /i/ respectively. The third condition was real words with the same initial mora as nonwords such as /ko ri tu/. This condition was design to ascertain the well-established principle of lexical status effect which suggests that real words are pronounced more quickly than nonwords. According to this procedure, thirty-six sets of two-mora words, thirty-six sets of three-mora words and thirty-six sets of four-mora words under three of the above conditions were created; a total of 108 sets or 324 stimuli were used. Stimuli were divided into three counterbalanced lists with an equal number of nonwords (with and without identical vowel repetition) and real words. The 42 subjects were also divided into three groups of 14. In this manner, assignment of the three stimulus words in each set was given to a different subject. For example, /ko ho mo/, /ko ha mi/ and /ko ri tu/ (all three words in the same set) appeared separately on three different lists. Thus, no subject saw any more than one of these three stimuli during the same task.

Procedure: Stimuli of nonwords were individually presented to subjects in the center of a Toshiba J-3100 plasma display at a comfortable distance away in a dimly lit, quiet room. Stimuli were randomly presented 600 milliseconds after the appearance of an eye fixation point marked by an asterisk '*'. Subjects were required to pronounce each string of nonwords as quickly and as accurately as possible. The next fixation point was indicated 600 ms after the examiner pressed the space key.

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Results

A two-way 3 X 3 ANOVA with repeated measures was carried out on naming latencies and error rates relating to the two factors of stimulus conditions and mora structure. Statistical tests follow analyses of both subject (F1) and item (F2) variability.

Naming latency: Only correct responses of nonwords and real words were used as data in the analysis of naming latency. The two-way 3 X 3 ANOVA indicated that a main effect of stimulus conditions was significant in subject analysis [$F1(2, 82)=135.12$, $p<.0001$] and item analysis [$F2(2, 70)=253.73$, $p<.0001$]. A main effect of the three types of mora structure was also significant in subject analysis [$F1(2, 82)=186.20$, $p<.0001$] and item analysis [$F2(2, 70)=176.08$, $p<.0001$]. The interaction of both main effects was also significant [$F1(4, 164)=60.37$, $p<.0001$; $F2(4, 140)=38.45$, $p<.0001$]. Real words were named consistently faster than nonwords; from 513 ms for those with two morae to 580 ms for those with four morae. The average naming latency for all real words was 560 ms. The fact that this figure was 133 ms less than the average for nonwords with the same vowel repeated and 103 ms less than that for nonwords with no repetition of same vowels confirmed the lexical status effect. Further analysis with an orthogonal polynominal comparison was carried out to identify the difference between the stimulus conditions of repeated and non-repeated vowels. Significant differences were found with respect to the two stimulus conditions of repeated and non-repeated vowels on two mora [$F1(1, 41)=16.00$, $p<.0005$; $F2(1, 35)=10.63$, $p<.005$], three mora [$F1(1, 41)=15.37$, $p<.0005$; $Fi(1, 35)=10.63$, $p<.005$] and four mora [$F2(1, 41)=5.00$, $p<.05$; $Fi(1, 35)=6.66$, $p<.05$] nonwords. These results indicate that it took longer to name a nonword when the same vowel was repeated.

Error rates: The same ANOVA analysis was conducted on error rates. A main effect of stimulus conditions was significant in subject analysis [$F1(2, 82)=77.68$, $p<.0001$] and item analysis [$F2(2, 70)=43.28$, $p<.0001$]. A main effect of the three types of mora structure was also significant in subject analysis [$F1(2, 82)=32.38$, $p<.0001$] and item analysis [$F2(2, 70)=16.32$, $p<.0001$]. The interaction of both main effects was also significant [$F1(4, 164)=9.74$, $p<.0001$; $F2(4, 140)=6.11$, $p<.0001$]. The average error rate in naming real words was only 1.59%, whereas the average for nonwords was 13.82% with same vowel repetition and 7.08% with no such repetition. The error rates also supported the presumed effects of lexical status. Further analysis with an orthogonal polynominal comparison was carried out. Significant differences were found between the two stimulus conditions of repeated and non-repeated vowels on two mora [$F1(1, 41)=16.00$, $p<.0005$; $F2(1, 35)=7.13$, $p<.05$], three mora [$F1(1, 41)=15.37$, $p<.0005$; $F2(1, 35)=8.23$, $p<.01$] and four mora [$F1(1, 41)=5.00$, $p<.05$; $F2(1, 35)=8.03$, $p<.01$] nonwords. The results of these error rates also confirm effects of same vowel repetition on nonwords.

GENERAL DISCUSSION

The present study sought out to reveal how the OCP concerning identical vowel repetition affects phonological processing of Japanese nonwords. Nonwords with identical vowel repetition were named slower and less accurately than nonwords with no such repetition. This trend was observed in all sets of nonwords containing 2-4 morae in a CV string. Consequently, an effect of the OCP related to identical vowel repetition is apparent in the phonological processing of nonwords.

The explanation proposed for the putting together of smaller phonological units (i.e., assembled phonology) when processing nonwords is the 'whack-a-mole' phenomenon. The vowel in the first CV mora continues to have a high activation level even when following CV morae are activated. When the same vowel is repeated throughout the CV morae, as in some of the nonwords used in this study, all the CV morae are simultaneously excited to reach the activation level. For example, since the three morae of /kohomo/ share the same vowel of /o/, the first vowel /o/ will be activated to combine with the first consonant /k/ to form the first mora /ko/. However, since the vowel /o/ must also be combined with the second and third consonants /h/ and /m/, it creates a high activation levels of the subsequent morae /ho/ and /mo/. To avoid confusing the sequential order of morae in a CV string, subsequent morae must be inhibited so as not to be activated to the same degree as the previous CV mora.

This pattern of activation (or excitation) and inhibition results in the decreased speed of phonological processing of nonwords with identical vowel repetition and in the increased rate of pronunciation errors. In contrary, as for naming nonwords with no repeated vowels, phonological assembly of morae in sequential order within a CV string is not affected by the activation of other morae. For example, the nonword /kohami/ does not share the same vowel throughout the CV string, so assembling its sequential order of phonological structure is not affected by identical vowel repetition. Thus, nonwords with varying vowels are named more quickly than nonwords with repeated vowels and, concomitantly, fewer errors are observed.