The effects of vocal difference on repetition deafness

Masato NAKAIJIMA and Tadashi KIKUCHI
University of Tsukuba*

Repetition deafness (RD) refers to a reduced performance in reporting a repeated item, compared to a nonrepeated one, during a rapid auditory presentation. We investigated the effects of a vocal difference on RD in order to examine whether an encoding failure was as a cause of RD. The stimuli pronounced by a male and a female were presented binaurally in a serial order. The results showed that RD was observed only under different voice conditions. We propose an alternative hypothesis that an encoding failure is a cause of RD.

Key words: repetition deafness, vocal difference, encoding failure, binaural presentation

Introduction

Repetition deafness (RD) refers to a reduced performance in reporting a repeated item, compared to a nonrepeated one, during a rapid auditory presentation. Previous studies have suggested a confusion in memory or an encoding failure could be the cause of RD. Soto-Faraco and Sebastian-Galles (2001) observed RD using physically mismatched (different voices) stimuli with a dichotic presentation under a low memory load. They observed that a larger repetition deafness was produced with different voice conditions, rather than with the same voice conditions. Their conclusion was that because RD could be observed for an identical phoneme, irrespective of physical identity, it was produced by an encoding failure. However, because their investigation used a dichotic presentation the cause of repetition deafness is still unclear. A dichotic presentation, for example, could cause some effects on RD such as a spatial attentional shift or cause some form of perceptual limitation (e.g., precedence effect). Physical mismatching could also cause a processing load to discriminate two voices.

In the present experiment, we investigated an encoding failure hypothesis as explanation of the cause of RD. Specifically, we focused on the effects on repetition deafness of a vocal difference by using stimuli presented in a serial binaural manner.

* Institute of Psychology, University of Tsukuba, 1-1-1 Tennoudai, Tsukuba, Ibaraki 305-8572

Method

Participants Twenty graduate and undergraduate students participated in the experiment. The data from two participants with high error rates were excluded from the analyses.

Materials and design Three CV syllables (/pa/, /pi/, and /po/) were pronounced by a male and a female and digitally recorded at 44.1 kHz. Each of the stimuli was also compressed by up to 100 milliseconds without any alteration of the original pitch quality.

We constructed lists of stimuli (lists of two and three elements) by combining two or three of the compressed syllables in 300 milliseconds. The lists contained two successive syllables as critical elements (CE). The lists of two elements consisted of the CE followed by 100 milliseconds of silence. The lists of three elements consisted of the CE preceded, or followed, by another syllable. The study involved two main factors: voice (the same, or a different voice); and repetition (repeated or unrepeated). In the same voice condition the quality of the voices was matched, whereas the voice quality was mismatched in the different voice condition. The repeated condition consisted of two syllables which were the same as the CE. In the unrepeated condition another syllable was used for the second CE of a repeated list.

Procedure The stimuli were presented binaurally through headphones attached to a personal computer. The participants were asked to recall all of the syllables, irrespective of the quality of the voice.
Mistakes in the order were permitted. The participants were also required to recall repeated elements as many times as they were heard.

Each trial began with a warning tone with a frequency of 500 Hz and a duration of 500 milliseconds. Then, after 500 milliseconds of silence, the 300-millisecond list was presented. Presentation of the list was followed by a masking noise for 100 milliseconds. The participants used the computer keyboard to indicate their responses.

Results

We counted a response as correct if the first and second CEs were reported correctly. The mean percentage of CE recall in each condition is shown in Figure 1. An analysis of variance was calculated with within-participant factors of voice (the same vs. different) and repetition (repeated vs. unrepeated) from data using the lists of two and three elements. The analyses indicated that an interaction between voice and repetition was significant for the two-element list, $F(1, 17) = 12.39, p < .01$ and for the three-element list, $F(1, 17) = 48.75, p < .01$. The simple main effect of repetition and a different voice was significant for the two-element list, $F(1, 17) = 11.82, p < .01$ and for the three-element list, $F(1, 17) = 72.02, p < .01$. But the effect of repetition and the same voice was not significant for either of the lists.

Discussion

The results of the present experiment demonstrated that RD was observed only under different voice conditions and irrespective of whether a two- or three-element list was used. This finding suggested that different voices would cause RD. Repetition deafness for the same voice was not observed, unlike the study of Soto-Faraco & Sebastian-Galles (2001). The RD observed in their experiment, therefore, may have been caused by some perceptual limitation which was produced by a dichotic presentation. This explanation would be able to account for the larger RD of the physical mismatch obtained in their study (Soto-Faraco & Sebastian-Galles, 2001).

From the present results, we propose an alternative hypothesis of encoding failure as the cause of RD. An encoding failure could be explained by the refractory period, in which the sensitivity to a repetition of an item is reduced by the recognition unit after being activated by a preceding identical stimulus. Our hypothesis suggests that the refractory period would be produced by discriminating the quality of the voice. After a specific vocal phoneme is encoded and activates a representation, the representation could accept an identical phoneme but could not accept a physically mismatched one during activation in the refractory period. Thus an encoding failure would be caused by a physical mismatch. Different phonemes, however, would be encoded by different recognition units so that encoding would not fail. The correct recognition of physically mismatched and repeated items would therefore be reduced and RD would occur.

References