

ON THE RHYTHM PATTERN OF REPETITIVE UTTERANCES

Seishi R. Hibi

INTRODUCTION

In a previous report by the author¹⁾, a comparison was presented between the degree of inconsistency of responses to external stimuli in terms of the standard deviations of the response frequencies and the reaction time between auditory and visual stimuli. It was pointed out that the effects of the feedback mechanisms on the pattern of repetitions of the monosyllables uttered in response to the external stimuli remained to be investigated.

The aim of the present study is to examine the degrees of consistency of responses by comparing the values of the abovementioned parameters between the following pairs:

Auditory stimuli with feedback vs. Auditory stimuli without feedback

Visual stimuli with feedback vs. Visual stimuli without feedback

Auditory stimuli with feedback vs. Visual stimuli with feedback

Auditory stimuli without feedback vs. Visual stimuli without feedback.

There seems to be some feedback mechanism when we produce repetitive movements such as tapping. Also, it can analogically be predicted that there is an auditory/visual feedback system during the production of repetitive utterances.

In order to examine this possibility, the following experiments were set up. In the first experiment, the subject was requested to produce repetitive utterances in time with auditory signals which were pre-recorded without masking noise. In the second, the subject was requested to do the same task using auditory signals together with a masking noise. Thus, the subject was to produce repetitive utterances without using his own feedback system even if there is one.

For the third experiment, a visual feedback apparatus was constructed additionally. The auditory wave form of an utterance /pa/ consisted of one part that shows an explosion for the consonant /p/ and one part that shows the glottal vibration for the vowel /a/. The visual feedback apparatus has an LED which is emitted by a pulse wave triggered by the /p/ explosion. Using the abovementioned visual feedback apparatus together with a visual signal generator, the subject was requested to produce the repetitive utterances in time with pre-set visual signals, looking at both signal LED and feedback LED simultaneously (these LEDs were located at about 5mm distance side-by-side). The subject could thus be considered to produce the repetitive utterances using his own feedback system, if any.

In the fourth experiment, the operation of the LED feedback apparatus was eliminated so that the subject produced the repetitive utterances without visual feedback.

PROCEDURES

1. Stimulus signal generator and feedback apparatus

a-1 Auditory stimulus signal

As auditory stimuli, pre-recorded tone bursts with duration of 5 msec. and frequency of 1kHz were used. These tone bursts were previously made by using a sinewave generator, a pulse generator and a clock pulse generator.

a-2 Auditory stimulus signal with masking noise

The same tone bursts, this time pre-recorded together with a masking noise, were used.

b-1 Visual stimulus signal

As visual stimulus, the light of an LED emitted by a specially constructed trigger apparatus was used. As the aforementioned auditory stimulus signal waves were fed to this apparatus, the LED visual stimulus signals were shown to the subject.

b-2 Visual stimulus signal and visual feedback signal

In addition to the LED for the visual stimulus signal, another LED was juxtaposed. The wave of an explosion of /p/ in each utterance /pa/ was converted into a pulse wave with duration of 50 msec by the aforementioned trigger apparatus. Thus, each utterance of /pa/ was feedback to the subject in the form of the emitted light.

2. Subjects and test utterances

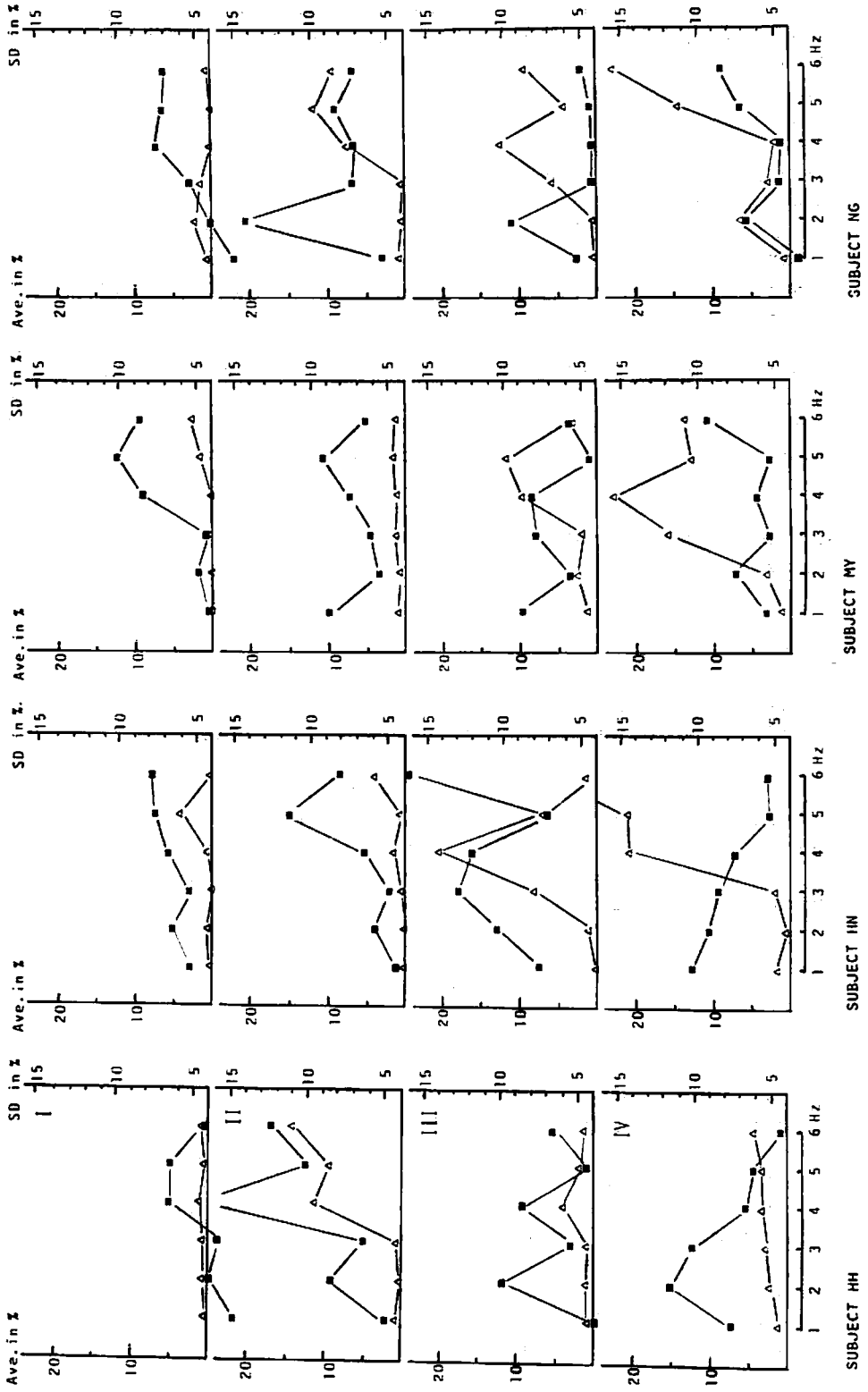
The subjects were four normal male adults aged 20-45. The subjects were asked to produce the monosyllable /pa/ in time with the pre-set auditory or visual signals, producing at least 30 utterances at each rate from 1 to 6Hz.

RESULTS

The following Figures show the main part of the data obtained in the present experiments.

In the figure, the left ordinates show the errors of average interval in percentages with respect to those of the stimulus signals for each experiment, and the right ordinates show the standard deviation. The abscissas represent the rates of the stimulus signals. Each Δ shows the average interval, and \blacksquare indicates the standard deviation.

Figures I and II show the results of the first and second experiments respectively, where auditory stimulus without masking noise and with masking noise were used.



Figures III and IV show the results of the third and fourth experiments, where visual stimuli with and without feedback system were used. The following points were generally observed:

- 1) The rhythm patterns of response utterances in the auditory stimulus experiments were more consistent than those in the visual stimulus experiments. In other words, both the errors of average interval and the standard deviation were smaller in experiments I and II than in experiments III and IV.
- 2) In the auditory stimulus experiment, the feedback mechanism appeared to contribute to the accuracy of the rhythm patterns, while it might create a disturbance in some occasions in the visual stimulus experiments.
- 3) As a distinctive feature, the rhythm patterns at around 5Hz were rather accurate in many cases. Namely, the standard deviation became smaller than the others even if the errors of average interval were relatively large. For example, in experiments II and III for subject HH, III for subject HN, and III and IV for subject MY, the standard deviation decreased drastically at around 5Hz.
- 4) It was observed that both the errors of average interval and the standard deviation were within 10% in the first experiment for almost all of the subjects.

COMMENTS

It was revealed that the tone burst signal was one of the best cues when it was used as a stimulus signal without any disturbance.

It was also found for the auditory stimuli that both the errors of average interval and the standard deviation were within 10% for normal subjects.

From the results of the visual stimuli experiment, it is plausible to consider that the stimuli over 4Hz are not effective as the "feedback signal"; rather, the subject appeared to utter the monosyllable only depending upon his own intrinsic timing.

References

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