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INTERACTION BETWEEN TWO TONES IN SUCCESSIVE PRESENTATION

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1. Introduction

It has been recognized that context effects are influenced by the range and distribution of target stimuli (1), and by the presentation-order. The experimental results on context effects have shown that "assimilation" or "contrast" can be observed in the identification for the target stimuli with context, and that the magnitude of the context effects can be determined quantitatively by measuring the shift of the category boundary in identification for the target stimuli. The perception of two tones successively presented has been investigated by the study of auditory interaction between two tones (2) and the study of recognition masking.(3) The results indicate that the influence of the following tone upon the preceding is larger than the influence of the preceding upon the following. The purpose of the present study is to investigate (1) the effect of presentation-order, and (2) the effect of inter-stimulus interval (ISI) upon the context effects.

2. Method

Nine steady-state stimuli were synthesized on the vowel continuum /u/-/a/. The first formant frequency of these nine stimuli (S_1 to S_9) ranged from 330 Hz to 780 Hz, while the higher formant frequencies were fixed at 1250 Hz (F2), 2750 (F3), 3500 Hz (F4), and 4500 Hz (F5). The fundamental frequency for each stimulus was held constant at 130 Hz. The duration of each stimulus was 200 msec. The eight target stimuli consisted of S1, S2, S3, S4, S5, S6, S7 and S8, while the context stimulus was S9. All the stimuli were generated by digital simulation of a terminal-analog speech synthesizer, read out at a sampling rate of 10 kHz with an accuracy of 10 bits per sample, converted into the analog waveform, and recorded for off-line experiments. The recorded stimuli were presented to subjects in an anechoic room through a loudspeaker at a sound pressure level of approximately 78 dB(c). The subjects were four female adults with normal hearing.

In Experiment 1, the eight target stimuli were presented in random order at an interval of 4 sec, and the subjects were asked to identify each target as either /a/ or /u/. In Experiment 2, each target stimulus was either preceded (the F-condition) or followed (the B-condition) by a context stimulus, and the subjects were asked to identify both the context and the target stimuli as either /a/ or /u/. The inter-stimulus interval (ISI) lasted .01, .1, .2, .3, or 3 sec (Fig. 1). Twenty judgments for each pair of context and target (or target and context) were obtained from each subject. In both experiments, the probability of response for /a/ can be approximated by a cumulative normal distribution and the mean (μ_1 or μ_2, where the suffix indicates the experiment number) corresponds to the category boundary. The difference ($\Delta\mu$) between μ_2 and μ_1 can then be regarded as an index for the context effect.

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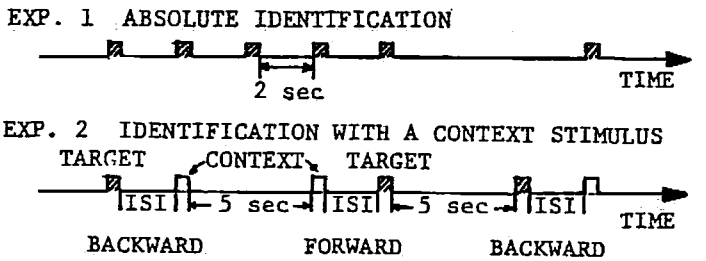

Fig. 1. Presentation of stimuli in Exp. 1 and 2

3. Results and Discussion

The magnitude of the context effect expressed in terms of $\Delta\mu$ is shown as function of ISI in Fig. 2. The results are summarized as follows.

(1) The context effects were always contrastive at all ISI values.
(2) The contrast decreased as the ISI is increased from .01 to .2 sec, but became almost constant at larger values of ISI both in the F- and in the B-condition.
(3) The context effects were seen to be more contrastive in the B-condition than in the F-condition at all values of ISI.

These results are discussed as follows.

In the F-condition, the memory of a preceding context stimulus is stored in a short-term memory, and influences the category boundary for the identification of the following target stimulus. In the B-condition, on the other hand, the memory of a preceding target stimulus is stored in a short-term memory, and the context stimulus which followed the target influences the category boundary for the identification of the preceding target stimulus. The present experimental results may be interpreted as suggesting that the interaction between context and target consists of two components with different decay rates, regardless of whether it is the target or the context stimulus that is stored in the short-term memory. The present results also suggest that the context-target interaction is greater in the B-condition than in the F-condition at all values of ISI

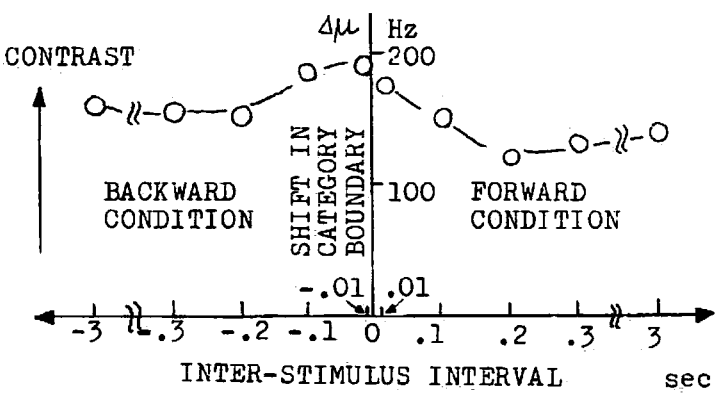

Fig. 2: Context effects shown as the function of ISI (averaged results).

examined. In order to discuss the interaction more precisely, it is necessary to separate the short-term memories into the categorical and non-categorical short-term memory. (4)

References

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