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NOISE EVALUATION IN BROADCAST LISTENING

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INTRODUCTION

There are various kinds of effect of environmental noise on our daily life, such as interference with conversation, radio or television listening, reading, studying, resting and sleeping. Some reports on the interference with these behaviors were presented by means of the social surveys. However, few experiments have been done in which the subject evaluates the effect of noise while they are doing something, such as doing a sum, or listening to speech or music. In almost all the experiments of noise rating in laboratory, only the noise to be evaluated was presented to the subjects, who listened to noise without any tasks. It is doubtful whether the rating obtained by such experiments could estimate the effect of annoyance induced by noise in our daily life.

In this experiment we intended to get the noise rating in the similar situation of our daily life. Therefore we made the subjects rate the noise in listening to the speech or music. Leq was calculated as the measure for evaluating the annoyance of noise.

Many noise rating scales have been proposed for various noise sources, i. e. road traffic noise, aircraft noise, train noise and so on. However, as the urbanization progresses further and the social frameworks become more complex, the kind of noise as well as its intensity will increase much more so that it may happen that we are annoyed by more than two different kinds of noise at the same time. It becomes a serious problem in the near future how we should evaluate the effect of noise in these cases.

In order to deal with such cases, we have a pressing need for a universal noise rating method. Leq was applied to the rating of various kinds of noise and it was found to be a pretty good measure for noise rating. So Leq seems to fulfill the requirement for a universal rating to some extent. The studies reported here are concerned with suitableness of Leq for a noise rating scale in

listening to the broadcasting program.

METHOD

Subjects Eleven students aged 20 to 24 years with normal hearing ability, participated as subjects in the experiments. Three of them were experienced in noise rating. The rests were not familiar with such a psychological experiment. They underwent training consisting of two 1-hour listening sessions before the main experiment.

Broadcasting program The speech and music were used as broadcasting program. The speech was the reading of novels and it was actually used as radio program. Three of them are male voice and the rests, female one. Five kinds of music were used, Mozart's 36th, 38th and 39th symphonies, Bach's Brandenburg concerto and Beethovens ninth symphony. Level distributions of speech and music are measured and L_{50} of them were adjusted to 70 dB SPL.

Noise Three kinds of noise; steady noise, intermittent noise and impulsive noise, were used. Three peak levels were selected for each noise. For the intermittent and the impulsive noise, the mean rate of occurrences was also changed. The time when the noise was presented was made random. 21 kinds of noise whose parameters were shown in Table 1, were used in the experiment. The envelopes of the intermittent noise and the impulsive noise were shown in Fig.1. The rise and decay time of the intermittent noise were 300 msec and its steady part was 5 sec. The rise time of impulsive noise was 3 msec and the decay time was 100 msec. The carrier of these stimuli was a pink noise. Each noise was presented for three minutes and only once par a session of experiment. The order of the presentation was made random.

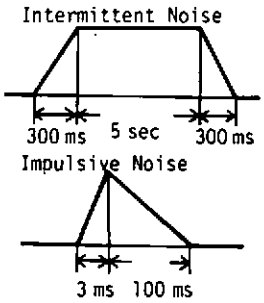

Fig.1 Time patterns of the noise used in the experiments.

Table 1 The parameters of the noise used.

Noise	Peak Level (dB)	Rate (1/min)
steady noise	65 70 75	
intermittent noise	70 75 80	1 2 6
impulsive noise	80 85 90	4 12 30

Procedure The subjects were continuously presented the reading or the music through headphone in the sound proof room. They are instructed to suppose that when they made themselves at home and listened to the radio, the noise would enter their house and interfere with their

listening, and to judge the annoyance of the noise. After a session of the experiment, we asked them some simple question to make the subjects concentrate on the reading. They gave right answers to the almost all the questions. The noise was presented on the same condition for three minutes. After that the subjects were forced to judge the annoyance of the noise. The method of successive categories was adapted. The subjects judged the annoyance of each noise using seven categories from 7; very annoyed and almost unbearable, to 1; not interruptive at all, shown in Table 2. There were no definition for the categories except 1 and 7. They are leaved to the judgment of the subjects. The responses of the subjects were recorded on the memory of the computer. It took about 70 minutes to judge the annoyance of 21 kinds of noise. The level of speech or music were made constant under the experiment.

No.	comment
7.	Very annoyed and almost unbearable.
6.	
5.	
4.	
3.	
2.	
1.	Not interruptive at all.

Table 2 The seven categories and its comments used in the experiments.

RESULTS AND DISCUSSION

The results are shown in Fig.2 and Fig.3, in which the average of the data of all subjects are plotted. Fig.2 represents the relation between Leq and annoyance in listening to the reading of the novels, and Fig.3 in listening to the music. In these figures the abscissa represents the Leq of noise and the ordinate shows the averaged values of annoyance.

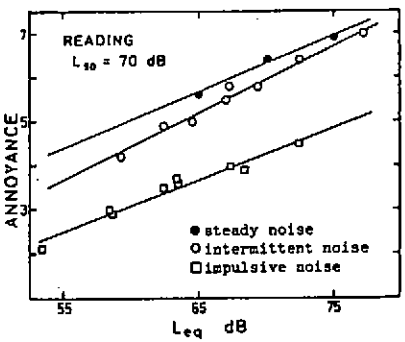

Fig.2 Relation between Leq and the annoyance of various kinds of noise in listening to speech.

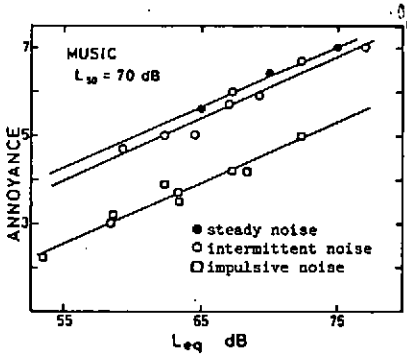

Fig.3 Relation between Leq and the annoyance of various kinds of noise in listening to music.

The two figures show the same tendencies as follow;
1) The annoyance of the steady noise is the greatest, one of the intermittent noise is the next, and the impulsive noise is the least annoying. But the difference between the annoyance of steady noise and one of the intermittent noise is small.
2) The relation between Leq and annoyance seems to be linear for the same kind of noise.
On the other hand, what differs from each other is that the slope of the line for the impulsive noise is more gentle than one for the others when the speech is used as a signal shown in Fig.2. This must be explainable as follows; Even if the impulsive noise becomes intense, it does not make the intelligibility lower so much, because its duration is very short. Fig. 4 shows the relation between the peak levels of the steady noise and the syllable intelligibility calculated. As the noise level is increased, the intelligibility drops sharply. This figure shows that the intelligibility is one of the cues on which the noise rating is based.

CONCLUSION

The annoyance of noise is found not to be determined only by Leq, but it depends on the kinds of noise in the case where we are listening to the radio or watching the television. The difference between the annoyance of the steady noise and one of the impulsive noise amounts to more than 10 dB.
It remains to be proved how the annoyance is affected by the duration of the intermittent noise.

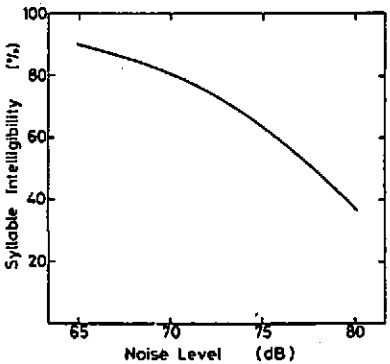

Fig.4 Relation between the noise level of the steady noise and the syllable intelligibility.

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