Studies on Influences of Train Noise upon Schoolchildren: III. Changes of Voice and GSR

STUDIES ON INFLUENCES OF TRAIN NOISE UPON SCHOOLCHILDREN : III.

CHANGES OF VOICE AND GSR*

By

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The changes of vocie in loudness and of GSR caused by train noise were investigated under six conditions of the noise using six undergraduate students as Ss. The results showed that the loudness level of vocalization of numerals became clearly high under the noise of more than 70 phons, and that the changes of GSR began to appear at the noise level of 65 phons and occurred frequently under the conditions of 75 and 80 phons.

Teacher and schoolchildren will have to talk with each other in a loud voice in the schoolroom with noisy surroundings. In a quiet room, they will be able to communciate well in a quiet, low voice. In the preliminary investigation on disturbance caused by train noise in schools near the railway, there were found several reports that the fatigue of a teacher in a noisy schoolroom is increased by strain of loud vocalization.

To investigate the change of voice in loudness caused by train noise is a main purpose of the present experiment. At the same time, the influence of the noise on GSR is examined.

Method

Procedure: The Ss fixed their foreheads at a definite distance (10～20 cm) from a microphone of sound level meter and were requested to read aloud a list of calculation problems, imagining themselves to be teachers who are giving children a lesson of sums.

The problems of calculation were presented automatically one by one at intervals of 4 seconds by means of memory drum. A list of problems of calculation was composed of 18 itmes: three repetition of six problems as presented in Table 1. In the Table, "3" was pronounced as "sʌn" Japanese, and "4" was as "jɔn". Only the loudness levels of these "3" and "4" which appeared alternately in the list of problems were measured

Table 1. The calculation problems which were read aloud by Ss. These six problems appeared at a door of memory drum three times repeated.

5+3	3+4	4+3	2+4	8+3	6+4

* This experiment was carried out while the author was at Tohoku University.

by reading the sound level meter on phon scale. These figures were chosen, because their swings of the indicator in the sound level meter can meet the experimenter's eye most easily of all numerals from 1 to 9.

The noise induced by a passing train was given to the Ss through a speaker of tapecorder from behind Ss. Onset of the noise began at the presentation of 5th problem and became out of hearing with that of 15th problem as shown in Fig. 1. At

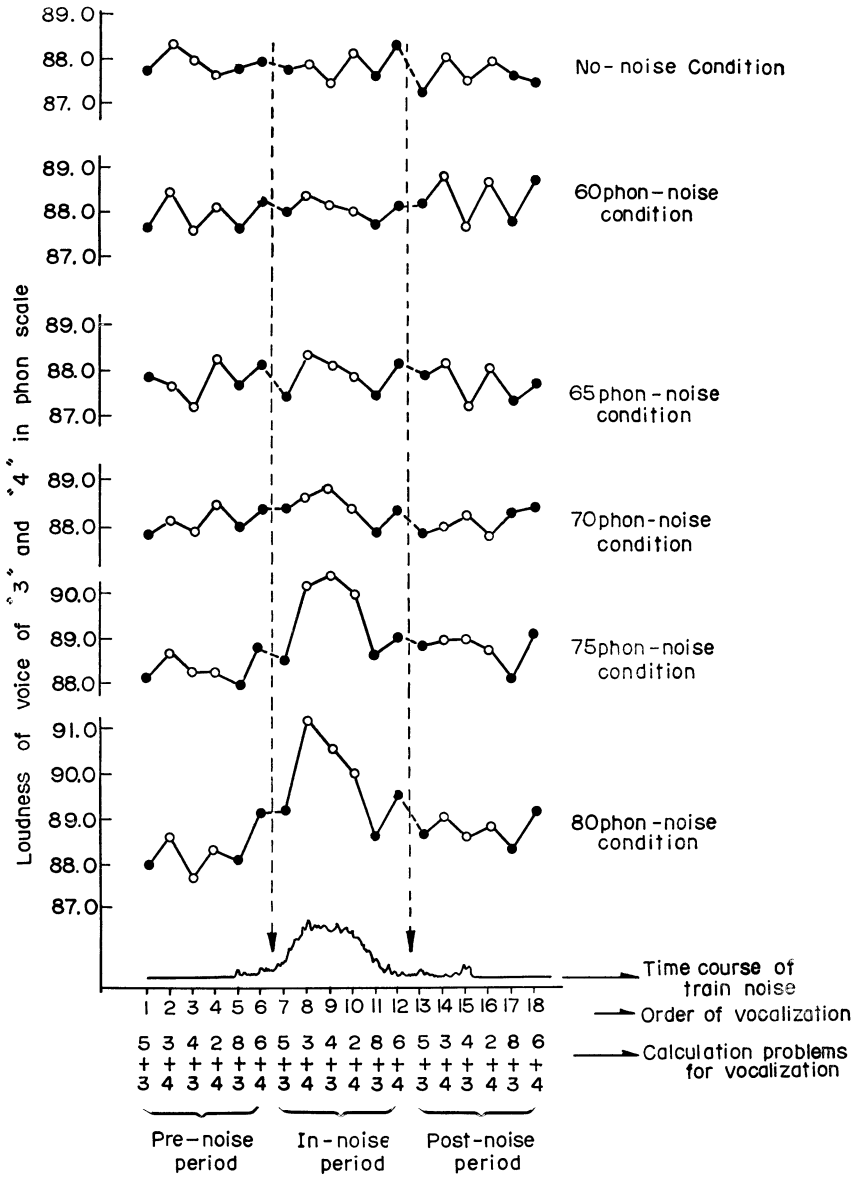

Fig. 1. Mean results of six Ss on the change of loudness in vocalization under six train noise conditions.

the period of the presentation of problems No. 7 to 11, the noise grew loud, and a maximum invasion existed between 8th and 10th problem. Loudness levels of noise in the maximum invasion were arranged into 60, 65, 70, 75 and 80 phon level. These six experimental conditions including now a silent condition, were randomly assigned to each six S.

After each experiment under six conditions, Ss were asked to evaluate the degree of disturbance of the noise by four categories' scaling.

GSR was recorded directly on Bridge-circuit from the electrodes which were set on the edge of the index finger and the middle finger of Ss' left hand.

In the laboratory, there was at least a constant noise induced by the rotation of memory drum. It registered about 56~59 phons.

Subjects: The Ss were four men and two women undergraduate students from the department of psychology at Tohoku University.

Results

Changes of voice in loudness: The results from six Ss are presented in Fig. 1. In the figure, mean loudnesses of six Ss' voice are plotted on phon scale against each presentation order of calculation problems for reading aloud. Time relationship between the problems and a presentation of the train noise is also attached in the abscissa.

Pre-noise period denoted the session including the first six problems (1st to 6th), in-noise period the second six (7th to 12th), and post-noise period the third six (13th to 18th). In the in-noise period, 8th, 9th and 10th problem suffered from the maximum noise invasion of which loudness levels are indicated in the figure. These problems are identical with 2nd, 3rd and 4th problem in the pre-noise period, and also with 14th, 15th and 16th problem in the post-noise period, respectively. Therefore, a mean of loudness was calculated from the above three problems for each period and thus three means were obtained as representatives of the loudness level of voice for each noise period. Both F- and t-test were applied to the three means.

The main results obtained from the figure may be described as follows.

(1) The voice of "4" are generally greater in loudness than that of "3".

(2) The result of a F-test on the no-noise condition showed that there is no significant differences among three noise periods.

(3) Nothing of significant effect was found under the presentation of both 60 and 65 phon noise.

(4) In the 70 phon-noise condition, there appeared a little increment of voice in loudness by the noise. This increment, however, is not significant as compared with the change in the no-noise condition ($P<0.10$).

(5) Voice became louder obviously under the invasion of 75 phon noise.

(6) Under the 80 phon-noise condition, loudness increment of voice began at the time of 6th problem and reached a peak at that of 8th problem. After-effect of the loud voice remained even if the noise had been removed.

(7) It may have been attributed to effects of the initiation of high level noise that the voice of 1st problem was loud itself in the 75 phon- and 80 phon-condition.

Results of GSR: An example of changes of GSR is seen in Fig. 2. In the figure, the magnitudes of reflex are proportional to the loudness levels of voice, and the reflex induced by vocalization can be discriminated from that due to the train noise itself.

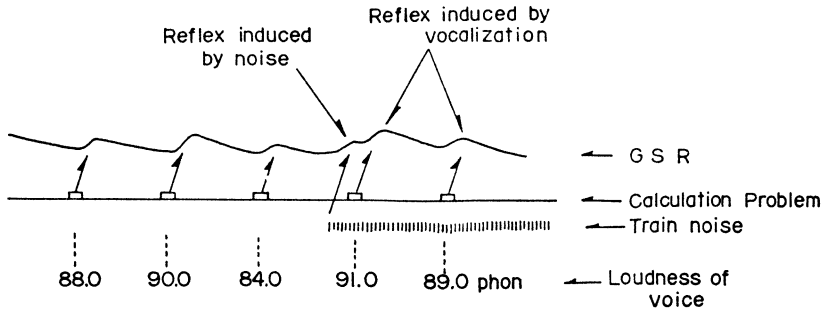

Fig. 2. An example of changes of GSR by vocalization and by onset of train noise.

Table 2. Effect of train noise on GSR.

Ss \ Level of noise	60	65	70	75	80 phon
Yo	⧺ n	⧺ n	⧺ n	⧺ n ⧺ v	⧺ n ⧺ v
Na	−	−	−	⧺ v	⧺ v
Fu	−	+ n	+ n	⧺ n	⧺ n
Oi	−	+ n	⧺ n	+ n + v	+ n + v
Ne (woman)	−	−	−	?	?

Although the pattern and the magnitude of reflex had some individual differences, the changes of GSR could be classified into at least the following three types: (1) reflex produced by vocalization, (2) reflex due to train noise itself and (3) reflex owing to both of them.

Based on the above classification, the results of changes in GSR of five Ss are summarized as shown in Table 2. The GSR as to a female S could not be measured.

In the table, the amount of change in GSR was classified into the following six categories. −: no effect, +n: stopping of falling down of the base line in GSR by the train noise (weak effect of noise itself), +v: stop of falling of the base line in GSR accompanied with increment of the voice in loudness, ⧺n: occurrence of the GSR clearly due to the train noise, ⧺v: occurrence of the GSR clearly due to the increment of the voice in loudness, ?: inhibition of reflexes owing to both the noise and the increment of vocalization effort.

The results from Table 2 may be summarized as follows.

(1) The influences of 60, 65 and 70 phon noise on GSR appeared in several Ss, though these noises did not affect the loudness of voice.

(2) The train noise of 75 and 80 phons produced clear changes of GSR for all Ss.

Evaluation of the degree of disturbance by the train noise: The results of rating in the noise disturbance are presented in Table 3. The degree of disturbance is rated according to the following four categories; −: no disturbance, +: a little disturbance, ++: considerable disturbance, +++: heavy disturbance.

Table 3. Results of rating on the degree of disturbance.

Ss \ Noise	60	65	70	75	80 phon
Yo	−	−	+	+++	+++
Na	−	−	−	+	+
Fu	−	−	−	+	+
Oi	−	−	±	+	++
Ne (woman)	−	−	−	+	++
Ma (woman)	−	−	+	++	+++

A complaint of disturbance by the train noise began to appear at the level of 70 phons and a marked disturbance was reported at the time of both 75 phon and 80 phon noise in all Ss.

Conclusion

Increase of voice in loudness as well as a complaint of disturbance by the train noise appeared at the level of 70 phons. They became severe under the noise of 75 and 80 phons. Changes in GSR came out at the level of 65 phons and became frequent under the noise of 75 and 80 phons.

It may be concluded that the loudness level of the train noise should be limited to 65 phons or so, in order to expect no influence of the noise on the vocalization effort.

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Zusammenfassung

Die Veränderungen in Stimmumfangs des Vorlesenden und in GSR wurden untersucht, die auf Grund des Zugsgeräusch eintraten. Sechsartige Geräusche wurden dabei 6 Studenten als Vpn. gebebn. Aus den Ergebnissen folgt: die Stimmumfangsstufe der Vokalisation beim Vorlesen der Zahlen wurde auf der Stufe von mehr als 70 Phon Geräusch unverkennbar erhöht: die Veränderungen des GSR traten erst auf der Stufe des 60 Phon Geräusches ein und sie wurden auf der Stufe des 75 und 80 Phon Geräusches noch klarer.