

Studies on Influences of Train Noise upon Schoolchildren: VI. GSR during Mental Calculation

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STUDIES ON INFLUENCES OF TRAIN NOISE UPON SCHOOLCHILDREN : VI.

GSR DURING MENTAL CALCULATION*

By

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Noise induced by a train passage was given to elementary school children, while they were assigned simple calculations. The influences of the noise were measured by the changes of GSR and calculation time. Disturbances caused by the noise emerged under 70~80 phon level of the noise. The difference of the influences between the visual presentation and the auditory presentation of the calculation task was not significant.

It is assumed that under noisy conditions mental activities are disturbed and then general levels of mental tension are heightened. In this experiment, therefore, GSR, that is sensitive to the changes of general level of mental tension, was recorded to measure the effects of noise on mental activities. At the same time the changes of score of mental calculation were measured.

Method: Noise induced by a train passage was given to Ss while they were assigned for simple mental calculation and the changes of GSR were recorded at the same time. As a mental work, not too difficult questions of mental calculation, addition and subtraction, were selected on the basis of the preliminary test. The questions of calculation were presented in the following two ways: (A) visual presentation by memory drum and (B) auditory presentation by tape recorder. GSR was read directly on Bridge-circuit. Electrodes were set on the edge of the index finger and the middle finger of left hand. Noise was given only once during working by speaker from the front of S.

(A) *On the case of visual presentation of the questions*

Procedure: A total of twelve questions was presented automatically by memory drum one by one at a time at intervals of six seconds. Each subject was asked to calculate mentally as soon as he saw the question presented and to answer orally within six seconds. The questions were comparatively easy ones that could be answered by most of children without making errors within six seconds, as had been ascertained from the preliminary test. Table 1 shows the three kinds of questions for 2nd, 4th, and 6th graders, and time relationships between the questions and

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

Table 1. Questions of calculation for 2nd, 4th and 6th graders. Each of the three lists was printed on the paper of memory drum and automatically presented one by one at its door.

	Questions for 2nd grader	Questions for 4th grader	Questions for 6th grader
	Exercise $4+3=$ $2+4=$ $7-2=$ $9-6=$ $3+7=$ $5-3=$	Exercise $8+7=$ $3+9=$ $10-4=$ $13-9=$ $5+8=$ $11-6=$	Exercise $14+7=$ $8+9=$ $14-8=$ $11-4=$ $13+5=$ $17-8=$
	Let's get started	Let's get started	Let's get started
	3+2=	7+5=	11+8=
	2+5=	6+8=	5+16=
	9-3=	12-4=	15-9=
	6+2=	6+5=	14+6=
	7-3=	13-6=	22-7=
	3+6=	5+9=	6+17=
	8-5=	11-5=	13-6=
	6+4=	8+5=	7+12=
	7+2=	9+7=	13+11=
	10-6=	10-6=	12-5=
6-3=	12-7=	14-8=	
3+4=	3+9=	4+12=	
The end	The end	The end	
Answers in addition distribute between 6 and 10, in subtraction: 2~6.	Answers in addition: 11~16, in subtraction: 4~8	Answers in addition: 16~24, in subtraction: 6~9, and 15.	

Table 2. Distribution of Ss in each of five noise conditions.

Grader	Noise condition					Sum of Ss
	Quiet	65	70	75	phon 80	
2nd grader	3	3	3	3	3	15
4th grader	3	3	3	4	3	16
6th grader	4	4	4	4	4	20

presentation of noise. Questions of subtraction were written in red ink to prevent mistakes. After six practice questions were assigned, twelve questions of main series followed. The train noise began reaching S's ear at the time of 4th question, and when 6th and 7th questions were asked, it reached highest peak and was out of hearing when 11th question was presented. There were five conditions of giving noise to Ss: (1) no noise or quiet, (2) 65, (3) 70, (4) 75, and (5) 80 phon noise. Ss were different in each condition. They were children of elementary school in Sendai. A total of 51

Ss were grouped into 15 groups as shown in Table 2. Each subject reported answers orally to the experimenter who was sitting by S's side. Ss were instructed to pass to the next questions after giving up answering the given question if they could not answer within six seconds.

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

Results of GSR: GSR can be classified into three kinds of reflexes here, i.e., (1) reflex induced by vocalization, (2) reflex to noise itself, and (3) reflex owing to both of them. In this experiment, however, general levels of mental activity in the situation where Ss give answers orally on the whole were taken into consideration. With respect to GSR, it was examined how the reflex during noise period (corresponding to questions from 5th to 8th) changed on the following indexes in comparison with those during quiet period that is before and after noise period (corresponding to questions from 1st to 4th and from 9th to 12th questions). Indexes of (1) the newly emerged reflex when noise was given, (2) the amount of reflex, (3) changes of wave, (4) latency, (5) fluctuation of base line, (6) reflex time, and (7) numbers of reflex. The changes found in these indexes were summarized and the degree of effects of noise on GSR was rated into the following five grades:

- ##: the case where the clearest reflex emerged during the noise period (4 points).
- +: the case where a clear reflex was found (3 points).
- ±: the case where reflexes emerged (2 points).
- ±: the case where a little reflex was found (1 point).
- : the case where no reflex was found (0 point).

The mark “-” in the category of no-noise stands for that no special change was found during the period corresponding to the noise period and the mark “±” stands for

Table 3. Result of GSR. - signs in quiet condition indicate that there are no remarkable responses in the period correspond to the noise period in noise condition. ± signs: some responses in the period.

Grader	Noise condition				
	Quiet	65	70	75	80 phon
2nd Grader	-	-	-	+	±
	-	+	+	-	±
	-	-	-	+	-
4th Grader	-	+	-	+	±
	-	-	±	##	±
	-	±	+	-	##
6th Grader	-	-	##	+	+
	±	-	+	±	+
	-	±	±	+	+
	±	±	-	-	+
Mean score	0.2	0.7	1.2	1.6	1.9

that a little change was found.

Form Table 3, the results are summarized as follows.

- (1) No difference is found among three grades.
- (2) All children are affected by 80 phon noise.
- (3) Even by 75 phon noise, they are considerably affected.

(4) It may be the extent between 65 phon and 70 phon noise, to which Ss do not feel mentally overloaded.

Results of time for mental calculation and errors of calculation: Time for mental calculation, i.e., the lapse of time from the presentation of question to S's answer, was recorded on the recording paper of GSR. Changes of the time of mental calculation were measured to examine if the time necessary for the calculation would be lengthened or not by noise. 12 questions were distributed into the three periods as shown below and the mean time was calculated for each period.

1. Quiet period before noise was given — 1st, 2nd, 3rd, and 4th.
2. Noise period — 5th, 6th, 7th, and 8th.
3. Quiet period after noise period — 9th, 10th, 11th, and 12th.

The time of incorrect answers and non-answers were excluded from the calculation of mean. Rate of prolongation is the ratio of the period before noise (A) to the noise period (B) and the ratio of the period before noise (A) to the period after noise (C), i.e., $(B)/(A) \times 100$ and $(C)/(A) \times 100$. The results in every condition are shown in Fig. 1.

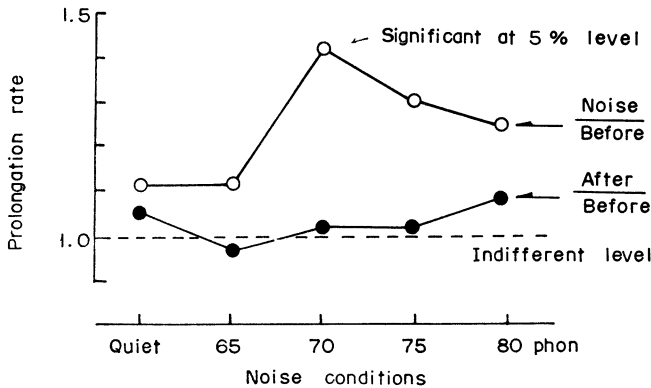


Fig. 1. Result of prolongation in calculation time.

The results of time of mental calculation and errors are summarized as follows.

(1) The time of mental calculation becomes longer obviously under 70 phon noise condition.

- (2) The rate of prolongation by 75 and 80 phon noise is statistically insignificant.
- (3) No difference is found between the results before and after the noise period.
- (4) Numbers of incorrect answers and of nonanswers increased a few by 70 and

75 phon noise.

Reports of impressions on the noisiness of noise: Ss began to report that the noise had been more annoying as the levels of noise became higher. Especially in case of 70 phon noise, 7 out of 9 Ss complained of the noisiness. Someone reported that he had trembled when 80 phon noise was given. On the other hand, one S mistook the train noise for music.

Conclusion: Results of GSR, time of mental calculation and reports of impressions may be summarized as follows. Results of GSR shows that many Ss began being affected by noise of about 70 phons, and more. But it is clear that 70 phon noise make the calculation time delayed and that S's complaints of annoyance increase. It is, therefore, undeniable that just 70 phons of noise disturbs man's performance considerably. But considerable reduction of the rate of disturbance was observed even when the noise level went down to 65 phons. Accordingly, it may be somehow in case of less than 70 phon or down to 65 phon noise that remarkable effects of noise do not emerge. By the way, even when the Ss were only hearing noise, there emerged GSR for 3 out of 4 Ss.

(B) *On the case of auditory presentation of questions*

Purpose: The writer assumed that greater effects of disturbing stimulus (noise) on the task might result when both of the noise and the task were presented through the same sensory modality.

Procedure: The procedure of this experiment was almost the same as in the experiment already described except that the questions of calculations were presented auditorily by tapecoder. Ss answered orally. 26 children served as Ss. GSR was recorded here also.

Results: Table 4 shows the results. Three kinds of noise conditions were settled.

The way of indications in this Table is the same as in the previous experiment.

(1) GSR appeared remarkably when 75 phon noise was given.

(2) It cannot be concluded that the greater effects were found when the questions were presented auditorily in comparison with the case of visual presentation of questions.

The rate of prolongation of calculation time under noisy conditions is shown in Fig. 2. The time of calculation seems to be lengthened with the increment of noise level, but there is no statistically significant difference for the rates of prolongations. It cannot be said that errors increase by noise in the case of auditory presentation.

Conclusion: It was found that there emerge disturbances of performance by noise under 75 phon level of noise. Results were almost similar to those of visual presentation of questions. It was not, however, ascertained that greater effects of noise would result under condition of auditory presentation of question than under those of visual presentation.

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Table 4. Result of GSR in the experiment of auditory presentation.

Grader	Noise condition		
	Quiet	65	75 phon
2nd grader (10 Ss)	-	-	-
	-	±	+
	-	±	±
4th grader (16 Ss)	-	-	+
	-	-	-
	±	+	+
	-	-	+
	-	±	±
Mean score	0.1	0.6	1.3

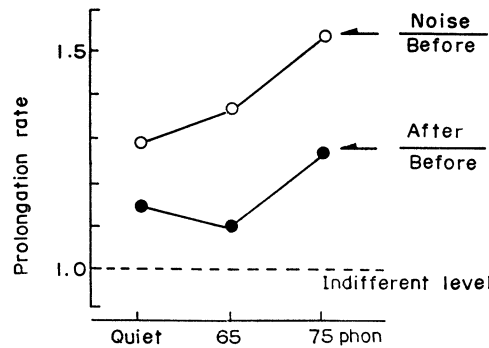


Fig. 2. Result of prolongation in calculation time in the experiment of auditory presentation.

ZUSAMMENFASSUNG

Während des Zuggeräusches, wurden einfache Rechenaufgaben den Schulkindern gegeben. Die Einflüsse des Zuggeräusches auf die Schulkinder wurden mit den Veränderungen des GSR und der Rechenzeit gemessen. Die Störungen durch Zuggeräusch wurden die Vpn. bei der Rechnung auf 70~80 Phon Stufe vom Zuggeräusch beeinträchtigt. Der Unterschied der Einflüssen des Zuggeräusches auf die Rechnung zwischen visueller und akustischer Vorzeigung der Rechenaufgaben war nicht signifikant.