EFFECTS OF INTERMITTENT NOISE ON PHYSICAL AND MENTAL WORKS

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by

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(I) Introduction

In accord with the increase of population in large cities, with the development of culture, traffic and mass communication, it is inevitable that the various sorts of intense and unpleasant noises occur. In consequence, inhabitants of large cities are suffering from the psychological and physiological influence of noise. It seems to be no doubt that the irritation, uneasiness and anxiety are produced at least in part by noise.

How much then noise causes harmful psychological effects on the individual? Some of the well controlled experiments on the effects of noise have appeared till now. They were reviewed by F. K. Berrien (1946)[1] and D. E. Broadbent (1958)[2] thoroughly. As it is clear from these reviews, the psychological effects of noise, in contrary to expectation, have not been clearly found in the laboratory experiments. For example, it is not conclusive in the experiments by S. S. Stevens (1941)[3] and by Viteles and Smith (1946)[4]. Perhaps the remarkable effect was found by Broadbent, and recently by Azrin[5], on the visual discrimination. According to the opinion of Broadbent, the negative results of Stevens and Viteles may due to these factors: (1) the intensity of the noise used was less than 90 db, (2) work period or noise exposure time was too short, or (3) the task itself was not appropriate. According to our opinion, these negative results may due to the delicate nature of psychological effects of noise, as well as the complexity of the conditions. An attempt was made to obtain positive effects of noise and the following experimental plan was elaborated.

1. As a stimulus one has used mostly continual noise only. However, to the continual noise we get more or less adaptation. Therefore, being the intensity and quality of the sound the same as that of continual noise, we attempted to use intermittent noise, to which people are difficult to adapt and which exerts stronger effects than the continual noise.

2. It is clear that the effects depend upon the pitch also. Therefore we used white noise which contains sounds of various pitch.

3. It is certain that there are different tasks, on which the effects of sound come out easily and clearly or they are concealed out of sight. On this point, it is expected that there would come out perhaps considerably different effects of sound between physical work and mental work. Even in the mental work, unless it is relatively complex and difficult, the effect would not be clearly shown.

4. If the work is of such sort, then although the intensity of noise is below 90 db, that is, if the loudness of noise is 60 or 80 phon, which seems to be the average loudness of sound in large cities, the effect would come out clearly. On this assumption, we used white noises of 60 phon and 80 phon.

The noise was presented intermittently from the front half left side at a 60 cm. distance from subject. We presented the noise for one second, then no noise for 1.7 seconds and again noise for one second and so forth. The intermittent noise was generated by a white noise generator (constructed by the Laboratory of Electric Communication, Tohoku University) which is combined with a intermittent time stimulator (made by Takei Kiki kôgyo Co., Ltd.). The noise was amplified and conducted to a loud-speaker.

(II) Effects of noise on physical works

As physical works we selected two sorts of tasks.

(1) The work by the pursuit rotor

(2) The work of picking up beans with Hashi (a pair of chopsticks)

(1) The work by the pursuit rotor

The pursuit rotor consists of a target moving with a relatively high rate of speed (35 R.P.M.). It has a smooth turntable in which is set a brass target button with 1 cm. in diameter, at a 10 cm. distance from the center. The turntable is revolved by a synchronous motor by a gear system. The subject is to pursue the target button with a jointed stylus. The score of his task is counted on kymograph which marks one sign every 0.5 seconds when his stylus is touching with the target during each practice period This work is considerably difficult, being it requires mental and physical tension or striving. However, its practice effect is remarkable. The work by the pursuit rotor was carried out through following two experiments.

Results of the 1st experiment

The first experiment was consisted of two experimental series.

1st experiment 1st series: This is control experiment. Five subjects work

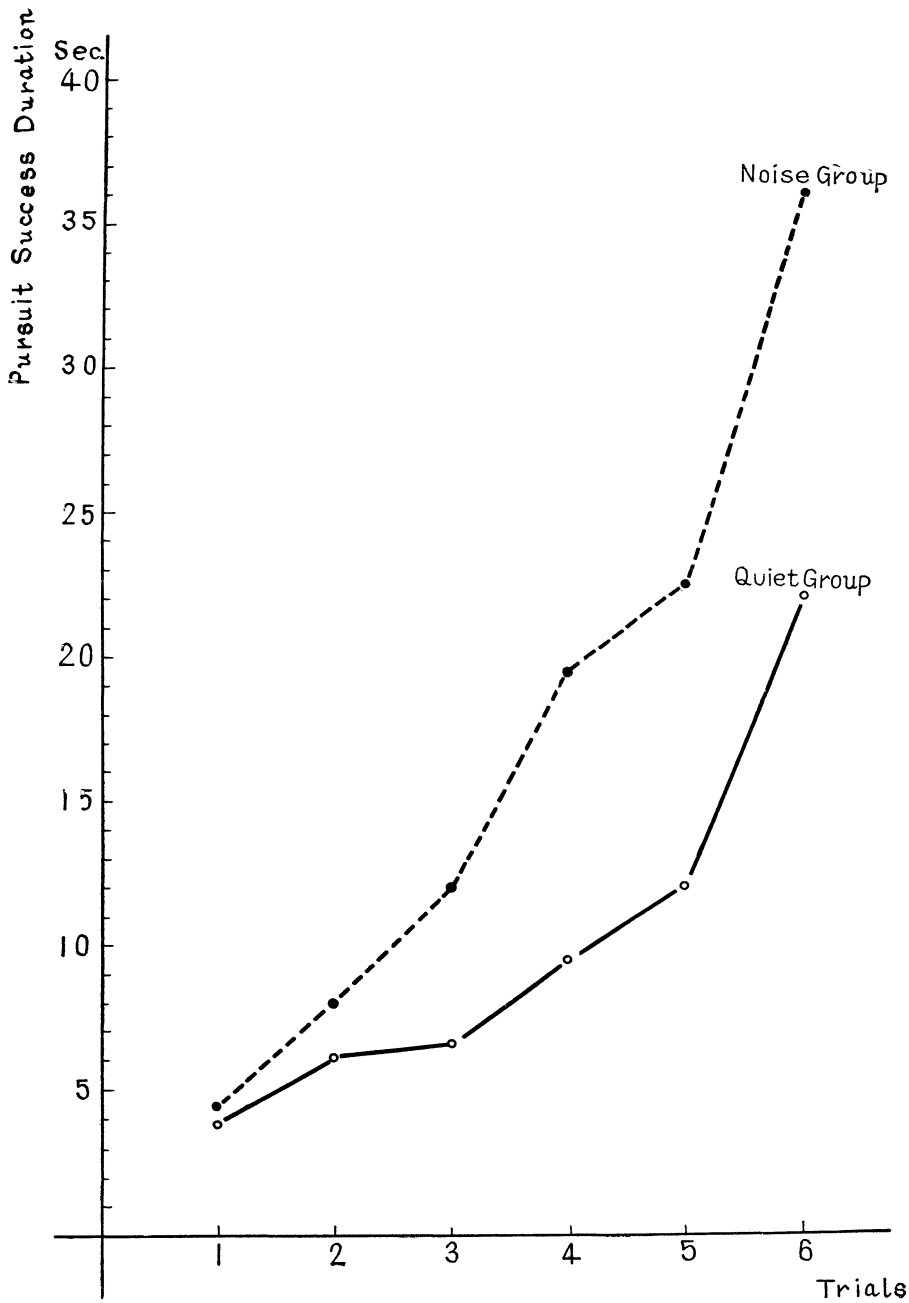

Pursuit Success Duration
Sec.
40
35
30
25
20
15
10
5
Noise Group
Quiet Group
1
2
3
4
5
6
Trials

Fig. 1

without noise. One minute pursuit (trial) after one minute pause. They worked six trials in total.

1st experiment 2nd series: Five subjects work always under noise. These five subjects are different from those in the first series. We have given 80 phon noise only.

We counted the number of signs on the kymograph. As one sign corresponds to 0.5 seconds, we converted the number of signs into duration. The results are shown in Fig. 1. Each point is the mean of five subjects.

On the Fig. 1 we recognize that the duration of work of second series group, who tried under noise, was a little longer than that of the first series group, who tried in the quiet condition. In order to confirm the existence of a difference between them, we tried t test.

(1) The sixth trial

Between 36.00 sec. (Noise) and 22.00 sec. (Quiet) $t_0=0.62$

$t_4(0.05)=2.132$ (One tail)

Therefore, no difference.

(2) The fourth trial

Between 19.80 sec. (Noise) and 9.40 sec. (Quiet) $t_0=0.97$

Therefore, no difference.

(3) The third trial

Between 11.90 sec. (Noise) and 6.90 sec. (Quiet) $t_0=0.57$

Therefore, no difference.

In consequence, we assume that there is no difference between the works done in quiet and in noise. That is to say our results which showed no negative effect of noises, coincide with that of S.S. Stevens' experiment[3].

It is remarkable that in the first as well as in the second series we find a considerable rise in the sixth trial. We have tried an experiment at this sixth trial, in order to ascertain the effect of noise. This is the second experiment.

Results of 2nd experiment

The 2nd experiment the 1st series: There was no noise from the 1st to the 5th trial. Only at the sixth trial we exposed noise. But in the seventh trial we exposed no noise again. The subjects are six who are not concerned in the 1st experiment.

The 2nd experiment the 2nd series: From the first till fifth trial we exposed noise, but in the sixth trial we did not give it, and at the seventh trial we gave it again.

It was found that the work under no noise from the first to fifth trial was, on the contrary to the first experiment, better than that under noise. However, if we tried t test on the difference on each trials we could not find statistical significance.

As one can see from the Fig. 2, in the first series of the second experiment where noise was present at the sixth trial, the pursuit success time

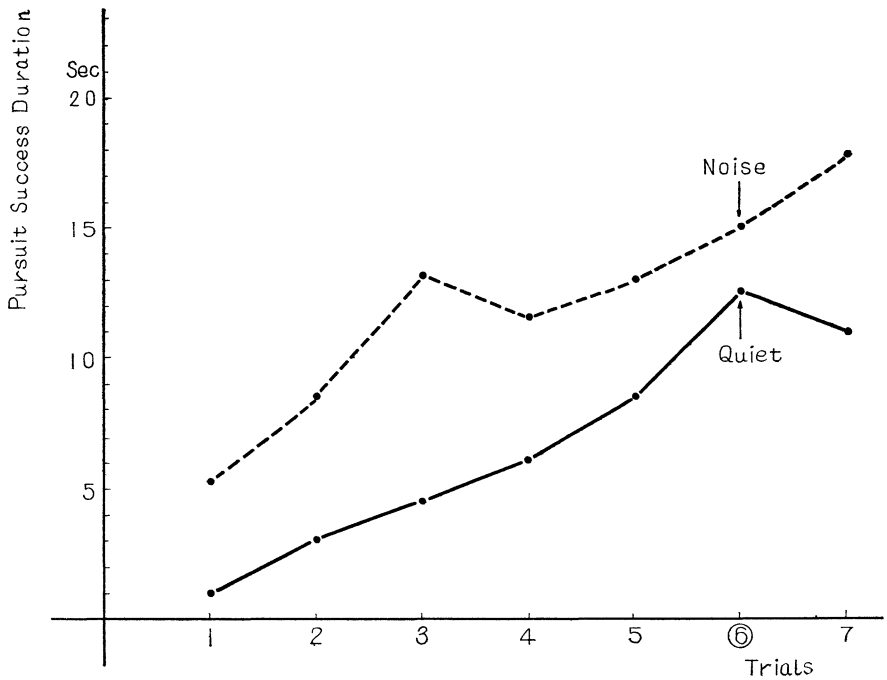


Fig. 2

seemes to have been decreased through the effect of noise. On the contrary, in the second series where no noise was presented at the sixth trial, the pursuit success time tended to increase in the sixth trial. In consequence one may assume that there was sound effect in some extent.

Now from the analysis of results of two experiments on pursuit rotor work, we have found that such a work does not necessarily suffer from regular intermittent noise.

(2) The work of picking up beans by Hashi (a pair of chopsticks)

On the work of pursuit rotor we have found almost no disturbing effect of noise. Now, does the noise have no disturbing effect on the work, or on the contrary does it have rather facilitatory effect? Or, does it have almost no effect? To ascertain this problem we have planned the second work.

As such physical work in which minor practice effect occurs and for which delicate finger skill is necessary, we selected the work of picking up beans by Hashi. As it is a delicate manual work, it requires certain concentration of attention and psychological tension. We expected that this work will be easily affected by noise. On the other hand, as this work to pick up something with a pair of

chopsticks is familiar to the Japanese, we have expected that the practice effect would not occur too much and individual difference of practice effect would be very small.

This is the manual work to pick up beans which is about 15 mm. long and 8 mm. in diameter as large as coffee beans of which surface is smoother, which were piled up in a black lacquer box 15×15 cm. wide and 4 cm. deep, by bamboo chopsticks, which are 24 cm. long and 0.5 cm. in diameter, and more slender at about 4 cm. length from its end. Subjects put them into a wooden cup as fast as possible in one minute. Then one minute pause and again one minute picking followed. In this way one carried out the work four times, then comes a pause for five minutes. Thereafter one tried to work three times with one minute break in each time. Every subject must hold the stick in the same position. The scheme of this work is shown in the following figure (Fig. 3).

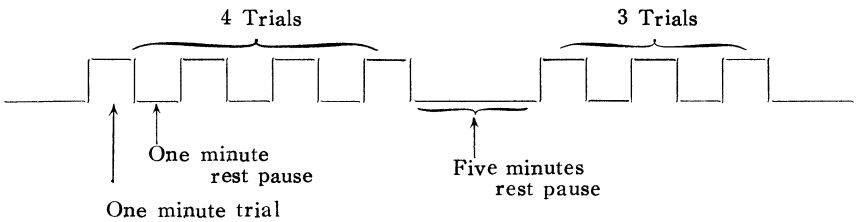


Fig. 3

We constructed three groups of subjects.

(1) The first group was the quiet group to which no noise was presented.

(2) The second group was the group to which noise presented at every trial before the five minutes pause (Fig. 4).

(3) The third group was the group to which noise was exposed during five minutes pause as well as to every trial after the pause (Fig. 5).

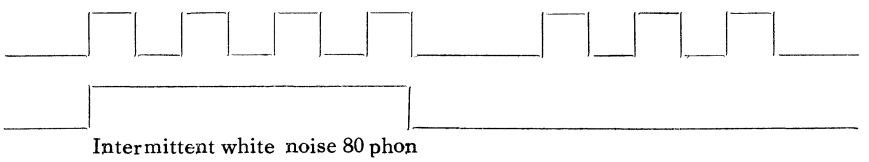


Fig. 4

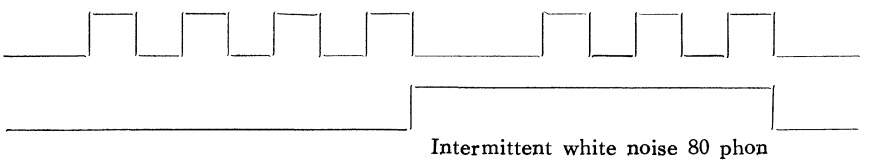


Fig. 5

The number of subjects was 26; the first group 12; the second group 7 and the third group 7. They were all different persons each other and different also from those of the first experiment. They were all university students and had no auditory and other defects. The noise used was 80 phon white noise.

We planned those three groups of works based on the following expectations: if we present noise during rest pause, then the rest would be disturbed and in the following trials the scores would not so high as otherwise. On the contrary, if we expose noise to the trials before the pause and do not expose noise during rest pause, then we could facilitate the rest effect, consequently the scores of trials after the pause would be higher than when noise was not present during the trials before the rest pause.

Results and consideration

As scores we take the number of beans picked up. The results of experiments are as follows:

We supposed that the scores of fourth trial will reach 30 and in accord with it we modified the scores of the other trials.

As one can see on the Fig. 6, initial striving is found especially in second and third group. However, the scores of the first four trials are comparatively similar among three groups. After the rest pause, the trial score is going up more or less. This upward curve will be considered as the rest

Table 1

Groups	Ss \ Trials	1	2	3	4	Rest pause	5	6	7
Group of quiet	I_z	25	27	36	32		31	33	39
	U_t	30	33	33	40		32	30	39
	S_a	34	27	25	26		29	30	30
	S_k	28	22	27	23		28	30	31
	T_a	36	36	30	34		37	34	31
	N_a	33	31	37	32		33	37	38
	T_k	32	25	22	36		33	48	34
	H_i	33	41	43	41		46	43	46
	M_i	39	43	42	45		47	52	50
	F_u	33	39	47	42		48	48	48
	K_i	31	30	44	34		35	33	37
	F_k	35	33	32	36		37	36	39
	$\bar{x}$	32.4	32.2	34.8	35.1		36.3	37.8	38.5
	$(\bar{x})$	28.5	27.7	30.1	30.0		31.3	32.6	33.2

Group of the intermittent noise before rest pause

Ss \ Trials	Intermittent noise 1	2	3	4	5	6	7
W_a	32	24	26	28	24	29	26
O_w	22	22	21	24	25	23	26
K_u	26	23	24	21	26	29	26
M_o	34	30	31	35	38	31	30
I_s	28	29	26	33	34	35	36
T_o	17	19	24	17	26	25	25
O_r	32	29	34	35	33	34	36
$\bar{x}$	27.3	25.1	26.6	27.6	29.4	29.4	29.2
$(\bar{x})$	30.1	28.1	30.0	30.0	33.1	33.3	33.0

Group of the intermittent noise during and after rest pause

Ss \ Trials	1	2	3	4	Intermittent noise 5	6	7
S_i	27	29	29	26	31	27	26
H_a	28	30	27	31	28	32	27
F_h	24	20	30	27	27	28	28
I_d	32	35	34	32	36	35	32
H_o	34	32	27	30	32	31	26
O_y	32	26	27	29	29	29	28
F_d	39	32	32	30	27	30	34
$\bar{x}$	30.9	29.1	29.4	29.2	29.4	30.2	28.7
$(\bar{x})$	31.6	29.8	30.3	30.0	30.8	31.0	29.5

$(\bar{x})$: Adjusted mean values supposing the 4th trial will reach 30.0

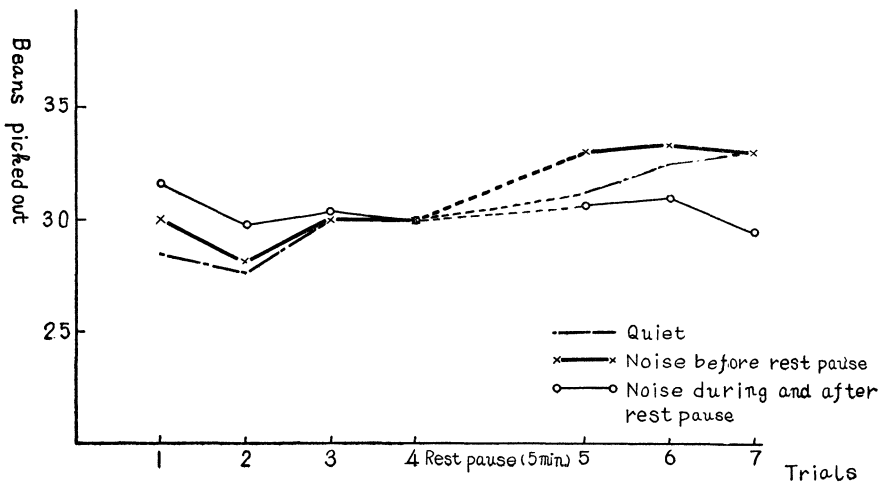


Fig. 6

effect. This rise of score is greatest in the second group to which noise was presented in the trials before the rest. On the contrary, in the group to which noise was given during the rest period and afterwards, their scores were scarcely going up. In the first group to which noise was never presented from the beginning to the end, the rise of scores after the rest period is in the middle point between the two groups. Therefore, the result confirms our supposition.

However, if we tried F test on the ascending rate of the fifth trial to the fourth trial between three groups, we could not get significant statistical difference. This may due to the large individual difference.

Consequently, the effect of noise on the picking up work of beans is remarkably weak : that is we cannot say the noise is disturbing or facilitating. But we cannot say that it has no effect. Only quite faint disturbing effect seems to occur.

(III) Effects of noise on mental works

It is not appropriate to divide mental work from physical work. We cannot classify them clearly. However, it is convenient to contrast comparatively pure mental to physical work, because it seems to be probable that there is considerable difference in the noise effects between upon mental and physical works. From this supposition and in order to acknowledge noise effect as clearly as possible, we selected more complex and difficult mental work than simple and easy one. For example, work of addition as Kraepelin addition test, seems to be too simple and easy. Therefore we have selected two sorts of mental works.

(1) Work to interchange the position of two vowels in five letters nonsense syllables.

(2) Work to select addition or subtraction according to the settled condition and to count (according to H. Düker's procedure[6]).

These two works are comparatively complex and difficult mental work, so that one may expect somewhat negative effects of noise through this experiment and therefore one may measure the effects quantitatively.

(1) Work to interchange two vowels.

We used the following ten nonsense syllables consisted of five letters. These syllables are exposed one at a time through the window of N. Ach 's serial exposition apparatus, every 1.5 seconds. The one round of ten syllables takes about 15 seconds and then about five seconds pause. Then the syllables appear again. Subject must interchange the position of the vowels, for example if 'cotef' comes out he must change the position of 'o' and 'e' and pronounce

'cetof'. The work is repeated untill all exchanges of ten syllables were correctly pronounced. This number of repetitions needed was taken as an index of noise effect in comparison with quiet group's work.

After some preliminary experiments, it became clear that the practice effect was remarkable, therefore we devided 17 subjects into the following three groups. They are students of Psychology, Tohoku University.

(1) Control Group:

To this group no noise was exposed. 7 subjects.

(2) Experimental Group I:

To this group 60 phon noise was presented. 5 subjects.

(3) Experimental group II:

To this group 80 phon noise was presented. 5 subjects.

Noises were given through the exchange work from beginning to end. The experimenter has a sheet of paper on which the ten syllables with correctly exchanged vowel position are printed and seeing it he checces the correctness of subject's pronounciation and write it down on protocol.

Results and Consideration

Error of the vowel position exchange becomes smaller according to the

Table 2. Control group (n=7): Quiet

Ss \ Trials	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A	9	10	8	6	5	1	5	2	1	1	0							
B	9	7	7	7	5	5	4	1	1	1	1	1	1	2	2	1	1	0
C	7	8	9	8	3	4	4	2	4	4	5	0						
D	5	3	2	3	4	3	3	3	3	3	3	5	3	2	3	3	5	0
E	5	3	3	0														
F	6	5	3	2	3	1	2	2	1	3	1	0						
G	5	4	2	3	5	3	0											
Means	6.5	5.7	4.9	4.1	3.6	2.4	2.5	1.4	1.4	1.7	1.4	0.9	0.6	0.6	0.7	0.6	0.9	0.0

Table 3. 1st experimental group (n=5): 60 phon noise

Trials \ Ss	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
H	9	7	6	4	5	4	3	3	2	4	1	1	1	0								
I	8	9	8	9	3	6	6	6	5	3	1	1	2	2	2	1	1	1	0			
J	8	5	5	3	5	5	3	4	2	2	2	1	0									
K	7	7	8	6	9	6	5	3	6	1	6	5	1	4	3	3	5	5	3	3	1	0
L	6	4	2	1	1	1	1	1	1	1	0											
Means	7.6	6.4	5.8	4.6	4.6	4.4	3.6	3.4	3.2	2.2	2.0	1.6	0.8	1.2	1.0	0.8	1.2	1.2	0.6	0.6	0.2	0.0

Table 4. 2nd experimental group (n=5) : 80 phon noise

Ss \ Trials	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
M	10	9	9	8	7	8	6	5	6	5	5	6	5	4	4	4	7	3	5	4	7
N	10	8	9	8	7	4	9	4	5	5	6	7	6	4	3	1	1	1	1	1	0
O	10	6	9	8	8	6	5	6	3	5	6	4	4	4	3	4	3	6	4	3	5
P	9	9	7	8	9	7	9	9	5	5	6	7	9	7	6	7	8	7	2	6	6
Q	8	5	7	6	4	5	4	4	4	7	4	6	2	3	4	3	4	3	1	4	3
Means	9.4	7.4	8.2	7.6	7.0	6.0	6.6	5.6	4.6	5.4	5.4	6.0	5.2	4.4	4.0	3.8	4.6	4.0	2.6	3.6	4.2

22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
2	4	4	5	2	3	3	4	4	4	4	4	3	3	4	5	4	3	3	3	2	3	1	0
2	3	2	2	2	1	2	1	1	3	0													
8	5	5	6	6	7	4	8	4	6	7	5	3	4	3	2	0							
2	4	5	3	1	2	4	3	2	2	2	5	8	1	4	3	2	5	2	0				
2.8	3.2	3.2	3.2	2.2	2.6	2.6	3.2	2.2	3.0	2.6	2.8	2.8	1.6	2.2	2.0	1.2	1.6	1.0	0.6	0.4	0.6	0.2	0.0

repetition of the work. The average value of subjects in three groups is shown in the following tables.

The Fig. 7 is a graphical description of average error of three groups.

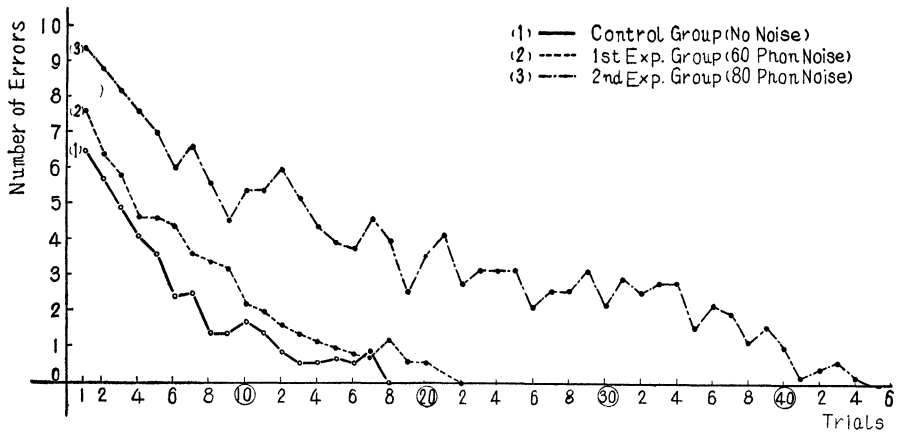


Fig. 7

The first group, to which no noise was given, succeeded in pronouncing ten syllables with no error at 18 th trial : while the second group, to which 60

phon noise was given, succeeded at the 22nd trial: while the third group, to which 80 phon noise was given, succeeded at the 45th trial at last. The noise effect of 80 phon is undoubtedly clear. However, 60 phon noise effect is also found in some extent. On three groups, we analyse distribution of (A) the number of errors at the beginning of the trial, (B) the number of trials required before the disappearence of the error.

Table 5. Distribution analysis about number of errors in the first trial.

Source of variation	Sum of square	df	Mean square	F_0
Between groups	23.42	2	11.71	5.82
Within group	28.11	14	2.01	
Total	51.53	16		

Significant at 5% level.

Table 6. Distirbution analysis about number trials reqiured before the disappearence of the error.

Source of variation	Sum of square	df	Mean square	F_0
Between groups	1787.26	2	893.63	21.95
Within group	569.80	14	40.70	
Total	2357.06	16		

Significant at 1% level.

From this analysis, we can observe the noise effect more in the experimental group where noise was presented than in the control group where no noise was presented. This effect is, as one can observe in the process graph (Fig. 7), especially clear in the second experimental group (80 phon noise). In this group, there appears much more error even from the beginning of the trial than the control group ($0.05>p>0.02$, $t_0=2.69$, $df=10$). On the contrary, in the control group (no noise was given) and in the first experimental group (60 phon noise was given) there occurred relatively few errors and the work of changing vowel position proceed to the success in short time. Between these two groups, there is no statistical difference in the numbers of error. On the other hand, in the group to which 80 phon noise was presented, the decreasing rate of error is smaller and work of changing vowel position does not so smoothly proceed to success.

About the difference of the number of trial required before the error disappeared, we have already observed in the Fig. 7. Between the control group (18 th trial) and the first experimental group (22 th trial), there is no significant difference. On the contrary between those and the second experimental

group (45 th trial) there is significant difference ($p>0.001$, $t_0=6.48$, $df=10$).

In addition to quantitative analysis above mentioned, we have gotten several introspective reports from most subjects, which confirms tendency above mentioned. Also the degree of difficulty at the beginning of the trial to exchange vowels is about the same among the three groups. Almost all subjects of the second experimental group (80 phon group) felt uneasy about noise and disturbed by it or became nervous and did not succeed in transposition even when at one moment he could succeed to pronounce. They confessed that they were most strongly disturbed when noise was exposed just at the moment when he is about to pronounce the transposed syllable. On the contrary, in the first experimental group to which 60 phon noise was presented, almost no subject has reported such disturbance.

From such observations, we may state that the disturbing effect of noise especially of 80 phon noise is remarkable on the more complex and difficult mental work.

Now let us observe the noise effect on a little more complex work in which thinking process is involved.

(2) The work to select either to add or to subtract according to settled condition and to count.

This is the work of mental calculation to count 150 problems in total. An example is as follows.

(1)	3 + 8	9
(2)	4 + 5	6
(3)	9 − 4	1
(4)	4 − 6	6
(5)	6 + 7	4
(6)	9 − 3	1
(7)	6 − 5	8
(8)	8 − 5	7
(9)	3 + 1	9
(10)	7 − 1	2

One problem is exposed for 2 sec. through the memory drum window. Therefore it takes five minutes to solve 150 problems. Every problem is different each other. The way of counting is as follows: subject carrys out at first two numbers according to the settled sign (+ or −) and comes to answer (11), then he must compare this answer (11) with the third number (9). If the answer is larger than the third number, he must carry out subtraction. If, on the contrary, the answer is smaller than the third number, he must carry out addition. Therefore these problems are much more complex than the simple addition or subtraction. This is the work of double addition or double subtraction. He must at first grasp the first count and then compare this answer with the third number and determine whether he should add or subtract.

Subject answered orally. The experimenter, inspecting the correct answers which were written in a sheet of paper, checked the subject's answers.

We want to test whether noise influences on such mental work or not.

We divided subjects in two groups.

(1) Control group: to which no noise was exposed. Subjects 7 students.
(2) Experimental group: to which 80 phon noise was exposed. Subjects 10 students.

As we have observed on the work of exchange of vowel position, 60 phon noise did not exert clear influence. In this experiment, we do not use 60 phon noise but 80 phon noise only. Besides, this work has big practice effect, so that we devided subjects in two groups as this. In instruction, we have talked to Ss to count as correctly as possible and not to give up counting in halfway but to continue work until end.

Results and consideration

The results of this experiment are shown in Tables 7, 8 and Fig. 8. We classified the subject's answers into three: (a) impossible to answer, (b) incorrect answer and (c) correct answer.

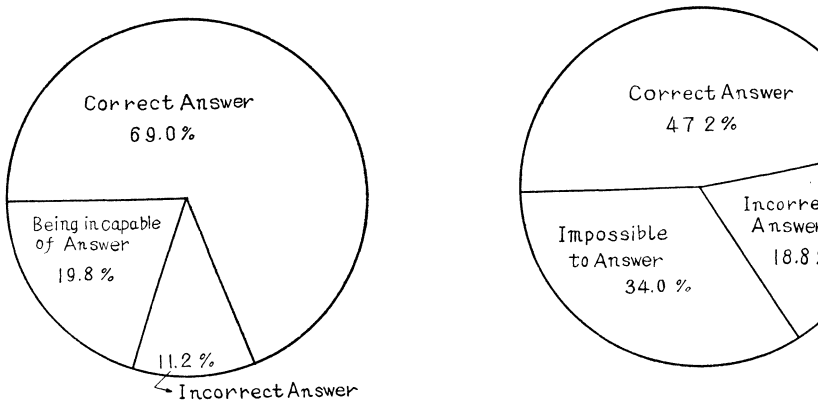
Table 7. Control group ($n=7$)

Ss	1		2		3		4		5		6		7		Total	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Impossible to answer	35	23.3	20	13.4	28	18.7	46	30.6	36	24.0	31	20.7	12	8.0	208	19.8
Incorrect answer	17	11.4	9	6.0	8	5.3	23	15.4	25	16.7	22	14.7	14	9.3	118	11.2
Correct answer	98	65.3	121	80.4	114	76.0	81	54.0	89	59.3	97	64.6	124	82.7	724	69.0
Total	150		150		150		150		150		150		150		1050	

n: Numbers of answers which belongs to each of three categories of answer classified

Table 8. Experimental group ($n=10$)

Ss	1		2		3		4		5		6		7		8		9		10		Total	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Impossible to answer	55	36.7	33	22.0	69	46.0	31	20.7	62	41.3	37	24.6	56	36.3	78	52.0	40	26.7	49	32.7	510	34.0
Incorrect answer	33	22.0	64	42.6	36	24.0	12	8.0	26	17.4	23	15.4	26	17.4	20	13.4	27	18.0	15	10.0	282	18.8
Correct answer	62	41.3	53	35.4	45	30.0	107	71.3	62	41.3	90	60.0	68	45.3	52	34.6	83	55.3	86	57.3	708	47.2
Total	150		150		150		150		150		150		150		150		150		150		1500	



Control group Experimental group

Fig. 8. Percentage of three sorts of answers

As is clear from the Table 7, 8 and Fig. 7, the number of "impossible to answer" is 19.8 % in average in the control group (no noise was given), while it is much larger (34.0 %) in the experimental group (80 phon noise was given). In control group 69.0 % of the answers was correct answer, while those in the experimental group was only 47.2 %. The difference between two groups is clearly significant in the three sorts of answer ($\chi^2=118.7$, $\chi_0^2(0.01)=9.21$). That is to say 80 phon noise has exerted on the counting work a distructing effect very much. Especially, as we have just mentioned, "impossible to answer" is so often observed in the experimental group. In these cases, if subject had difficulty to answer and made errors, then in most of these cases the subjects lost their self-possession, concentration and came to err successively. Indeed, there were such subjects in the noise group who gave so many correct answers as those in the quiet group, and vice versa. However, this is very rare. Anyhow there is much individual difference about such counting work.

On the two sorts of experiments just mentioned, we could observe disturbing effect of noise, especially 80 phon noise, on the more complex and difficult mental work.

Now, in our experiments on the mental work, in the work of exchanging position of vowels as well as in the counting work, we let subject to pronounce the answer, then we must consider the noise effect on the pronouncing movement also. The more the noise becomes louder, the more strives the subject to announce loudly. It would be possible, therefore, that the tension to pronounce louder destructed exchanging work or counting work. This tension may be considerably large. However in the second experiment the answer is a number, so that the striving to pronounce would not so large as in the first expe-

riment where the answer was nonsense syllable. In spite of this noise effect strongly appeared in the work. Consequently it would be more adequate to regard this result as the destruction of counting work itself than to regard as effect of the striving of pronounciation. In short noise destructs relatively difficult mental work itself.

(IV) Conclusion and Summary

In so far as our experiments concerned, the destruct effect of intermittent white noise is clearly observable on the relatively complex and difficult mental work. Even 60 phon noise destructs in some measure but 80 phon noise disturbs remarkably.

To the physical work, on the contrary, 80 phon noise seems to produce only a little distrubing.

At the end we thank to the Governer of Miyagi Prefecture, late Y. Ônuma and the members of the Department of Public Health of Miyagi Prefecture and to our subjects sincerely.

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Résumé

Les autheurs ont exécuté des recherches suivantes pour préciser et étayer les influences du bruit sur le comportement de l'homme et son degré. Comme le bruit que des expériences préliminaires ont regardé pour le stimulant approprié, le bruit blanc intermittent a été choisi. Ses forces ont été 60 phon et 80 phon.

Ils ont mesuré l'effet du bruit sur des travaux corporels (la première expérience) et sur des travaux mentaux (la seconde expérience). Les travaux corporels ont été (a) ceux de la poursuite de targette de rotor et (b) ceux de

relever de la fève par des baguettes. Les travaux mentaux ont été (a) ceux de l'échange des positions des voyelles dans des non-sens-syllables et (b) ceux de sélecter des sortes de compte (addition ou soustraction) et ensuite compter (après H.Düker).

Dans la mesure où ces expériences concernent, l'effet noctif du bruit blanc intermittent est observé clairement dans travaux mentaux qui sont relativement complexes et difficiles. Le bruit 60 phon même est dérangeant en quelque mesure, mais le bruit 80 phon dérange le comportement remarquablement.

Quant aux travaux corporels, au contraire, il semble que le bruit 80 phon les influence un peu seulement.

Zusammenfassung

Die Wirkung des Geräusches auf menschliches Verhalten ist objektiv noch nicht übereinstimmend bewiesen. Wir haben angenommen, dass nicht dauerunde, sondern intermittierende Geräusche stärker wirken werden. Aber auch in anderen Hinsicht haben wir angenommen, dass die Wirkung bei körperlicher Arbeit etwas anders als bei geistiger Arbeit sein wird. In dieser Annahme haben wir die intermittierenden weissen Geräusche als Reiz gebraucht. Ihre Stärken sind 60 Phon und 80 Phon.

Als körperliche Arbeiten haben wir (a) auf den sich umdrehenden elektrischen Knopf mit einem Stabe drücken lassen, und (b) mit zwei Hashi (Essstäbchen) die Sojabohne auflesen lassen. Als geistige Arbeiten haben wir gewählt, (a) die Arbeit, zwei Vokale in dem sinnlosen Worte umzuwechseln und zu lesen, (b) Rechnungarbeit (nach H. Düker).

Unsere Versuchsresultate haben bewiesen: (1) Die Wirkung, die weissen intermittierenden Geräusche von 80 Phon auf körperliche Arbeit haben, können wir kaum oder nur ganz schwach erkennen. (2) In den geistigen Arbeiten, im Gegenteil, können wir ganz deutliche Wirkung nicht nur durch das Geräusch von 80 Phon, sondern selbst durch das Geräusch von 60 Phon erkennen. Die Geräusche stören unsere Arbeit, insbesondere schwerere, kompliziertere geistige Arbeit.