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THE INFLUENCE OF DISTRACTION UPON MENTAL TEST PERFORMANCE [1]

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The experiment to be reported here was carried out in connection with the examinations given in the process of selecting men for guides and policemen at the Century of Progress Exposition. While a number of tests were given and a great deal of data collected, this investigation is concerned only with the two tests of general intelligence which were used.

It was assumed that many of the men selected as guides would, at times, be required to carry on their duties under distracting circumstances. It was further assumed that the men who would be least distracted from their tasks by disturbing influences would, other things being equal, make the better guides. We were therefore asked by those in charge of selecting the men to examine them for any differences which might be revealed in working under distracting or annoying conditions. Of course it was impossible to duplicate in the examining room either the actual work the guides would be required to do or the type of distracting circumstances under which they would be expected to work. It was taken for granted, however, that a measure of the influence of distractions on a pencil and paper test would yield a fair indication of the influence of distracting conditions upon their ability to perform their actual tasks. This may be an unwarranted assumption.

The pencil and paper tests selected for this purpose were the Otis Self-Administering Tests of Mental Ability. As there are four alternative forms of these tests, they served the purpose well.

[1] The writers are grateful to Dr. Chester W. Darrow for his suggestions in this study, and also to Miss Eleanor Garm for her assistance in the statistical calculations.

Two types of distractions were used: first, what we have called "sensory," consisting mostly of noises of various kinds, and second, what we have called "ideational," i.e., meaningful material. These will be discussed in order and will be followed by two or three related problems.

The Influence of Noise or Sensory Distraction on Efficiency in Mental Test Performance

The sensory distractions consisted of the noise produced by pounding a suspended Ford break-drum with a small sledge hammer; by playing two different jazz phonograph records with a hole punched off center; by blowing a siren, a horn, and a whistle. These were presented in various combinations and sometimes all together. The object was to create as much din as possible while the men were taking the second intelligence test.

The distractions were presented over a microphone through an amplifier. The amplifier used was capable of reproducing either music or voice or both together. Either could be amplified or reduced in volume with control.

While no measure of the intensity of the distractions was secured, they were purposely made extremely severe. Certainly the noise was much more intense and piercing than that which a worker would encounter in most factories. In this part of the study 63 men were used as subjects. The Otis Self-Administering Test, Form A (30 minute time limit), was given to this group in the usual manner at the beginning of the testing period. Then, after the men had taken the other tests, i.e., after about one hour of work, they were given the Otis Self-Administering Test, Form B (30 minute time limit) with the distractions. All the tests were given between 8 and 10 o'clock in the evening.

The mean raw score on test A which was given without distraction was $44.8 \pm .97$ and the mean for the test with the distractions was 48.0 ± 1.06. The correlation between the two tests was $.84 \pm .02$. Otis reports a practice effect of 4 points from one test to another, but he also reports that Form B which was given second is 4 points more difficult on the average than Form A. In so far as A was given first and B second, the difference in difficulty should, therefore, cancel the practice effect. There is, then, an increase in score of 3.2 in raw score under distraction. This difference divided by P. E. diff. is 2.7. We can at least be fairly sure that the distraction did not decrease the mental performance.

Kornhauser,[2] who studied the effect of noise on the production of four typists in a large Chicago office, found that 3.2 per cent more lines were written under quiet conditions, but that there was 23 per cent more wasted lineage in the form of discarded letters in the quiet than in the noisy room so that the net figures for total completed letters favored the work under the noisy conditions 1.5 per cent.

Morgan [3] who made one of the earliest studies of the influence of distractions upon performance also found that noise in the form of a variety of buzzers, electric bells, and phonograph records not only fails to slow up work but seems to spur the subjects to increased activity.

Several studies [4] have been made in England on the influence of noise upon performance. The results are in general agreement with our own. Vernon and Warner [5] who studied the influence of noise on arithmetical computation found that the ticks of a metronome accelerated performance 1.3 per cent while an intermittent electric bell accelerated it 2.6 per cent. Loud mixed noises had no effect on test time. The investigations of Lorrain-Smith, Pollock, and others [6] produced practically the same results, namely, that in a simple repetitive task a continuous noisy background appears to have a stimulating effect. Subjective reports of the subjects, however, seem to agree that both noise and vibration are "disagreeable" or "uncomfortable" accompaniments of work.

The Influence of Ideational or Meaningful Distraction on Efficiency in Mental Performance

When it was discovered that mere noise or sensory distractions seemed to increase rather than decrease efficiency, it was decided to investigate the influence of ideational or meaningful distractions on performance.

The distracting material used for this part of the experiment consisted of short stories and abbreviated articles on a variety of subjects presented over a microphone with the same amplification

[2] A. W. Kornhauser, The Effect of Noise on Office Output, *Indus. Psychol.*, 1927, 2, 621–622.

[3] J. J. B. Morgan, The Overcoming of Distractions and Other Resistances, *Arch. Psychol.*, 1916, 5, No. 35. Pp. 84.

[4] Eleventh Annual Report, Industrial Health Board, London, 1931, pp. 62–65.

[5] *Ibid.*

[6] *Ibid.*

unit as previously described. An endeavor was made to select topics of popular interest, interspersed with various bits of humor. The type of distraction was changed about every three minutes and presented by different individuals so that there was little opportunity for adaptation to any one distraction or voice.

For this part of the study 488 men were used as subjects. Otis Self-Administering Test, Form A (20 minute time limit), was given under the distractions mentioned above. All of the tests were given at one sitting and with this group the test under the distractions was given last so that there was chance for the additional element of fatigue to reduce the score.

The mean raw score on test A (without distractions) was $45.4 \pm .30$, while the mean raw score on test B (with distractions) was 47.8 ± 36. The correlation between A and B was $.82 \pm .01$. Here again, allowing that the difference in difficulty would cancel the practice effect, the men improved with the ideational distractions. There is an average gain of 2.4 points in raw score. This difference divided by P. E. diff. is 11.4. We can therefore be fairly certain that this increase in score under ideational distractions is a reliable one.

To make certain that the increase in performance under distraction was not a function of the difference in difficulty of the test, we reversed the order of the tests, giving Forms B and D first without distraction and Forms A and C second, with distractions. For Forms A and C the additional distraction of "set" was added, but the average increase under the distraction with "set" was 6 points for 460 men.

In each of the above experiments the distractions were given during the second test. When, however, the distractions were reversed, i.e., given during the first test, and when the difference in difficulty and the influence of practice, as stated by Otis, were taken into account, there was less than one point difference between the result of the two tests for 195 men.

The Influence of an Increase in the Duration of the Distraction on the Performance

The increase in the performance under the ideational distractions just noted was on the basis of a 20-minute time limit. Several of the groups were given the tests under exactly the same conditions as above except that a 30-minute time limit was used. We

were thus able to get some estimate of the effect of increasing the duration of the distraction.

On the basis of a 30-minute time limit the mean raw score for 171 men on Form A, without distractions, was 52.9 ± .64 while the mean on Form B with distractions was 54.2 ± .63, an increase under distraction for the 30-minute time limit of 1.3. This difference divided by the P. E. diff. is 3.8, which substantiates the conclusion reached in the previous section. The increase under distraction for the 20-minute time limit, as stated in the previous section, was 2.4. There is, then, a tendency for the amount of improvement under distraction to decrease with the increase in duration of the distraction.[7] It is possible that if we were able to compare the amount of work done with and without distraction over a longer period of time we might find that the distraction would decrease, rather than increase the performance.

Comparison of Errors Made with, and without Distraction

Although there is an improvement in performance with both sensory and ideational distraction, nevertheless, it was possible that there might be, at the same time, an increase in the number of errors.

To test this hypothesis the average of the percentage of errors in relation to the number of items attempted (not including the omissions) was computed for 220 cases on Form A which was given without distractions. This was found to be 14 per cent. The same group on Form B, given with distractions, made 23 per cent errors. The distractions, therefore, increased the number of errors with this group of 220 by 9 per cent. This increase in errors was checked by the same calculation on another group of 197 men with the order of the tests reversed, i.e., when Form B was given first *without* distraction and Form A given second *with* distraction. The increase in errors in this case was 6.3 per cent.

It seems, therefore, that for this type of work under these conditions, the distractions seem to spur the subjects to increased activity, but at the same time makes them more liable to make errors.

[7] The diff. of 1.1 between the 20- and the 30-minute test divided by P. E. diff. is 2.7. The P. E. of a diff. between differences = P. E. diff. $(A - B)_1^2$ — P. E. diff. $(A - B)_2^2$. This formula was provided for the writers by Dr. Luton Ackerson.

Influence of "Set" or Attitude toward Distractions on Mental Test Performance

Another aspect of the study was an attempt to determine the amount of the ideational distractions which could be recalled. The problem was this: To what extent is it possible to carry on two mental operations at the same time, namely, that of concentrating on a mental test performance and attending to extraneous material?

To study this problem a set of 46 true-false questions on the ideational distractions was prepared. Some of the groups were told that they would be expected to answer those questions and were given additional motivation by emphasizing that those who could recall most would make the highest score. Other groups were given the true-false questions without previous warning.

For a group of 220 who were given the true-false tests without any previous warning there was not only an average gain on the Otis, which was given under distractions, of 2.1, but the men were able to recall a considerable amount of the material given as distractions. The range of the amount recalled was 3.66 (the questions were scored right minus wrong).

The results of the effect of the distractions on the group to whom it was explained that they would be expected to recall are quite different. There is a consistent loss under the distractions when given with "set." The group of 460 men on a 30-minute time limit showed an average loss of 2.07. Another group of 197 men on a 20-minute time limit showed an average loss of 6.85. This consistent tendency to lose is probably due to the introduction of the third element of "set," and the difference in the loss in performance (i.e., the difference between 2.07 and 6.85) of the two groups could probably be accounted for by the difference in the degree of attention given to the distractions.

In the process of the experiment two other relationships were studied which may be of some general interest:

1. There is only a slight relationship ($r = +.18 \pm .04$, $N = 203$) between general intelligence as determined by the average score on the two tests and ability to recall the material presented as distractions.

2. There is also only a slight relationship ($r = .19 \pm .03$, $N = 368$) between general ability as determined by the two tests and the amount of gain or loss under the distractions. The correlation is about 6 times the P. E. and perhaps indicates a slight

tendency for the dull ones to be more disturbed than the bright ones.

Summary

1. Mental efficiency as measured by mental test performance does not seem to be greatly impaired, at least for a short period of time, either by severe sensory or ideational distractions. There seems to be fairly strong evidence that the so-called distractions act as an incentive to greater mental activity.

2. The amount of improvement under the distractions seems to decrease with the increase in the duration of the distractions.

3. While the distractions seem to produce greater effort and consequently to increase the actual amount of work done, they also tend to increase the number of errors.