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PRELIMINARY STUDY OF THE EFFECT OF DENTAL TREATMENT UPON THE PHYSICAL AND MEN- TAL EFFICIENCY OF SCHOOL CHILDREN.

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INTRODUCTORY.

Studies concerning the loss of efficiency due to defective vision, impaired hearing, presence of adenoids, etc., have been made by Dr. Leonard Ayres, Dr. Walter C. Cornell and others. Last year Dr. J. E. Wallin made an attempt to "measure the relation between community mouth hygiene and intellectual efficiency of elementary school-children." This work was done in the city of Cleveland, and very promising results were claimed. The weak point in the work there, as is conceded by the experimenter, is the fact that only the class of children receiving dental attention was tested, thus giving no opportunity for comparison with other children not receiving treatment. The present paper is a first attempt to trace the effect of dental treatment with proper check-tests of non-treated children.

THE METHOD.

Two fifth grade classes in the same down-town school were selected for the purpose of comparison. The classes were as evenly graded as is possible in ordinary school classification. Both were so-called German-English classes; that is, each gave a part of the day to the study of the German language. The

children came from the same neighborhood, so that home and social conditions were largely the same. A census showed that in one class (Room 21) there were 16 children who were themselves foreign born and whose parents were foreign born, while 13 children were American born with foreign born parents. In the other class (Room 18) 21 children were foreign born with parents of foreign birth, and 13 were American born with foreign born parents. In all but three of the above cases the places of birth were Russia, Austria, Servia and Hungary. The home conditions were thus more than usually of like kind.

The choice of the experimental class was decided by the toss of a coin. Room 21 was chosen. The classes were about equal in numbers, starting out exactly so, and the proportion of boys and girls in each was the same.

Room 21 received all the care that dental science could give, including treatment, tooth-brush drills, dinners to afford opportunity to teach proper mastication, etc. The other class received only such attention as they sought, which was found to be practically none. A nurse and social visitor followed all experimental cases and saw that instructions were carefully heeded.

THE TESTS IN DETAIL.

The physical tests included weight and height standing, and were made by the physical director of the school. All other tests were given by the same two experimenters, each taking certain ones.

The Psycho-physical Test. Here we used the Tapping Test (Test 10, Whipple's *Manual*); a tapping board with brass plates, a tapping stylus and a recording instrument, which showed the number of contacts made, were used. By means of a stop-watch the number of contacts was read at the end of each 15 seconds. The test for each hand extended over a period of one minute. The experimenter explained the manner of procedure by going partly through the test. The subject was then placed in position and given a few seconds' practice, followed by a rest. It was insisted that all movement be from the wrist, so as to secure more uniformity. At the beginning the subject was urged to do his best, but nothing was said during the work.

The Psychological Tests. I. The "A" Test (Whipple's Test 26). This is the familiar Cancellation Test. The subject is given a sheet of paper on which the letters of the alphabet appear in chance order and is told to cross out all of a certain letter as quickly as possible, line by line, without going back for corrections or omissions. On the sheet used each letter appeared 50 times. This test was given to a group, half the class being taken at a time and distributed through the room to avoid copying. A sample copy was explained from the blackboard, after which the test papers were placed on the desks, face down. Each child wrote his name on this reverse side. At an agreed signal, the papers were turned from left to right and work begun. A warning was given in advance not to sacrifice accuracy for speed. The time allowed was 150 seconds, and all hands were clasped on the heads at the close of the exercise while the papers were collected.

In May a similar sheet was used, but the letter crossed was "m."

II. The Rote Memory Tests. We used the Memory Span Method (Whipple's Test 38), by the group method. The test was explained by the use of a card on which appeared five discrete digits. A metronome was set at 60, and the class allowed to catch the rhythm. The card was then exposed and the class read the digits aloud, in time with the metronome beats. At the signal the digits were written on paper provided for the purpose. Attention had been called to the importance of recording the digits in the original order. After this practice, two cards each of 6, 7, and 8 digits were exposed and the papers collected as before.

III. The Learning Test. Substitution (Whipple's Test 37). This test seeks to measure the rapidity with which associations are formed by repetition. A piece of cardboard on which were printed nine simple geometrical forms (square, triangle, etc.) with an inscribed digit in each was used as a "key." This key was presented to the subject in connection with four sheets of paper each containing ten lines, five of the above symbols, arranged by chance, to each line and without the inscribed digits. The subject was requested to inscribe the proper digits, line by line. He was allowed to use the key for

the first three sheets, but not for the last one. Each line as completed was covered by the experimenter.

In the tests given in May the same symbols were used, save that different digits were assigned to them; moreover several different keys were put in use at the same time, and the children were informed of this, so that there might be no temptation to communicate when they returned to their classrooms.

THE RESULTS.

In all the figures given below, the median is used rather than the more common average, as it gives the central tendency of the class and neutralizes the effect of extremes at either end.

Only such children as were present in both groups of tests are counted; otherwise there has been no selection.

<i>Physical Tests.</i>		<i>I. Weight.</i>			
		<i>Oct.</i>	<i>May.</i>	<i>Gain.</i>	
Room 18.	38 cases.....	67.5 lbs.	76.5	9.	
Room 21.	40 cases.....	67.25 lbs.	73.	5.75	

Here we find that while the median for the two classes was almost identical, in October Room 18 leads in gain by 3.25 lbs.

<i>Physical Tests.</i>		<i>II. Height Standing.</i>			
		<i>Oct.</i>	<i>May.</i>	<i>Gain.</i>	
Room 18.	39 cases.....	53.2 in.	56.1	2.9	
Room 21.	40 cases.....	53.5 in.	56.	2.5	

The measurements here show no appreciable difference.

The Psycho-physical Test. In evaluating the results of this test we have taken into account the actual number of taps at each trial (marked "total"), and also the "fatigue element." The *fatigue index* is a per cent, which shows the ratio between the decrease in the number of taps during the last 15 seconds and the total number in the first 15 seconds (the tapping continued 60 seconds in all.) Results are given for each hand, one trial each. It will be noted that the total number of taps is significant, since it is likely that the fatigue-index will be less when the initial total is small. For example: Subject S. L. has the following record: 77-75-73-73; total 298; fatigue index 0.051.

Subject J. G. has the following record: 111-101-103-87; total 402; fatigue index 0.216.

Here, Subject S. L., with an initial speed of 77 taps, has a

fatigue index of only 5%, while Subject J. G., with 111 taps, has an index of 21%; yet the latter, with his total of 402 taps, has surely the better record, especially since the taps in the last 15 seconds exceed by 10 taps those of the first 15 seconds in the other subject's record.

<i>Right Hand, Total Taps.</i>		<i>Oct.</i>	<i>May.</i>	<i>Gain.</i>
Room 18.	41 cases.....	295	308	13.
Room 21.	41 cases.....	304	312	8.

Room 21 leads in both tests by 9 and 4 taps respectively.

<i>Left Hand, Total Taps.</i>		<i>Oct.</i>	<i>May.</i>	<i>Gain.</i>
Room 18.....		242	253	11.
Room 21.....		243	255	12.

Room 21 leads in both tests by 1 and 2 taps, respectively.

In computing the fatigue-index we found that sometimes there were more taps in the last than in the first 15-second period, which shows lack of proper effort on the part of the subject. There were 4 such cases in Room 18 and 1 in Room 21.

<i>Fatigue-index, Right Hand.</i>		<i>Oct.</i>	<i>May.</i>	<i>Gain.</i>
Room 18.	41 cases.	15.2%	13.1%	2.1%
Room 18.	41 cases, without minus cases.....	14.5%	13.3%	1.2%
Room 21.	41 cases.	17. %	12.5%	4.5%
Room 21.	41 cases, without minus cases.....	17. %	12.5%	4.5%

Although Room 21 shows greater fatigue in the first test by 1.8%, it shows less by .6% the second time, thus placing its endurance in the lead by 2.4%.

<i>Fatigue-index, Left Hand.</i>		<i>Oct.</i>	<i>May.</i>	<i>Gain.</i>
Room 18.	41 cases.	15.1%	14. %	1.1%
Room 18.	41 cases, without minus cases.....	15.0%	13.6%	1.4%
Room 21.	42 cases.	17.5%	13.5%	4. %
Room 21.	42 cases, without minus cases.....	17.5%	13.3%	4.2%

As with the right hand, although Room 21 shows greater fatigue in the early test, it shows .5% less in the second, and thus shows a gain in endurance of 2.9% over Room 18. As pointed out above, the fact that Room 21 leads in every case in total number of taps makes the lead in endurance the more conspicuous.

Psychical Tests. I.^a The Cancellation Test.

This is a test in perception, and is scored by the number of letters cancelled in a fixed time. In this case the time was 2½ minutes. The results are given in simple percents, which indicate the accuracy of the performance; the time is constant.

<i>Cancellation Test.</i>		<i>Oct.</i>	<i>May.</i>	<i>Gain.</i>
Room 18.	40 cases.	61 %	84 %	23%
Room 21.	37 cases.	56.5%	74.5%	18%

Here Room 18 takes the lead; 5% in the lead in the beginning, it gains in the second test, making a total gain of 5% more than that of Room 21.

In looking over the individual records we find that the time-limit seemed to interfere greatly in Room 21. The work done there is accurate, but in most cases the papers were unfinished when time was called and the score was thus reduced, as it was based on the crossing out of the complete number of "a's."

II. The Rote Memory Test.—The evaluation of results is again in percents, credit being given both for the reproduction of the digits and for the order of their reproduction. Two cards of each series were used, and the average of the two results is taken in the table. A correct digit properly placed received 4; if one place removed from the proper place it received 2; no other credit is given, except in case of a series of three digits in correct succession but wrongly placed, when only the first of the series lost its credit. In this way, when there were six digits in the series, 24 represented a perfect record of 100%, and others were calculated accordingly.

<i>Rote Memory, Six Digit Series.</i>		<i>Oct</i>	<i>May.</i>	<i>Gain.</i>
Room 18.	40 cases.	87.5%	96.6%	9.1%
Room 21.	38 cases.	91.6%	100 %	8.4%

Room 21 leads at the beginning by 4.1% and at the second test by 3.4%. Its median of 100% makes it impossible to show a greater gain. This is evidently too easy a test for children of this age.

<i>Rote Memory, Seven Digit Series.</i>		<i>Oct.</i>	<i>May.</i>	<i>Gain.</i>
Room 18.		71.4%	71.4%	0 %
Room 21.		74.9%	85.7%	10.8%

Room 21 leads at the beginning by 3.5% and by 14.3% in the second group, finishing with a gain of 10.8% over its first record as against no gain in the other class.

<i>Rote Memory, Eight Digit Series.</i>		<i>Oct.</i>	<i>May.</i>	<i>Gain.</i>
Room 18.		56.3%	62.5%	6.2%
Room 21.		59.3%	65.6%	6.3%

Room 21 leads in the first group by 3%, in the second by 3.1% and in gain by .1%. We here reach the limit of memory span for this age and the possibility of gain is therefore less.

III. The Learning Test. Substitution.

The results are based on the percents in accuracy and time in seconds and represent the amount of time necessary to approximate 100% in accuracy. There are 50 symbols on a page; each one correctly inscribed receives 2. The time, in seconds, taken for the work is noted. The index of efficiency is then obtained by dividing the time thus expressed by the per cent of accuracy. By multiplying this index by 100 we get the amount of time needed to approximate 100%. For example:

Subject I. J. shows the following record for the first sheet:

<i>Time.</i>	<i>% of Accuracy.</i>	<i>Index of Eff.</i>
186.4"	96%	1.941

Multiplying the index by 100 we find it would take this subject 194.1 sec. to approximate 100%. The tables below give the results for the first and last sheets only as they alone are necessary to calculate the learning power.

<i>Substitution, Sheet I.</i>	<i>Oct.</i>	<i>May.</i>	<i>Gain.</i>
Room 18. 43 cases.	201.6"	172"	29.6"
Room 21. 38 cases.	206.5"	183"	23.5"

As indicated above, the figures show that in the first test Room 18 needed 201.6" to reach a perfect record in the first, and 172" in the later test. Similarly, Room 21 needed 206.5" in the first and 183" in the second test. Room 18 shows the better record.

<i>Substitution, Sheet IV.</i>	<i>Oct.</i>	<i>May.</i>	<i>Gain.</i>
Room 18. 43 cases.	118.8"	110.5"	8.3"
Room 21. 38 cases.	127.4"	104.9"	22.5"

It will be remembered that in Sheet IV the work was done without reference to the key, and thus indicates the learning power.

In this test Room 18 needs 118.5" in the first, 110.5" in the second trial, making a gain of 8.3". Room 21, although needing 127.4" in the first trial, reduces this to 104.9", making a gain of 22.5".

The real values in the above test are shown in the next table which gives the "learning power;" i. e., the saving in time between that needed for the first sheet the first time and that needed for the last sheet the last time.

<i>Learning Power.</i>	<i>Sheet I, 1st time.</i>	<i>Sheet IV, last time.</i>	<i>Gain.</i>
Room 18.	201.6"	110.5"	91.1"
Room 21.	206.5"	104.9"	101.6"

Room 21 leads, with a learning power expressed by a saving of 101.6", compared with 91.1" in Room 18.

CONCLUSIONS.

In summarizing we find that there is a decided lead taken by the Experimental Class. This holds true in all but one of the psychological tests. The improvement in appearance and deportment in the experimental class has been marked by the numerous educational and social workers who have visited the school during the year. To make the comparisons more valid we have planned to follow these classes for another year, submitting each to a new series of tests at the beginning and close of the school year. The disturbing factor introduced by the actual carrying on of the dental work in the experimental class, which we feel was to a degree adversely involved this year, will be slight, since the original timidity has been overcome and but little treatment will be needed to keep up the present good oral conditions.

In the following tabulation we have sought to show at a glance which group led, on the average for each test, save the physical, both before and after the dental treatment:

<i>Test.</i>	<i>Room showing net superiority</i>	
	<i>Before dental treatment.</i>	<i>After dental treatment.</i>
Total taps, right hand.....	21	21
Total taps, left hand.....	21	21
Endurance, tapping, right hand.....	18	21
Endurance, tapping, left hand.....	18	21
Rote memory, 6 digits.....	21	21
Rote memory, 7 digits.....	21	21
Rote memory, 8 digits.....	21	21
Cancellation.	18	18
Substitution.	18	21
Learning.	18	21

In all, then, Room 18 led five times out of a possible ten when the tests were given first, so that its ability would seem to be equal with that of the treated class. After dental treatment of its competitor, Room 18 leads but once, while Room 21 maintains its previous lead in five tests and gains the lead in four of the five remaining tests, finishing with a total of nine out of a possible ten.