

PRACTICE AND TRANSFERENCE IN NORMAL AND FEEBLE-MINDED CHILDREN¹

HERBERT WOODROW

University of Minnesota

PART I. PRACTICE

The work here reported was carried on to determine how feeble-minded children compare with normal children of the same mental age as regards practice effects and the transference of training. The problem is a large one, as no conclusions are valid unless they are true for the vast feeble-minded population as a whole. It is not to be expected that one investigation, conducted with small groups of children and with one particular set of tests, will lead to a final solution. It is reasonable to suppose, however, in view of the importance of the problem for the understanding of education and of the nature of intelligence, that the present work will be extended by others who will test and modify the conclusions here reached.

The plan of work adopted required four groups of children. These groups were a normal practice and a normal control group, and a feeble-minded practice and a feeble-minded control group. The children of each group were selected so as to give about the same average mental age, namely, nine years.

The mental age of the feeble-minded children, inmates of the State School for Feeble-Minded at Faribault, Minnesota, was determined by means of Kuhlmann's revision² of the Binet tests. Children who had not been tested recently were retested. All were tested by Dr. Kuhlmann himself, and the ages used are the ones furnished by him. The average chronological age of both the feeble-minded groups was slightly under fourteen.

In the case of the normal children, the chronological age alone has been used. It is reasonable to suppose that with these children the difference between the average mental age of a group and the average chronological age would be slight. It would very likely be less than the difference between the average mental age as determined by the Binet tests and the average true mental age.

¹ The writer begs to acknowledge gratitude to Dr. A. C. Rogers, Superintendent, and to Dr. F. Kuhlmann, Director of Psychological Research of the Minnesota School for Feeble-Minded and Colony for Epileptics. Thanks are also due to Dr. F. E. Spaulding, Superintendent of the Minneapolis Public Schools.

² J. of Psycho-Asthenics, Monog. Sup., Vol. I, 1, pp. 41.

The composition of the various groups with respect to age is shown in Table I. The ages have been left in years and months. Thus, 9.3 means nine years and three months. Boys are distinguished by a star placed before their ages.

TABLE I
Composition of Groups with Respect to Chronological and Mental Age

Group	F. M. Practice		F. M. Control		Normal Practice		Normal Control	
No.	Chron.	Mental	Chron.	Mental	Chron.	Grade	Chron.	Grade
1	15 0	9 3	*15 2	9 4	*9.8	3A	8.10	3B
2	*12 6	9 4	*10 5	9 4	*9 6	3A	*9.0	3A
3	15 3	9 8	*13 8	9 2	8 7	3B	*8 11	3B
4	19 3	10 0	20 7	8 8	8 1	3A	9 2	3A
5	12 5	9 0	12 4	8 2	8 2	3B	*9.1	3A
6	17 0	9.2	*12 1	9 0	8.8	3A	9 2	3A
7	12.8	8.4	18 11	8 6	9 11	3A	8 6	3A
8	*12 0	8 0	14 1	9 0	*9 3	3A	*9 1	3A
9	*13 1	8 2	10.3	8 2	9.2	3A	*9 1	3A
10	15 0	8 10	15 2	9.6	9.5	3A	8 11	3A
11	13 1	8 2	20 4	8 8	*9 3	3A	9 0	3A
12	16 6	9 0	*12 8	8 2	9 2	3A		
13	*11.6	8 0	*10 11	8 0	9.7	3B		
14	*11 6	9 6	*11 3	9 0	*9 0	3B		
15	*12 2	8 0	*11 3	8 2	*8 11	3A		
16	12.9	10 4	11 6	9 0	9 2	3B		
17	10 1	7 11	15 6	8 4				
18	13 3	9 2						
19	14.8	8 0						
20	*14 5	8.6						
Av.†	13 8	8.10	13 10	8.9	9 1		9 0	
M. V.	1 9	.8	2.8	.5	.5		.2	

The groups were selected so as to secure equality, not only in mental age, but also in initial ability. The feeble-minded children were selected by going through the files of the state institution and writing down the name of every inmate, under twenty chronologically, recorded as mentally eight or eight and a fraction. A few somewhat under eight were also listed, when there was reason to believe that they had improved since their last testing, which in some cases was several years back. This procedure gave a list of over one hundred children. This list was taken to one of the officers of the institution who scratched off the names of the children who for one reason or another were not available. Some had epilepsy, some were working on the farm, some had gone home, some were sick, some lived in a cottage too far away for the attendant to go after them, etc. The list of available children was thus reduced to fifty.

Work was begun with all these children, in two sections, work with one of the sections beginning a week later than with the other. At the end of the initial tests, both sections were divided into two groups of equal average initial ability, one group becoming thereupon the practice group and the other, the control group. For the final tests the groups came together again in two sections as at first. While the work at the state institution was being carried on, children were constantly leaving for home, for vacation, so that, while at the beginning of the work there was a practice group of 28 and a control group of 22, at the end, the practice group numbered only 23 and the control group 19.

In order to equalize the feeble-minded groups with each other in initial ability in the end tests and with the normal groups in initial ability in both the practice tests and end tests, it was necessary to reject the results of several children. The number rejected was the smallest that would render all four groups about equal in initial ability. Three were rejected from the feeble-minded practice group and two from the feeble-minded control group, thus leaving 20 in the former and 17 in the latter. The records that were rejected were above the average and were made in all cases but one by children whose mental age, at the last testing, was ten or over. The rejecting of these cases rendered the average age of the feeble-minded groups a few months less than that of the normal groups, but it was thought better to have equal initial ability than exact equality of mental ages.

The normal groups were selected, each from a different Minneapolis school, by going to the principal and asking for a group of children who were of normal grade for their age and who would average nine years chronologically. The normal practice group originally numbered nineteen, but as two children missed several periods on account of sickness, and one girl was dismissed after a few days because of chorea, the group became reduced to sixteen. In the case of the normal control group, in the Lowell school, the ranks were greatly depleted at the time of the final tests on account of a scarlet fever epidemic which broke out in the school. The original group of nineteen was reduced to thirteen. Two of these thirteen were rejected in order to get a group which matched the other three groups in initial ability.

The plan of work followed was the same for both the normal and feeble-minded groups. First, both the practice and control

groups were given the end tests, four in number. The four end tests were all given the same day, but given twice, so that two days were devoted to them at the beginning and also at the end of the work. They consisted of the following: sorting five lengths of sticks into five boxes of corresponding length; sorting colored pegs; a letter cancellation test; and a geometrical form cancellation test. After the initial giving of the end tests, the practice group was given thirteen days' practice (consecutive except for Saturdays and Sundays) in the practice test. The control group "rested" for the same period. At the end of these thirteen days, in the case of both groups, the end tests were given again.

Before taking up the results on transference, those on practice will be presented. After a detailed description of the practice test and the method of giving it, the data will be presented in full as tables and practice curves and then discussed with some reference to related work of previous investigators.

The practice work given to the practice groups was a geometrical form sorting test, consisting in sorting gun wads on which were pasted labels bearing the printed outlines of simple geometrical forms. There were five different kinds of these labels, and wads bearing the same kind of label had to be sorted into the same box. The outlines used were those of the Woodworth-Wells substitution test³ namely, star, circle, square, cross and triangle. Woodworth-Wells blanks, after being painted on the back with mucilage, were cut up until 10,000 small bits of paper were secured, each having printed on it a geometrical form. These printed forms were stuck onto gun wads, the same form being stuck on both sides of the wad. These gun wads were then divided into twenty sets of 250, each set containing 50 of each type. The set of 250 was placed in a paste-board box 6" square and 1.5" deep. Each wad had to be transferred from this box into a small box, bearing the same label. The small boxes, five in number, were 3" x 2" x 1.5". They were placed in a line at the edge of the child's desk furthest from his body, and the large box placed between the body and the line of small boxes. The order in which the small boxes was placed was changed every second day, as it was thought best to exclude practice effects due to becoming familiar with a certain order and to prevent the test from becoming too automatic.

³ Psychological Monog., Vol. XIII, 5, p. 53.

Preliminary practice trials with a few children showed that it would not require much more than 4 minutes to sort the entire 250 wads. As 4 minutes did not seem long enough for a day's practice, it was decided to give the test twice, allowing 4 minutes each time. On account of the labor of preparing the tests and the number of boxes required, only one set of tests was used. Consequently, immediately after the first sorting, the children were instructed to dump the wads again into the large box. The box was then covered, the wads shaken up and the sorting done over again. Only the results of the second sorting were counted, except on the first day. On this day, only one sorting was required, so that it would be possible to obtain the really initial ability of each child.

The instructions were to sort the wads as rapidly as possible, using only one hand and picking up only one wad at a time. No mention was made of accuracy. Each day the children were reminded that they should do their "level best" and that it was how many they got sorted that counted. With these instructions, which were solely and unambiguously for speed, the best way of scoring is to take merely the total number correctly sorted; and it is this number that is given in the tables and practice curves. The number of mistakes made was recorded, but was found so small that space will not be taken to present the data on this point for the separate individuals, but only for the groups. The number sorted was noted separately for each form. It was found that the total number sorted by each child at each testing was usually well distributed among the five different forms. Consequently, only the total number sorted will be reported.

Every effort was made to keep the conditions as uniform as possible throughout all the work with all the groups. That perfect uniformity was attained is, naturally, improbable. In both groups certain boys at times became more interested in each other than in the tests. This was particularly true of three boys in the normal group, and remained true even after their seats were changed. On the other hand, it is true, that, in a general way, the feeble-minded children were more disorderly than the normal ones. The disorderliness of the feeble-minded children, however, was kept in check. They came in and went out boisterously, and one hardly dared turn his back on them;

but, while the actual work was in progress, they seemed always to be trying to do their best. All the tests on both groups were given by the writer, who tried to maintain throughout a machine-like regularity in his directions. It is probably impossible, however, entirely to avoid variations in enthusiasm, which may affect the class. Other varying factors were the weather (the feeble-minded were tested in the summer vacation and the normals in the fall) and the work done by the children during the forenoon (both practice groups were tested in the afternoon).

The results are given in Tables II and III. In Table II, are given the scores made by each child on each day, and also the averages for the group. Immediately below each average, in the line headed, at the left, P. E., is given the probable error of a single measurement. In the line headed, at the left, Av. Er., is given the average number of wads wrongly sorted. It will be seen that this is usually much less than one per child, and therefore of negligible importance. The averages of Table II are plotted as practice curves in Figure 1. In Table III, are given for each child the initial ability, the final ability, the absolute improvement (I) and the percentage improvement ($\% I$).

TABLE II

Data on Practice in Sorting Geometrical Forms, by Normal and Feeble-Minded Children of the Same Mental Age

*Order	1, 2, 3, 4, 5	5, 1, 2, 3, 4	5, 3, 2, 4, 1	4, 1, 3, 2, 5	1, 5, 2, 3, 4	4, 1, 5, 3, 2	3, 1, 2, 4, 5						
Trial	1	2	3	4	5	6	7	8	9	10	11	12	13
F. M. 1	129	128	126	158	139	163	169	158	185	167	158	171	175
" 2	94	116	101	139	129	144	130	135	114	121	150	131	146
" 3	154	188	174	190	213	197	230	218	218	204	222	226	201
" 4	112	166	177	190	166	197	176	185	200	186	192	178	203
" 5	120	145	157	165	180	186	186	194	208	222	197	224	193
" 6	108	148	144	167	156	152	152	175	181	192	173	179	167
" 7	127	140	129	120	126	128	143	143	146	143	141	143	144
" 8	94	125	115	134	162	173	174	213	169	206	199	191	209
" 9	136	132	128	139	146	160	139	169	120	128	132	157	166
" 10	120	142	116	119	138	155	146	137	164	159	150	152	142
" 11	138	169	169	173	177	172	168	161	167	169	186	155	184
" 12	125	158	147	142	146	141	133	170	200	157	188	167	182
" 13	83	79	77	112	90	101	87	107	101	107	102	104	111
" 14	127	144	141	165	127	140	145	108	133	186	168	176	212
" 15	122	94	103	98	122	105	91	97	102	93	81	102	103
" 16	104	123	99	99	121	125	121	136	137	127	140	158	149
" 17	124	166	139	139	146	181	171	184	192	193	188	200	179
" 18	140	175	181	179	190	192	193	199	199	192	196	209	214
" 19	142	154	164	182	181	223	188	188	218	202	197	217	208
" 20	114	143	149	161	152	163	157	187	188	203	185	188	203
" Av.	121	142	137	149	152	160	155	163	167	168	167	171	175
" P. E.	12	17	19	19	19	20	23	23	25	26	23	23	22
" Av. Er.	1	1	0	1	2	0	1	1	0	1	1	1	0
Normal	147	148	151	152	191	166	182	176	191	173	182	187	197
" 2	144	156	156	150	176	172	152	166	157	144	143	165	176
" 3	130	149	140	144	164	198	195	200	199	180	177	192	191
" 4	119	135	127	160	157	177	156	151	182	173	165	149	166
" 5	114	137	142	150	148	168	162	148	149	161	156	163	197
" 6	118	136	127	154	158	170	153	170	151	166	147	173	159
" 7	107	125	131	139	149	143	149	140	148	153	163	169	173
" 8	125	143	146	128	149	184	154	166	162	197	178	173	163
" 9	100	112	95	107	119	116	131	120	115	133	125	129	132
" 10	122	150	158	166	160	175	172	198	198	182	191	224	213
" 11	113	153	141	143	141	160	165	172	155	150	172	172	186
" 12	104	117	87	132	126	146	147	169	152	151	157	157	163
" 13	99	76	119	106	119	124	124	107	112	135	135	142	144
" 14	121	131	99	119	137	130	109	153	150	141	156	152	156
" 15	155	145	154	182	168	183	193	189	149	167	180	187	204
" 16	129	166	179	192	188	200	191	181	200	200	184	222	199
" Av.	122	136	135	145	153	163	158	163	161	163	163	172	176
" P. E.	11	14	16	16	14	16	16	16	18	13	12	17	15
" Av. Er.	0	0	1	0	1	0	1	0	0	0	0	0	0

* In designating the order, numbers are used in place of the actual geometrical forms pasted on the fronts of the small boxes. Thus, the order, 1, 2, 3, 4, 5, means that the small boxes were arranged from left to right as follows: star, circle, square, cross, triangle. The order was changed every second day.

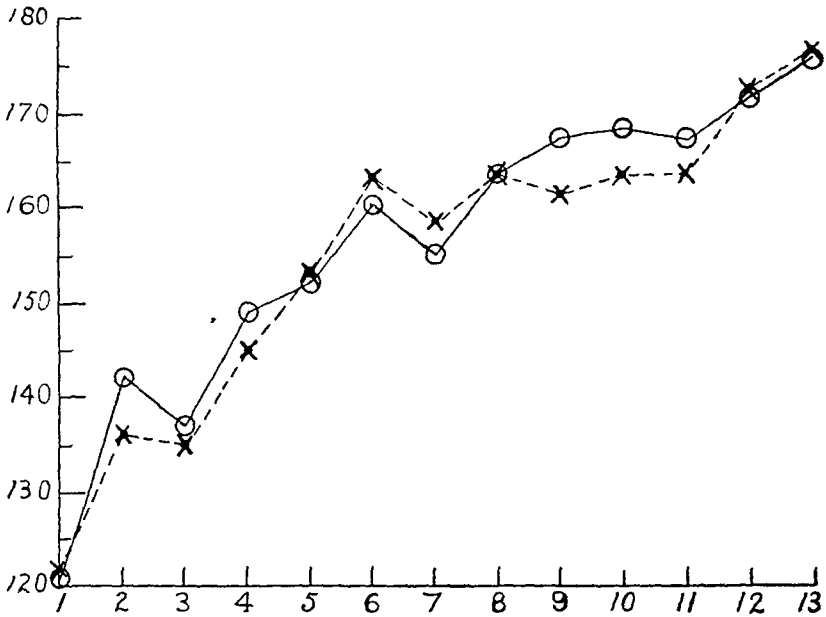


FIGURE 1.—Practice Curves. Ordinates represent the group averages, and abscissae, the number of days practice. The results obtained with the feeble-minded group are represented by circles, connected by continuous lines, and those with the normal group, by crosses, connected by dashes.

TABLE III

The Absolute and Percentage Improvement of Each Child of Both Normal and Feeble-Minded Groups

	Feeble-Minded				Normal			
Child	Initial	Final	I	% I	Initial	Final	I	% I
1	129	175	46	36	147	197	50	34
2	94	146	52	55	144	176	32	22
3	154	201	47	33	130	191	61	47
4	112	203	91	81	119	166	47	39
5	120	193	73	61	114	197	83	73
6	108	167	59	55	118	159	41	35
7	127	144	17	13	107	173	66	62
8	94	209	115	123	125	163	38	30
9	136	166	30	22	100	132	32	32
10	120	142	22	18	122	213	91	75
11	138	184	46	33	113	186	73	65
12	125	182	57	46	104	163	59	57
13	83	111	28	34	99	144	45	45
14	127	212	85	67	121	156	35	29
15	122	103	—19	—16	155	204	49	32
16	104	149	45	43	129	199	70	54
17	124	179	55	44				
18	140	214	74	53				
19	142	208	66	47				
20	114	203	89	78				
—	—	—	—	—	—	—	—	—
Av.	121	175	55	49	122	176	55	46

The question of main interest in connection with Tables II and III and Figure 1 is, whether the feeble-minded children show the same improvement with practice as do the normal children. This question, from whatever angle studied, must be answered in the affirmative. The equality of ability between the two groups (secured so far as initial ability is concerned by their manner of selection), remains fairly intact throughout the course of the practice, and is as definite at the end of the practice as at the beginning. For each group, the absolute improvement in average ability is 54, or about 45%. Upon computing the averages of the percentages of improvement shown by the individuals of each group (Table III), we obtain an average of 49 for the feeble-minded children and one of 46 for the normal children.

In both groups, the linear correlation between the initial abilities of the children and the percentages of improvement is negative, the correlation being $-.36$ (P. E., .13) for the feeble-minded group and $-.40$ (P. E., .14) for the normal group. If, instead of computing the correlation between initial ability and percentage of improvement, we compute that between initial ability and absolute improvement, we find in the case of both groups that the correlation remains negative but becomes very small (and unreliable), changing for the feeble-minded group from $-.36$ to $-.13$ (P. E., .15) and for the normal group from $-.40$ to $-.11$ (P. E., .17). On the average then, there was a tendency in both groups for the children who were below the average in initial ability to improve, relatively, more than, and absolutely, almost as much as, those who were above the average in initial ability.

So far we have spoken of amounts of improvement. It remains to be considered whether there is any difference in the regularity of the improvement of the individuals of the two groups,—whether the feeble-minded child shows greater fluctuation or irregularity in his practice curve than does the normal child. To determine this point, a table was constructed showing how much each child deviates each day from the general average of his group. The mean variations of these deviations were then calculated for each child. These mean variations serve as a fair measure of the regularity in the individual practice curves. The averages of the mean variations of the two groups may be used to compare the regularity in improvement of the normal children as compared with the feeble-minded. The average of the individual mean variations thus calculated was, for the normal group 9.0, P. E. *Av.*, 0.3, for the feeble-minded group, 10.7, P. E. *Av.*, 0.6. The difference is 1.7, P. E., .67. It is thus evident that the feeble-minded children showed somewhat greater irregularity in their improvement, but the difference being less than three times the probable error of the difference, is not great enough to have much significance.

To sum up, in the present experiment, feeble-minded children were found to show the same amount of improvement and to improve in accordance with essentially the same practice curve as normal children of the same mental age and the same initial ability. While in both the feeble-minded and normal groups

there existed great individual variation, it was impossible to discover any effects of practice which were significantly different for the two groups.

These results were obtained from one sort of work and on small groups of children. It is, therefore, interesting to inquire if there is any previous work that tends to indicate that the present results could not be generalized. So far as the writer can discover, there is not. Practice curves obtained on normal and feeble-minded children of the same mental age have not hitherto been published. Colvin has read a paper⁴ on practice and transference in normal and subnormal children but has not as yet published his data. Without the complete data, on an experiment of this sort, one cannot judge of the validity of any conclusions that might be drawn. Kuhlmann and others have published studies of practice in feeble-minded children, but they have not used normal children for comparison.

Kuhlmann takes for granted⁵ that the feeble-minded improve less with practice than normal children, but he does not say, expressly, less than normal children of the *same mental age*, or less than normal children of the same initial ability. Of course, we must remember that his study was made in 1904, before the origin of the Binet and Simon scale for measuring intelligence. The writer does not find anything in Kuhlmann's results that could not be duplicated in normal children. Slow progress or even retrogression is not necessarily a sign of an abnormal practice effect. The recent work of Ordahl and Ordahl,⁶ undertaken at the suggestion of Kuhlmann, shows practice curves from feeble-minded children that are as *normal* as could well be imagined.

Now it is true that we can get at the characteristics of the feeble-minded by comparing them with normal persons of the same chronological age. We thus come to the conclusion that they are characterized by inability to learn, by lack of attention, by incapacity for sustained voluntary effort, by lack of judgment and reason; but all these shortcomings characterize a six-year-old child compared with a ten-year-old child. Before we can conclude that the feeble-minded differ in any of these characteristics

⁴ *Proceedings of the American Psychological Association*, Psychol. Bull., 1915, Vol. XII, p. 67.

⁵ *Experimental Studies in Mental Deficiency*. Amer. J. of Psychol., 1904, Vol. XV, p. 413.

⁶ J. of Psycho-Asthenics, Monog. Sup., Vol. I, 2, p. 33 and elsewhere.

from normals of the same mental age, we must carefully compare them with normals of the same mental age.

Some prejudice against admitting that feeble-minded children improve with practice as much as normal children of the same mental age probably exists because of the tendency to identify capacity for mental development with ability to learn, with ability to gain by practice. The writer sees no reason for such an identification, but believes that the preceding data (which will be corroborated by results to be presented on the control groups) strongly suggest that it is not inability to learn which characterizes incapacity for mental development, but inability to grow, and that the two are quite distinguishable. The matter of the spread of training has, however, to be carefully considered. It may be that normal and feeble-minded children of equal mental age show the same improvement in the activity practiced, but unequal spreading of that improvement to related activities. The data obtained on this question will be presented in a subsequent paper.