

# SOME EVIDENCE OF AN ADOLESCENT INCREASE IN THE RATE OF MENTAL GROWTH

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Many studies of mental growth have appeared very recently in our journals of psychology and education. Various phases of the subject have been attacked and defended by psychologists of note. The major issues of dispute seem to have centered about: first, the constancy of the ratio of mental development to age; that is, the constancy of the IQ, over various intervals of time and for various degrees of mental attainment; second, the comparative variability in mental development of the two sexes and of children of different life ages; and third, the limit of mental development, for normal and sub-normal subjects. Such an aroused interest in the theoretical, as well as the practical, problems of mental growth will undoubtedly result in new generalizations concerning the whole topic, and the special phase of the subject with which we are here dealing will again come into prominence.

That the problem of the increase in rate of development at adolescence should for some time have been so neglected seems perhaps strange to the student of the physical development of the body. However, obvious as it is that study of adolescent changes in rate of growth is one of the primary tasks of any development study, there are good reasons why psychologists have been side-stepping that issue somewhat.

Probably one reason for the popular neglect of our subject is that mental units, sufficiently accurate for measuring such fine distinctions as our subject calls for have not yet been found. Mental development is at present usually measured in terms of mental age. That mental age steps are equal in amount is a fact not theoretically insisted upon by Terman,<sup>1</sup> nor practically believed in by Kelley.<sup>2</sup>

<sup>1</sup> Terman, L. M.: *Journal of Educational Psychology*, September, 1921. "The Binet type of scale does not necessarily presuppose equality of mental steps."

<sup>2</sup> Kelley, T. L.: *Journal of Educational Research*, p. 239, October, 1921. "I would say with reference to scales of the Binet type which assume equivalence of successive age intervals, I think we already have abundance of evidence to refute assumption."

In order to show changes in rate of development accurately, it is, of course, necessary that the measuring scale used *shall* be made up of equal units. Objectivity and self-equality of units, such as are illustrated by the inch and the pound, will probably never be attained in such full measure in mental measuring rods, but the earnest hope and belief of all psychologists is that mental measures may, in the future, more closely approach these ideals. Some writers have suggested that certain forms of "point scales" already excel the Binet mental age method in providing equal measuring units. Full confidence in such measures must wait upon the settlement of controversies such as have been engaged in by Freeman and Peterson, as to the proper method of equating "time" and "work." Possibly some form of the method suggested by Thurstone, the determination of standards for each mental age that state the percentage of unselected children at each life age who reach or exceed that grade of intelligence, would help to solve the equal unit problem. At any rate, it is not solved at present. This fact offers good justification to psychologists for having, in the main, avoided attempts at measuring adolescent growth accelerations. The direct use of the IQ is, of course, out of the question, since this is a measure of relative brightness, not of mental status.

Another, and probably more important, reason, why psychologists have not paid much attention to changes in rate of mental growth at adolescence, is a very practical one. The science of mental measurement is young. Matters concerning really large differences in mental ability are still unknown to many laymen. Measurers of mentality have been busy pointing these out and doing practical, necessary service. Early in the short period during which the IQ has been studied, it was conclusively shown by Terman that no *large* adolescent spurts exist. Since that was done in 1916, until perhaps within the last 12 months, little time has been spared by the psychologists studying mental differences from the practical duty of dealing with large differences in mentality, to the mere theoretical pursuit of measuring small fluctuations in the rate of mental growth.

Now the time seems to have arrived when mental growth curves should be more minutely studied. Until better measuring units are available, various devices will have to be used to show up certain features of these curves.

To study the adolescent growth curve, we have employed the simple device of making comparison between the physical and mental sex differences which occur during the development ages. Boas, in an

article on the Growth of Children, *Science*, Vol. XXXVI, has set forth clearly and concisely the laws of physical growth. The curve for rate of growth, in almost all, if not all, organs and parts of the body, he shows to have two modes. The higher mode occurs during fetal life; the second, and lesser, occurs shortly before sexual maturity is reached. Since adolescence occurs at different ages in the two sexes, the pre-adolescent increase in rate of growth occurs at different ages—that in girls occurring about 2 years earlier than the corresponding acceleration in boys. The age for minimum increase in annual growth is given by Boas as 10.3 for boys and 8.2 for girls. The age for maximum increase is 13.2 for boys and 11.2 for girls. With these facts about sex differences in physical traits in mind, it occurred to us that if a similar sex difference were found to exist in mental ability, girls exceeding boys mentally during the same ages in which they exceed them physically, that this would constitute some evidence that an adolescent increase in rate of growth is a feature of mental as well as of physical development. We already had at hand measures used by us for another study, which made this comparison between physical and mental age-sex differences very easy to make. Records of 580 boys and girls, who ranged in age from 6 to 18, were used. All of these subjects at the time the measures were made were pupils of Punahou School, Honolulu, Hawaii. This is a private school which carries the pupils from the first grade through high school. All of the 580 pupils were American or British children, of Northern European descent. Most of them had lived all their lives in the Hawaiian Islands. The measures which we had at hand were made originally by us separately for independent purposes. The anthropological data were collected by Doctor Sullivan, the mental measures by Miss Murdock. The latter measurements were made by the use of group tests. The Otis Primary Test was used for Grades I to III; the National Intelligence Tests, Forms A and B, for Grades III to IX; the Terman Group Test, for the four high school grades. Mental ages were assigned to individuals on the basis of norms furnished by the authors or publishers of the tests. Adjustment was made in order to bring ages derived from the three different tests all to the standard of the National Intelligence Tests. Ages above and below those for which norms were available, were estimated from assumptions concerning the normal curve of distribution. IQs were found for each subject by dividing the mental age by the life age. (It is true that some doubt has been thrown by Freeman and others upon the permissibility of using mental ages,

derived from group tests, to obtain IQs. For the purposes for which we have used these IQs, however, we believe there can be no objection to the way in which we have derived them.) In the case of pupils from Grades III and IX, who received mental age ratings from two tests, an average of the two was used. The measures for weight were expressed in terms of pounds; those for stature, in terms of centimeters.

The results of the comparison of physical and mental measures for the two sexes at successive ages, are given in the accompanying tables. The average weight, stature, and intelligence quotient for boys and for girls at each age from 6 to 18 are given, and also the amount in each age group by which the girls exceed the boys, or the boys the girls, in weight, stature, and IQ. In the case of the IQ, the excess of girls over boys, and of boys over girls, is given for each age separately, and also as smoothed averages, in which the average given for each age group is in reality the average for the boys (or the girls) of that age group in combination with the age just younger and the one just older. Comparison of the excess columns is very striking in revealing that there is a similarity between the mental and physical ages of development. If we confine our attention to the "smoothed" averages for the IQs, and compare these with the physical measures, we find that the direction of excess, of boys over girls, or vice versa, at different ages, is as constant for mental and physical measures as it is between the two physical measures themselves. From 8 years of age until 13, the girls excel, physically and mentally. Thereafter they are behind the boys. The rough, or unsmoothed, excesses tell about the same story. The greatest exception occurs at the age of 18, where girls are seen to excel the boys, mentally, by an average of 2.4 IQ. It occurs to us as possible that the brighter of the 18-year-old boys may be sent to college more often than the bright girls of 18—parents disliking to have their daughters go so far from home at this early age. However this is only a supposition. The smallness of the groups naturally would result in irregular results for differences which are so small as those which we are attempting to measure. We would not, in fact, feel justified in presenting our data at all, based, as they are upon such limited numbers of cases, were it not for the fact that so many age groups unite in confirming the evidence.

Our own interpretation of our results is that they furnish evidence that a pre-adolescent increase in rate of mental growth occurs at the same time in the development of each sex that the physical increase in

development occurs. Whether or not boys excel girls mentally, as they do physically, after, and to a slight extent, before the adolescent growth periods, is a question on which our data hardly shed enough light for us to form an opinion. Neither do we feel justified in assuming anything about the amount of the adolescent mental growth acceleration, except that it is probably much smaller, comparatively, than the physical "spurt." The unit of mental age scales, by its very definition, is of such a nature that it tends to conceal any differences in rate of mental growth. Eleven years mental age means the mental age of the average 11-year-old child. If, on the average, children should develop little mentally from 10 to 11 years of age, and develop much from 11 to 12, properly arranged mental scales, of the age standard type, would entirely conceal such change in rate of development. (The IQ as a measure, is similarly limited, with the additional restriction, when it is used for purposes of studying mental development, that only subjects of the same life age can be compared. In our present study, we have used IQs, instead of mental age, only because our measures already had been converted into this form for other purposes. Since our comparisons all are between groups composed of individuals, who are of the same life age, the results are identical, whether mental age or IQs are used.) Since then changes in mental growth are concealed, rather than shown up, by the use of mental scales, it is impossible for us to arrive at a decision as to the amount of adolescent growth acceleration. Its existence at all, by the use of such scales, could not have been determined, were it not for the sex differences which we found. Mental scales have been standardized by the use of results obtained from the scores of both boys and girls.

On the whole our results seem to be in harmony with those of other investigators. Porteus, in his maze studies, found some correlation between physical and mental development, with a consequent superiority, in mental ability, of girls to boys from the age of  $11\frac{1}{2}$  to 13 years, and inferiority at both earlier and later ages. Yerkes and Bridges, by the use of their Point Scale for Measuring Intelligence, found boys superior to girls from 8 to 11, girls superior at 12 and boys again superior from 13 to 15. That the ages for the girls' superiority in our study come somewhat earlier than in these others, is possibly due to the fact of the early physical development, brought about by the warm climate or the social status of our subjects. Terman's findings seem also to yield substantially the same results as ours. On p. 75 of "The Stanford Revision of the Binet-Simon Scale" he says:

Averages									Sex differences in averages							
	Number of cases		Weight in pounds		Stature in centimeters		IQ		Excess in weight		Excess in stature		Excess in IQ		Excess in IQ (smoothed average)	
Age	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Girls exceed boys	Boys exceed girls	Girls exceed boys	Boys exceed girls	Girls exceed boys	Boys exceed girls	Girls exceed boys	Boys exceed girls
6	8	12	50	48	121	119	109.1	104.9	..	2	..	2	....	4.2	...	2.2
7	22	18	54	51	125	122	112.7	107.7	..	3	..	3	...	5.0	...	
8	18	25	58	59	130	129	99.7	103.2	1	..	..	1	3.5	...	2.0	
9	29	23	63	68	133	136	102.8	110.1	5	..	3	.	7.3	...	6.3	
10	32	22	68	75	136	142	105.0	115.6	7	..	6	..	10.6	...	5.7	
11	33	17	81	89	145	149	113.1	113.1	8	..	4	..	0.0	...	4.9	2.0
12	26	28	87	92	151	152	109.0	113.2	5	..	1	..	4.2	..	1.2	
13	27	28	97	111	155	160	113.2	113.0	14	..	5	..	...	0.2	1.0	
14	34	35	112	113	164	161	110.0	109.6	1	..	..	3	....	0.4	...	
15	24	19	129	118	171	164	110.9	106.0	..	11	..	7	....	4.9	...	1.7
16	18	32	135	123	173	164	107.9	108.7	..	12	..	9	0.8	...	...	2.6
17	14	18	135	122	175	165	114.4	108.5	..	13	..	10	...	2.9	...	0.1
18	7	13	140	122	175	165	109.9	112.3	..	18	..	10	2.4	...	...	

"In the main, therefore, the school progress of our subjects agrees with the intelligence tests, with the teachers' estimates of intelligence, and with the teachers' judgments of the quality of the school work, in showing a sex difference which is in favor of the girls before 14, and in favor of the boys thereafter."

This statement, however, is immediately followed by Terman with an explanation of what he thinks is the probable reason for his findings. He believes the apparent superiority of boys over 13, to girls, to be due to the effect of selection of his subjects. All of these were pupils in the elementary school, and his belief is that more girls than boys, of 14 years of age, had been advanced to high school. His final conclusion therefore is different from ours. It is that "the only possibility seems to be that the apparent superiority of boys at the age of 14, as well as also their diminished inferiority at 13, is due solely to the uneven selection which has taken place at these ages." However this may be in the case of Terman's subjects, it certainly is not true for ours that the superiority of the boys after 13 years of age is due to a selective influence, which places more girls in high school, for in our study high school students as well as those in elementary school are tested. All pupils of the ages 6 to 18 in the whole school, which consists of 12 grades, were included in our study (except those of other races). Another important study, whose results harmonize with our conclusions, is Mrs. Pressey's study of sex differences, in which she finds girls slightly superior to boys in mental ability. Mrs. Pressey's pupils were elementary school pupils, therefore mostly below 14 years of age.

We hope that in the future workers who compare the mental ability of the two sexes, will present their results in such a way that the sexes can be compared age for age during the developmental years. Further studies of this sort, including measures of many more subjects, alone can corroborate, or refute, our tentative conclusion that for both sexes there is an increased rate of mental as well as physical development for several years prior to the attainment of sexual maturity.