

DEGREE OF MENTAL DEFICIENCY IN CHILDREN AS
EXPRESSED BY THE RELATION OF
AGE TO MENTAL AGE*

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The object of this brief discussion is to present a scale of mental ages intended to roughly indicate the grade of mental deficiency of defective children on the basis of their combined chronological and mental ages. Incidentally this will indicate also the probable mental age in the future of any given child. The classification of mental defectives according to their mental ages had led to a confusion that needs to be cleared up. The mental age alone correctly indicates the degree of deficiency only in the case of adults, or after a chronological age is reached where intelligence has ceased developing. In the case of children the degree of deficiency must be expressed by some mathematical relation of the mental and chronological ages. This fact is usually overlooked by those not entirely familiar with the subject. The mental age classification of defectives has certain significant advantages over the old method of classifying into idiots, imbeciles, morons, and sub-classes, besides the greater accuracy that the method gives. Let us first compare the two in this respect. This will make clear the nature of the error involved in letting the mental age alone or the difference between the mental and chronological ages, represent the degree of deficiency in the case of children.

The old method of classifying aims to divide the range of

*This article was in manuscript when a recent publication by Bobertag, which contains the main ideas on which my scale of mental age is based, came to my notice. (See "Ueber Intelligenzprüfungen—nach der Methode von Binet und Simon"—*Zeitschr. f. angew. Psychol.*, 1912). The essential points that he makes are (1) that the normal rate of development is a constantly decreasing rate, so that a year of normal mental development becomes less and less with increasing age; (2) that feeble-mindedness is a retarded rate of mental development. From this follow several corollaries which are discussed in this paper, some of which Bobertag also takes up and at greater length. Anyone further interested in these questions should not fail to read Bobertag's article.

mental deficiency,- from the lowest to the highest grade, into more or less equal steps. The division is admittedly arbitrary. There are no fixed points of reference for the different grades, but only for the two ends of the scale. The lowest grade idiot represents the mental development of the normal child at birth. The highest grade represents the case just a little too deficient to be called normal. For the points between these two extremes needed to fix the limits of all the grades there are no fixed facts of reference. We must arbitrarily assume certain symptoms for each grade established. Of the two fixed points at the two extremes of the scale the first is again much more definite than the second. The development of the normal child at birth may be regarded as constant. It is also something with which we are more or less familiar. But the line drawn between the normal and the defective is by no means constant. It shifts according to the examiner because of varying ability and methods of examining. It shifts also with changing standards of the normal in the progress of time and under different social and other circumstances of the person examined. But to arbitrarily assume a set of symptoms that shall represent each grade of the arbitrary scale from the low grade idiot to the high grade moron, and to all agree on these, might not be an impossibility. We have, however, never reached this point with the old scale. The symptoms of the idiot, imbecile, and moron have never been described in sufficient detail to enable an examiner to accurately grade defectives by this scale. To divide each grade further into sub-classes is still very largely a matter of the individual examiner with whose results the results of another examiner would agree only in a very rough way. But assuming that we had come to an agreement as to the symptoms that should be chosen to represent each grade, this would not guarantee the equality of the steps into which the scale is divided. For to divide off the range of mental development into any such steps implies some sort of unit of measurement of mental development. But we have no such unit of measurement, or anything that could be taken to represent it. This will be made clearer directly.

This arbitrary scale has grown up chiefly in connection with

the grading of adult defectives. A further difficulty is met when the attempt is made to apply it to defective children. Feeble-minded children make some progress in mental development, but the rate of progress is slower than the normal. Hence what we might regard as evidence or symptoms of a certain grade of mental development, the imbecile grade, for example, in a given child may change with age to symptoms of a higher grade. The class into which a child would fall would therefore be determined by his age as well as by his real degree of deficiency, and at birth, to be strictly logical, all children would have to be called idiots. But this is evidently not what we mean by a grade of deficiency. We mean by it the amount below normal, or, from another standpoint, when we speak of children we may perhaps call it the capacity for development. Hence in grading feeble-minded children by the arbitrary scale we must somehow take account of the chronological age, either by making some sort of "allowance" for it, or by finding symptoms of capacity for development in place of symptoms of grade of development in adults. Considering the point we have reached in this matter in grading adults, it needs no discussion to understand that we have not even begun to make this adjustment of the arbitrary scale for the grading of feeble-minded children.

The classification of the feeble-minded according to their mental ages involves nothing that is arbitrary. There is a fixed point of reference for every grade instead of for only the beginning and the end of the scale. Each mental age represents the abilities of the normal child of the corresponding chronological age. When it comes to the finer distinctions we may have only an incomplete knowledge of the difference in the symptoms or abilities and acquisitions of one mental age and the next higher or lower. But the normal child is always there to refer to and consult. His mental characteristics for a given chronological age are always the same. We do not, therefore, as in the old classification, need to pick out a certain group of symptoms and arbitrarily assume it to belong to a certain grade of mental development. For the rougher distinctions no special knowledge is required. Everybody has some idea as to what a normal child

at a given chronological age can do. Attributing a certain mental age to a feeble-minded child or adult, therefore, means something, whereas classifying him as a middle grade imbecile, for example, means very little to anyone not entirely familiar with the feeble-minded and this classification.

These are the chief advantages of the mental age classification over classifying by the old, arbitrary scale. But when it comes to classifying feeble-minded children instead of adults one of the old difficulties remains. The mental age in case of both the adult and the child indicates present abilities. With the former it indicates grade of intelligence or degree below normal as well, since intelligence has become fixed and is no longer developing. With the child it does not alone indicate the degree below normal, as was noted above. It does not alone show the capacity for development in the future. Children of the same mental age but of different chronological ages are not of the same grade. The younger are the brighter. They are not so far behind the normal. This much is in fact readily understood. But the error constantly made is in the supposition that we need only to subtract the mental from the chronological age in any case to get the true degree of deficiency in the difference. It is assumed that a given number of years of mental retardation always represents the same degree of mental deficiency, independently of what the chronological age is. A year behind at twelve, for example, is taken to mean the same as a year behind at six. This is by no means the case. The older here is the brighter, is less behind the normal in grade of intelligence. We may indeed again, make some sort of allowance for the chronological age in any given case and thus roughly estimate the true degree of deficiency from the mental age that has been found. But this sort of allowance and estimating involves the same process and source of error that we have in grading feeble-minded children by the arbitrary scale, although it may be much reduced because of the fact that the mental age represents present abilities more accurately than does the classification into middle grade imbecile, or low grade idiot, for example. How can this difficulty be avoided? Can we find some relation or relations of mental and

chronological ages that will give the true degree of deficiency in the case of children as well as with adults? The scale of mental ages given below is intended to give a provisional, approximate solution. But before presenting this it will be well to consider further why the mental age alone, or the difference between the mental and chronological ages, does not represent the degree of deficiency in the case of children.

There are two reasons. One is that the rate of normal mental development decreases with age. Mental progress is rapid for the first few years and becomes slower as maturity is approached. We have at present no means of really measuring this rate of progress and its changes. But there is evidence of a change. The rate of development of the brain, as measured in terms of weight, decreases very rapidly at first, and comes very gradually to a stop. Functional development, that is mental, is probably not entirely parallel to this, since there are several ways in which the brain can develop physically that might be very important for mental development, and yet add but little to the weight of the brain as a whole. But a rough relationship is always assumed. More important evidence is the direct evidence we have in observing mental progress at different ages. We can readily recognize the difference in mental development between a normal two-year-old and a normal three-year-old child, for example. Between the ages of six and seven this difference is already difficult to discover, and between the ages of eleven and twelve the recognition of progress by ordinary observation is quite impossible. Hence, we know without any method of accurately measuring progress that the rate of progress decreases with age, although there is a further matter that must be taken into consideration in drawing this conclusion. This will be noted in a moment. The amount of mental development during a year cannot in any way be taken as accurately representing a unit of mental growth. For this reason alone a child of three years who is mentally only two might be seriously deficient. But a child of twelve who is mentally eleven might be still quite a normal child. A year's progress at eleven is so much less than it is at two.

The second and more obvious reason why this mental age alone or the difference between the mental and chronological ages, does not represent the degree of deficiency of feeble-minded children is that the younger the child is the less time he has had to fall behind the normal in development. Feeble-mindedness is a retarded rate of mental development. The term "arrested development," or "mental arrest," is a misnomer, for it implies that development has ceased. It is a common observation that feeble-minded children do develop mentally. We also find that their mental ages as measured by the Binet-Simon tests increase as they grow older. But the rate of their development is below the normal. Thus, independently of the first reason given, a child with a given constant degree of mental deficiency may have been only one year behind at six and be several years behind at twelve. He falls behind a certain fraction of a year's mental growth every year. His degree of mental deficiency has not changed all this time, but the number of years of mental retardation has increased. A little computation will show that this second factor is probably much the more important of the two, because it is large even for the only slightly defective and increases with the degree of deficiency. If the rate of mental development is much retarded the number of years of mental retardation will of course increase rapidly. A rate of development not retarded enough to be determinable by present methods during early childhood might show two or three years of mental retardation at the age of fifteen. A year's mental retardation during the first few years after birth would increase to several years by the age of fifteen.

This brings us to consider the further matter in connection with the greater ease with which we can recognize mental progress from one year to the next the younger the child is chronologically. It was noted that the fact that we can do this is evidence that the rate of progress decreases with age. We can see now that it may not be this decrease in rate of progress alone that enables us to do this, but that it is helped also by rates of progress that are retarded below the average normal rate and this increase in the total amount that the child falls behind with the increase in age. Young normal children are quite alike mentally be-

cause there has not yet been time for differences due to slight variations from the average normal rate of mental progress to accumulate. The degree of mental development at three stands out clear and distinct from that of two and four because the variations above and below the average are small. At twelve these differences have accumulated; the variations from the average normal are large, causing undoubtedly some over-lapping of mental and chronological ages within the range we call normal. That is, some normal children of thirteen would have a mental development equal to no more than that of the average normal twelve-year-old, and some eleven-year-old children would have a mental development equal to that of the average twelve-year-old. How much over-lapping of this sort there is at this age cannot be said definitely at present. But there is undoubtedly more than a year. We recognize that a child of thirteen with a mental age of twelve should not be called feeble-minded. The result of this is that the normal degree of mental development at the higher ages does not stand out clear and distinct from that of the next higher or lower as it does in the case of younger children. This tends to diminish the importance of the first reason given why the mental age alone or the difference between the mental and chronological ages does not represent the degree of deficiency in the case of children, and leaves us more with the second factor alone, the accumulation of the amount of difference between the mental and chronological ages with increase in age, as due simply to a retarded rate of development. We are now prepared to discuss a scale of mental ages that will show roughly the degree of deficiency for every relation of mental and chronological age.

Such a scale is easily constructed if certain assumptions are granted, and if we leave out of account the matter of the decreasing rate of mental development as age increases in the case of normal children. The latter must be left out of account because, although we may recognize this as a fact, we have no way of measuring the rate of progress, as already noted. In assuming the contrary we introduce an error. But the procedure is more justifiable than it would be to make some other assumption, that mental development runs parallel to brain development, for

example, the accuracy of which is equally unknown. Moreover this scale seems to work out better on the whole on this basis than on that of several other assumptions that were tested out theoretically. The other assumption required is that feeble-mindedness is simply a retarded rate of development whose ratio to the normal rate remains constant. If a child develops half as fast as the normal at any time he will continue to develop at that rate in relation to the normal. Now it is this rate of development alone that represents the true degree of deficiency, and if it bears a constant ratio to the normal rate the degree of deficiency is always shown directly by the fraction given by the mental age over the chronological age. If the rate of mental development is not constant for normal children we cannot find the degree of deficiency in feeble-minded children in this simple way. This will be clear from the following illustration. Let us suppose that we could measure mental development in terms similar to the centimeter in spatial measurements, and assume that the normal child develops 50 units a year. We would then have the following for the first four years:

Years	1	2	3	4
Units per year	50	50	50	50
Total units	50	100	150	200
Total units at half rate. . . .	25	50	75	100

If a child were mentally two years at the age of four he would have developed 100 units, or 100-200 of the normal, or at 2-4 the normal rate, which is given by the mental age over the chronological. Likewise we could compute what the mental age had been or would be for every age when the mental age for any chronological age is given. But suppose that the normal rate of mental progress is not constant from year to year, and that it decreases with age in something like the following manner:

Years	1	2	3	4
Units per year	100	50	30	20
Total units	100	150	180	200
Total units at half rate. . . .	50	75	90	100

In this case a child who is mentally two at the age of four would have developed 150 units, or 150-200 of the normal, or at

3-4 the normal rate, a rate not given by the mental age over the chronological. This illustration also shows the direction of the error that is made by assuming that the rate of normal mental development is constant from year to year. It gives the mental ages too low for any given retarded rate of mental development, and this amount of error decreases with increase in chronological age. This may be seen by working out the above illustration further. Proceeding now with the assumption that the rate of development is constant, we may compute the course of mental ages for each rate of development or degree of deficiency from birth to the age of fifteen. This gives the following scale of mental ages:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
.1	.1	.2	.3	.3	.4	.5	.5	.6	.7	.7	.8	.9	.9	1
.1	.3	.4	.5	.7	.8	.9	1.1	1.2	1.3	1.5	1.6	1.7	1.9	2
.2	.4	.6	.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3
.3	.5	.8	1.1	1.3	1.6	1.9	2.1	2.4	2.7	2.9	3.2	3.5	3.7	4
.3	.7	1	1.3	1.7	2	2.3	2.7	3	3.3	3.7	4	4.3	4.7	5
.4	.8	1.2	1.6	2	2.4	2.8	3.2	3.6	4	4.4	4.8	5.2	5.6	6
.5	.9	1.4	1.9	2.3	2.8	3.3	3.7	4.2	4.7	5.1	5.6	6.1	6.5	7
.5	1.1	1.6	2.1	2.7	3.2	3.7	4.3	4.8	5.3	5.9	6.4	6.9	7.5	8
.6	1.2	1.8	2.4	3	3.6	4.2	4.8	5.4	6	6.6	7.2	7.8	8.4	9
.7	1.3	2	2.7	3.3	4	4.7	5.2	6	6.7	7.3	8	8.7	9.3	10
.7	1.5	2.2	2.9	3.7	4.4	5.1	5.9	6.6	7.3	8.1	8.8	9.5	10.3	11
.8	1.6	2.4	3.2	4	4.8	5.6	6.4	7.2	8	8.8	9.6	10.4	11.2	12
.9	1.8	2.7	3.6	4.5	5.4	6.3	7.2	8.1	9	9.9	10.8	11.7	12.6	13
.9	1.9	2.8	3.7	4.7	5.6	6.5	7.5	8.4	9.3	10.3	11.2	12.1	13.1	14
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

In this table the first horizontal column gives the chronological ages from 1 to 15. The last vertical column on the right gives the mental ages at 15. The other figures give the mental ages at the different chronological ages for the different rates of development. Thus, if a child's mental age is 5 at 15 his rate of development is 5-15 of the normal, so he will be .3 year at 1, .7 year at 2, 1 year at 3, etc.

The practical usefulness of this scale depends not on whether it is entirely correct, but on whether it represents the facts more closely than we can determine readily in any other way. Complete accuracy could surely not be claimed for it. But in assuming it

to be accurate we would be making less error than by assuming that a given number of years of difference between the mental and chronological ages always means the same degree of mental deficiency, as seems to be the custom now. We have some means of estimating its general accuracy other than the more or less theoretical discussion so far given. The best way to test it would be of course, to find out empirically the course of mental ages for defective children. But since this would require the annual testing of a group of defective children for every grade of deficiency from birth to maturity, such an empirical proof is quite out of the question. Some approximation to this ideal would be to find out the mental ages of a large group of defective children for each chronological age, the children for each chronological age being a different group. The average mental ages, if from sufficient numbers, should show the average course of mental progress from year to year. But this again would require the examination of thousands of defective children. We may consider the results of a smaller number, 1006 cases, arranged in regard to this point. In the next table are given results on the mental ages of the inmates of the Minnesota School for Feeble-Minded. The children are first grouped into chronological age groups of 6-8, 9-11 years, etc., as seen in the first horizontal column. In the second horizontal column are given the corresponding average mental ages as found by the Binte-Simon tests. In the third are given the mental ages as theoretically determined by the method followed in the above scale of mental ages. The computed mental ages are found on the basis of a mental age of 5.5 years at the age of 15, or at a rate of development of 55-150 of the normal rate.

Age	6-8	9-11	12-14	15-17	18-20	21-30	30+
Ave. Men. age.	2.8	4.1	4.9	5.5	5.8	5.0	5.5
Computed Men. age.	2.6	3.7	4.8	5.5			
Difference2	.4	.1	.0			

This comparison of the empirical results with the theoretical determinations shows a close agreement. The difference is always less than half a year. It will be noted also that according to these figures increase in mental age stops at about the age of

fifteen. This seems to agree with our supposition about the intellectual development of normal children. It is an assumption made for the scale of mental ages given above. If, however, the method of computing these mental ages were carried further it is seen, of course, that the computed mental ages would continue to increase indefinitely with age. This is a minor discrepancy, but should not be overlooked. The last computed mental age given, 5.5, is for the age of 15 alone, instead of an average of computed ages for 15-17. This approximate agreement between the computed mental ages for this one rate of mental development, namely, the average rate for all grades of feeble-minded in general, and the actual average mental ages as found empirically may be taken so far as a proof of the correctness of the theoretical basis of the scale, the assumptions made, unless unforeseen errors are introduced by using the average mental ages in this way in place of the actual mental ages of the same children examined annually from birth to maturity. The possible misuse of averages leads us in conclusion to emphasize a necessary caution. The course of mental ages indicated in this scale for each grade of mental deficiency, even if the scale were entirely correct, represents the average case, and does not indicate what variations there may be from this average in individual cases. In certain individual cases the assumption that the relation of the rate of mental development of defective children to the normal rate remains constant may not be true. There are several ways in which variations from this average condition might occur. The feeble-minded child might develop at a rate that becomes retarded more and more with age. He might do fairly well at first, and fail to keep up his rate of progress, and even stop developing entirely before the normal child does. This is indeed an opinion sometimes held. But it is an opinion that can easily be derived erroneously because of the very fact as pointed out, that if feeble-mindedness is a retarded rate of development the amount of difference between the feeble-minded child and the normal will accumulate with age and become recognizable where first it was not. This is naturally interpreted as meaning that the child is not progressing as rapidly as at first. Secondly, the

opposite of this kind of variation from the average case might occur. A child might progress at a retarded rate at first and then improve with the removal of some physical handicap or other cause. Some have maintained that such a case is not one of feeble-mindedness. But the difference in opinion on this point arises over a confusion of the mental condition itself and the cause of it. If the child develops at a retarded rate his mental condition is that of feeble-mindedness, irrespective of whether the cause is permanent or remedial, unless we wish to misuse the term "feeble-mindedness" so it will refer not only to the mental condition but to the permanency of the cause as well. Its literal meaning excludes all reference to causes, and a child might be feeble-minded at first and become normal later. We might conceive of other variations from the average condition. But we do not know much about their actuality at present. The caution to be kept in mind is that we cannot use such a scale as the above as a means of predicting with certainty what the future and final mental age of a child will be. It tells us only what we may expect. It gives us probability.

DISCUSSION

Dr. H. H. Goddard: I am very much interested in this paper of Dr. Kuhlmann's. I fully agree with him on one point and think we all must. I think the method of estimating, by getting the number of years backward a child is, is a very crude procedure. It doesn't really mean anything at all. I can not yet see how results will fit in but it seems to me that there is considerable evidence that there are a good many children that develop at a normal rate up to a certain age and then slow down; some slowing down gradually and others rather rapidly. This is possibly accounted for by accidental conditions. Dr. Healy's case of traumatic feeble-mindedness is a good illustration of this. We have quite a good many cases, not a large percentage as yet, where it is pretty clear that they have developed very nearly normally up to the age of seven, eight or nine, so that I am very skeptical as to the possibility of formulating a rule for determining the rate