

besass, von denen der mediale die gewöhnliche Lage zeigte, während der andere zur selben Höhe lateral von dem ersten lag.

Die jüngeren Präparate bieten m. E. genügendes Beweismaterial um annehmen zu können, dass auch das Pharynxgebiss sich nach dem Bauprinzip der Zahnreihen anlegt. Diese Odontostichi verlaufen derart, dass sie mit der Medianlinie einen Winkel bilden und sie entwickeln sich, soweit wir das nachgehen können, in einer Richtung von mesial und lateral nach distal und medial.

Ziemlich bald aber sind so viele Elemente vorhanden und fängt der Zahnersatz an, wodurch ein so kompliziertes Bild entsteht, dass es unmöglich wird, von ihnen eine Einteilung in Odontostichi zu geben.

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Experimental Psychology. — *Imagination and attention during childhood.*

By D. WIERSMA, (Communicated by Prof. E. D. WIERSMA).

(Communicated at the meeting of April 25, 1936).

In 1930 a communication was made (6) of the standardizing of a test in which, by means of the recognition of objects wrapped up in a varying number of flannel covers, an investigation into intelligence can be made. For that purpose the results of this test were among other things compared with those of E. D. WIERSMA's tests of hazy photographs and of absurd pictures. Test persons were adults; the correlation of the last two tests proved to be nearly zero, which permitted the conclusion that they appeal to quite different intellectual functions. The test of the hazy photographs is an imagination test, the test of the absurd pictures yields a method to test judgment.

Whereas standard results for adults for both the imagination and the judgment are well known, the standardizing for children remains yet to be done. In this paper the standardizing of the test of the hazy photographs in children between the ages of 4 and 16 years is endeavoured. Besides, attention was involved in the investigation and this as well as the imagination was compared with the I. Q. obtained by a Binet examination. The first thing to be done was to make out, whether attention and imagination show a similar improvement with rising age as is known for general intelligence. Secondly the correlation between imagination and I. Q. had to be determined. A correlation of at least a moderate degree may be expected, as the imagination, i.e. the analysing of given complexes of ideas and the building up of new complexes from the elements, certainly is one of the most important elementary functions, that together form general intelligence. On the other hand general intelligence, as tested by the Binet

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method, contains much more than imagination alone: memory and judgment possibly are of no less importance. So we may expect a number of cases in which a discrepancy between the results of the test of the hazy photographs and the I. Q. is found, and these cases are likely to make out a very interesting subject for a later investigation, not in the last place as they may prove highly important in the practice of education and vocational guidance. I am inclined to expect, that a combination of a high I. Q. and a poor imagination may easily lead to serious failures of apparently promising pupils, when they reach the higher classes of secondary schools or when they are placed face to face with the difficulties of an intellectual profession.

Finally the correlation of the results of the attention tests with the I. Q. and the outcome of the hazy photograph tests respectively, had to be determined. In as much as the coefficients prove to be positive, the latter cannot be considered as a pure measure of general intelligence and imagination, as attention in itself is neither an intellectual function nor an element of imagination as defined above. Nevertheless, the results of the Binet method seem to a certain degree to depend upon a good attention and this may also prove to be of practical significance. For attention is far more accessible to training than any intellectual function, and so a low I. Q. that is partially due to a lack of attention may yield a less unfavourable prognosis as to school performances than a similarly low I. Q. in a child whose attention reaches the level of the average.

For the standardizing of the imagination and attention tests the children were divided into age groups with one year difference, the group of the 8 years old containing children of 7.6—8.5 years, that of the 10 years old, containing children of 9.6—10.5 years, and so on. The groups of children younger than 5 years were combined, each of them being too small for allowing any conclusions, and to the group of the 15 years old two older boys were added. The youngest child involved in the experiments was a boy of 3.4 years, the oldest a boy of 16.5 years.

For the determination of the degree of conformity between the various results I made use of a fourfold table and the coefficient $w = \frac{ad - bc}{\frac{1}{4} n^2}$, in which a , b , c , d represent the frequencies in each of the cells and n is the total number of test persons (7). The correlation coefficient r could not be applied, as the results of the attention tests had to be compared with the average of each age group (2).

Imagination and I. Q. — In the investigation with the test of the hazy photographs 101 children were involved: 70 boys and 31 girls. Their ages varied from 3.4 to 16.5 years. I made use of six series of six pictures each and the number of pictures properly recognized by each test person was noted. For each age group the mean number of proper recognitions and its standard deviation was calculated. The standard value for adults,

based upon investigations by ARKEMA (1), SCHULTE (4) and myself (6), is added for comparison, although a standard deviation for adults is not known. The results are put down in table I.

TABLE I.

Age group	Number of t.p.	m.	σ
< 5 years	4	10	2
5 years	5	10	3
6 years	4	11	1
7 years	11	14	4
8 years	10	13	2
9 years	11	14	4
10 years	11	15	2
11 years	8	16	3
12 years	8	17	3
13 years	11	17	3
14 years	10	17	3
> 14 years	8	18	3
adults	—	19	—

The test results appear to improve very regularly with the rising of the age. In 1908 VAN DER TORREN (5) obtained a similar result with HEILBRONNER'S test of incomplete pictures, which, however, has not been standardized as an imagination test. Among the present test persons only the seven years old show an exceptional rise, that disappears again in the next group. Possibly this rise is accidental, the groups being rather small and consequently the standard deviation rather high, but the possibility of a temporary improvement of the function of imagination in seven years old children may not be altogether rejected. The standard value to be expected for the seven years old is 12 (that of the six years old being 11 and of the eight years old 13), but the value of 14 may have some significance. I have, therefore, made my correlation calculations with the standard value 12 as well as with the value 14 as a basis.

Of all children, who were involved in the test of the hazy photographs, the I. Q. is known. It varies from 53 to 138 with a mean of 94 and a median of 95. In order to make the results of the test of the hazy photographs independent of age and have them ready for comparison with the I. Q. of each test person, I calculated the value of each performance, when the standard value of the group to which it belonged was made 100. So I

obtained a series of numbers W (abbreviation of the Dutch words „wazige photographieën”), that may be compared without difficulty with the series of the I. Q. *s.* Suppose that a child yields 12 proper recognitions. If it belongs to the age group of 5 years, the standard value of which is 10 recognitions, its $W = 120$, if it belongs to the group of 10 years, however, that has a standard value of 15 recognitions, its $W = 80$ only. The calculation of the coefficient w was, as I mentioned above, performed on the base of a standard value of the seven year old group of 12 recognitions and also on that of a standard value of 14 recognitions. Both coefficients are positive: in the first case we find

$$w = + 0.30$$

and in the latter

$$w = + 0.24.$$

So there is a marked degree of conformity between the results of the test of the hazy photographs and those of the Binet examination. Apparently imagination is a factor of some importance in general intelligence.

Attention and I. Q. — Attention was in older children tested by means of E. D. WIERSMA'S dotted papers (8). The instruction was to mark all the groups of four dots as quickly and as accurately as possible. The time required for each line, containing 25 groups of 3, 4, or 5 dots, was noted in seconds: 25 lines were performed. After the examination the mean time used for a line was calculated and considered as a measure of the speed of working, whereas its mean deviation was used as a measure of the working regularity.

This test could not be applied to younger children. Under nine years old most children work so slowly and so irregularly that their performances do not permit any conclusions. So I introduced a much simpler test for them: they had only to write down circlets on ruled writing paper and I took a note of their performances in every quarter of a minute; after the examination the mean performance in a quarter of a minute was again taken as a measure of the speed and its mean deviation as a measure of the regularity of working. The children under five proved too young even for this simpler test: they were not yet able to hand a pencil properly.

The dotted-paper test was performed by 58 children: 46 boys and 12 girls, varying in age from 8.1 to 16.5 years. They were divided into eight age groups and for each group the mean of the time means was calculated as well as the mean of mean deviations, the latter being expressed in percentages of the time means, in order to make the measure of regularity independent of the measure of speed. Because of the smallness of the groups the standard deviation was not determined. So the values obtained, which are to be found in Table II, cannot be considered as definite standard values.

TABLE II.

Age group	Number of t.p.	m.t.m.	m.m.d. %
8 years	2	23.3	13.3
9 years	5	23.1	12.3
10 years	5	19.6	11.3
11 years	8	20.5	13.2
12 years	10	17.5	11.3
13 years	10	16.6	11.9
14 years	10	15.1	9.8
> 14 years	8	14.3	10.0

We see a rather constant and regular improvement of the performances in this test with rising age: both speed and regularity of working are better in older children. As for speed, ROELS and FELDBRUGGE (3) obtained similar results in children between 8 and 12 years. They did not take account of working regularity. Among the present test persons the groups of 14 years and above have reached a regularity of the same amount as is ordinarily found in adults, although their speed of working remains inferior to the speed of adult people. No influence of beginning puberty can be noticed, although it is often held that attention becomes weaker in that period. Of course, it will be necessary to have a supervision of this point, when more subjects will be available.

In all children, involved in the dotted paper test, the I. Q. was determined. It varies from 53 to 138 with a mean of 95 and a median of 97. Because of the impossibility to treat the mean values of table II as standard values, the calculation of the conformity coefficient between attention test results and I. Q. had to be performed in another way as was used for the test of the hazy photographs. I therefore compared the time mean and the mean deviation of each child to the mean of their own age group and in this way put them in connection with the I. Q. Both conformity coefficients between I. Q. and attention proved to be positive; for speed I found:

$$w = + 0.11$$

and for working regularity

$$w = + 0.18.$$

Consequently the degree of conformity between general intelligence and attention is much lower than that between general intelligence and imagination. Nevertheless, the result of a Binet testing depends — according to these coefficients — to a certain extent upon attention. In so far it does not yield a pure intelligence measure.

The circlets test was performed by 40 children: 23 boys and 17 girls, varying in age from 4.9 to 11.3 years. They were divided into seven age groups and the mean of the performance means and that of the mean deviations expressed in percentages of the performance mean of each individual were calculated again for each group. The smallness of most groups did not allow the determination of the standard deviation. The results are put down in table III; they cannot as yet be considered as definite standard values.

TABLE III.

Age group	Number of t.p.	m.p.m.	m.m.d. %
5 years	2	5.7	18.8
6 years	3	6.7	16.0
7 years	10	9.1	15.9
8 years	10	12.7	12.0
9 years	9	15.9	12.2
10 years	5	16.2	10.0
11 years	1	16.2	12.1

Here again speed and working regularity show a regular improvement with rising age. The only exception, that may seem to be of any importance, is found in the group of the eleven years old, but it cannot make a deep impression, as the group contains only one individual. For that reason it could neither be involved in the determination of the coefficient w : it has to be left out of further consideration.

All children, who performed the circlets test, were tested with the Binet method; so their I. Q. is known. It varies from 64 to 111 with a mean of 91 and a median of 92. The determination of the degree of conformity between I. Q. and attention took place in the same way as for the dotted-paper test. The mean performance and the mean deviation of each individual were compared with the mean values of their own age group and after that put in connection with the I. Q. Now for the first time a negative coefficient was found, though to an extremely low amount; for speed and I. Q. I found:

$$w = - 0.04.$$

This figure has no other practical meaning than that speed in the circlets test apparently has nothing to do with general intelligence. Working regularity, however, is rather consistent with general intelligence, for here we find:

$$w = + 0.23.$$

Consequently the conclusion that attention is a factor of some importance for the result of an intelligence test can be maintained, in as much as it is based on the working regularity as a measure for attention.

Imagination and attention. — Finally we have to see, whether there exists any correlation between the results of the attention tests and those of the test with the hazy photographs. As for the children, who performed the dotted-paper test, 58 of them were also tested with the hazy photographs. Their age varies from 8.8 to 16.5 years, the value W from 59 to 150, with a mean of 101 and a median of 100. The calculation of the coefficient w could take place in two different ways. It was possible to compare the number of proper recognitions, yielded by each child in the hazy-photograph test, with the mean value of his own age group and connect the values with those of the attention test afterwards. But a simpler method — the results of which are to be mentioned here only — can be followed in using the continuous series formed by the values W . In this way for the conformity between W and the result of the dotted-paper test I found :

$$w = - 0.11$$

as to the mean time and

$$w = - 0.04$$

as to the mean deviation.

So there seems to be a slight discrepancy between imagination and attention, but it has no importance at all, because the working regularity, measured by the mean deviation, is a better standard for attention than speed and the coefficient in question hardly differs from zero.

A quite different result was obtained in the determination of the degree of conformity between the performances in the hazy-photograph test and the circlets test. 36 children, 21 boys and 15 girls had both tests in common, the ages varying from 5.6—10.3 years, the value W from 57 to 179 with a mean of 101 and a median of 100. The group of the seven years old did not make any difference in the coefficients, when the standard value of 14 or that of 12 proper recognitions was assumed, and so only the coefficients for the first case need to be mentioned. Just as in the case of the dotted-paper test I made use of the continuous series of the values W . For the conformity between W and the results of the circlets test I found :

$$w = +0.12$$

as to the mean performance and

$$w = +0.29$$

as to the mean deviation.

These coefficients seem to give a right to the conclusion, that there exists a certain correlation between imagination and attention. As the two at-

tention tests do not agree on this point, I cannot make out which of them is right. For the present we can only state that a connection between imagination and attention has not been demonstrated. It seems quite possible that the difference in age has something to do with the lack of agreement in the two attention tests. We may suppose that in younger children — as were involved in the circlets tests — a certain amount of attention is necessary for a good performance in the test of the hazy photographs whereas in older children the necessary amount of attention, according to its improvement with rising age, is always given and that a still further development of attention adds little or nothing to the performances in an imagination test. This, however, is nothing but a possibility, the verification of which necessarily must be left to later research.

The present investigation allows the following conclusions :

1. Imagination, tested with the method of hazy photographs, during childhood shows a regular improvement with rising age, just as general intelligence does. Standard values could be estimated for a great number of age groups. Hence it will be possible in future to determine whether in an individual child the development of imagination agrees with its age or not and in the latter case whether it surpasses its age level or fails to reach it. That of course is a valuable datum for answering the question whether continued education is advisable. Originality is only to be expected from subjects with a more than usually developed imagination.

2. A similar improvement with rising age could be demonstrated for attention, tested by means of dotted papers and circlets tests. For the present there are no indications of an unfavourable influence of the advent of puberty.

3. Both imagination and attention show a certain correlation with general intelligence. For imagination the degree of correlation is far higher than for attention, which agrees with the fact that imagination is, and attention is not an elementary factor of general intelligence. A good attention has only to be considered as one of the conditions that must be fulfilled for the coming into action of the proper intellectual functions. A high amount of attention does not seem necessary, however, for imagination acts, as a distinct correlation between attention and imagination could not, as yet, be demonstrated in older children.

It seems reasonable to regard the improvement of the performances during childhood as a phenomenon of mental growth and the conclusion is obvious that the growth of a complex of functions, as general intelligence is, can be understood as the result of the growth of its component elements. The growth of one of these elements, imagination, has been demonstrated in the present investigation. But mental growth embraces more. It appears in functions that are to a certain degree mutually independent, as is probably the case with imagination and attention. Still, in every respect the

growth shows such a regularity and such a harmony that there needs must be a regulating principle, ruling the growth as a whole. Psychology and especially child psychology will have to look out for such a mental principle regulating mental growth.

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Medicine. — *Experimental catatonia, produced by auto-intoxication.*
 II. *Experimental catatonia after ligation of the Arteria hepatica propria.* By A. GEESINK, H. DE JONG and F. J. NIEUWENHUYZEN.
 From the neurophysiological laboratory (Dr. H. DE JONG) of the neurological clinic of the University of Amsterdam (Prof. B. BROUWER). (Communicated by Prof. B. BROUWER).

(Communicated at the meeting of April 25, 1936).

Recent experiments have been made in our laboratory, starting from the question if by removal or by functional disturbance of certain organs any experimental catatonia might be produced.

In a previous communication¹⁾ we discussed experimental catatonia produced by artificial obstruction of the lumen of the intestine. Now we arrive at the question how far an experimental lesion of the liver might produce catatonia; for that purpose we ligated the arteria hepatica propria.

We observed a great variety of results in our experimental animals, notwithstanding the fact that we ligated the arteria hepatica propria or its two rami as closely as possible near the liver. It should be mentioned here as a technical detail that in the beginning of the experimental series the animals were operated under general anaesthesia, afterwards under

¹⁾ H. DE JONG, D. J. KOK, A. GEESINK and F. J. NIEUWENHUYZEN: "Experimental catatonia after artificial obstruction of the lumen of the intestine".