

INDUCTIVE THINKING IN SUBNORMALS

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Introduction

Wetherick and Freeland (1969) showed that in the normal child inductive reasoning capacity develops in stages. Broadly speaking, children of five showed no capacity to deal with either positive or mixed instances and no evidence of being able to learn to do so with knowledge of results. Children of six showed some capacity to deal with positive instances but still showed no improvement with knowledge of results. Children of eight dealt correctly with positive instances and very quickly learned to deal with mixed instances. Children of ten dealt correctly with both positive and mixed instances. Children were selected for the study on the basis of age and score on Raven's Coloured Progressive Matrices which ranged from 11 to 32. This range of intelligence scores may therefore be said to cover the whole range of ability on the test of inductive reasoning capacity from failure to grasp the point of the task to normal adult competence.

It is well known that the behaviour of subnormal adults does not resemble that of normal children who obtain the same scores on intelligence tests and that the behaviour of subnormal children does not resemble that of normal children of the same age. The present study tested the inductive reasoning capacity of S.S.N. adults and E.S.N. children, and the object was to see if their performance would throw any light on the nature of subnormality.

The sample of S.S.N. adults was drawn from a hospital for subnormals on the basis of their scores on the C.P.M. No I.Q. scores were available for the subjects but Orme (1961) has shown that the C.P.M. constitutes a satisfactory measure of intellectual subnormality in adults, correlating +0.93 with the W.A.I.S. (N=203). The sample of E.S.N. children was drawn from an E.S.N. primary day school. I.Q. scores were available but the children were tested on the C.P.M. as well.

The performance to be expected from S.S.N. adults is not easy to predict. Although their intelligence scores suggest that they should do as well as equivalent normal children it should be remembered that the performance of some older children was at the normal adult level. E.S.N. children may be expected to do worse than normal children of the same age. The question here was how their performance would relate to that of S.S.N. adults.

METHOD

(a) Subjects

S.S.N. Adults. Approximately forty institutionalised subnormals were tested on the C.P.M. and a sample of twenty-five was selected to match the scores of the normal children as closely as possible. The sample included twelve males and thirteen females and ranged in age from eleven to forty-two (mean age 25.12 years). Only two subjects were under sixteen and they were included to make up the number of C.P.M. scores at the bottom of the required range. Orme's experience was born out in so far as no serious difficulty was experienced in getting subjects to do the C.P.M. (in the individual form). A few proved untestable but where co-operation was obtained the scores tended to be quite high—witness the need to

include in the sample one subject aged eleven and one aged twelve. C.P.M. scores ranged from 13 to 30. From Orme's table of I.Q. equivalents it appears that this covers a range from I.Q. 50 to I.Q. 80+ on the W.A.I.S. Seventeen of the twenty-five subjects selected were clinically diagnosed as uncomplicated primary aments. The remaining eight suffered from clinical conditions involving intellectual sub-normality but their performance did not distinguish them in any way from the majority. There was no correlation between age and C.P.M. score. This sample constitutes a satisfactory comparison group with the sample of normal children if the basis of comparison is simply score on the C.P.M.

E.S.N. Children. A sample of nineteen children was selected on the basis of age and Terman-Merrill I.Q. (which had been obtained on admission to the school from one to four years previously). The children ranged in age from 7 years 5 months to 9 years 9 months and in I.Q. from 48 to 79. They were tested on the C.P.M. and obtained a range of scores from 3 to 21 which correlated significantly with their I.Q.'s ($\mu=0.76$, $P<.01$). Neither intelligence test score correlated significantly with age. This sample constitutes a satisfactory comparison group as regards age with the older part of the sample of normal children. Younger E.S.N. children proved untestable on the apparatus employed.

(b) Materials

The apparatus was described in detail in Wetherick and Freeland (op.cit) and is illustrated in Figure 1. Three sets of six problems were presented in the colour version only (with diamond-shaped patches of colour in place of the letters illustrated). The first set consisted of problems presenting two groups of two colours (the simplest possible case), the second of problems presenting two groups of three colours, and the third of problems presenting three groups of three colours. In each set three problems presented positive instances only and three, mixed instances (one positive, the rest negative). With each problem a different row of four instances was presented for the subject to select his response. Examples of the problems are given below (Positive instances in bold type).

Example A

Light blue—light green light blue—yellow (answer 'light green')

Example B

Light blue—yellow—dark blue light blue—light green—dark green
(answer 'light blue')

Example C

Red—black—dark green red—black—dark blue light blue—black—dark blue
(answer 'dark green')

(c) Procedure

The subject was first asked to name and point to the colours used in the task on a sample card. Once it was established that he could do this he was introduced to the task proper. Since performance both with and without knowledge of the results was of interest all the subjects were required to do the problem series twice, first without, then with knowledge of results.

In the first series the subject named and pointed to the colour that he thought indicated the presence of a marble and was rewarded by being told periodically that he was doing "very well" regardless of his actual performance. In the second he actually turned the knob of his choice and saw for himself whether the marble was there or not. If he was wrong he tried again till he got the marble. Every subject won eighteen marbles (which were exchangeable for sweets) although of course, only the first response was scored.

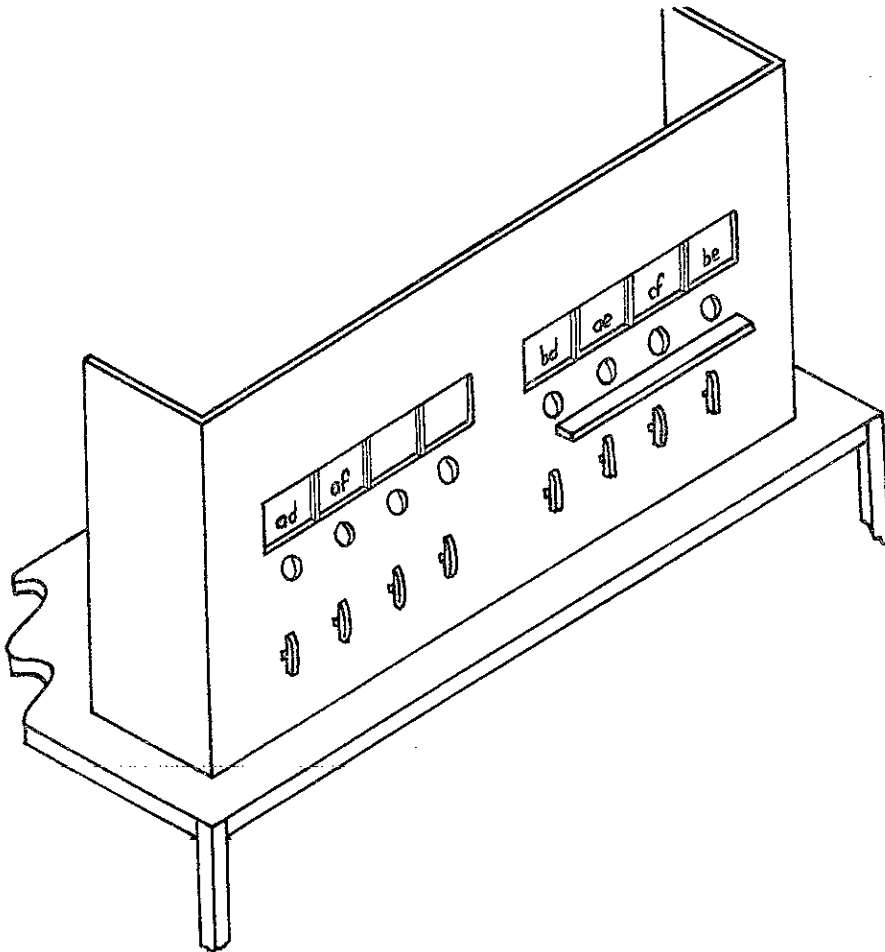


Fig. 1. The apparatus employed for presenting problems in inductive reasoning to pre-literate or non-literate subjects. Two rows of four windows may be seen at the top of the apparatus. The problem was presented in the left-hand row using two or three of the four available windows. Four letter (or colour) groups were presented in the right-hand row from which the subject chose his response. Beneath each window is a hole normally closed by an opaque shutter: by manipulation of the knob the opaque shutter may be replaced by a transparent shutter or removed altogether. In the problem illustrated, the subject ascertains by manipulating the knobs that there is a marble beneath each of the letter-groups to the left. If he is capable of solving the problem he concludes that A indicates the presence of a marble and turns the knob beneath the only window on the right showing A, the marble then rolls out on to the projecting tray.

Since the subject did the series first without knowledge of results, he had to be introduced to the task without being given practice with knowledge of results. The following procedure was adopted. A series of practice tasks was presented in which the subject was told that one colour in the window always indicated the presence of a marble. In each practice task the subject was told what the important colour was and verified for himself that marbles were only present where indicated by the colour. When the subject grasped the principle he was transferred to the actual problem series and informed that he would no longer be told which was the important colour but instead would be allowed to see for himself whether or not there were marbles under the colour groups on the left and would then have to decide what was the important colour and choose his response accordingly. No difficulty was experienced with the adult S.S.N. group since the untestables had already been eliminated at the C.P.M. stage. With the E.S.N. children it was found necessary to bring in an assistant to set up the problems.

RESULTS

The responses of each subject were examined individually to see whether any pattern could be detected either in the series without knowledge of results or in the subsequent series with knowledge of results. The most obvious pattern is of course that resulting from a series of correct responses (the series was so designed that no other pattern of responses could produce anything like a series of correct responses). At the opposite extreme is the total absence of pattern. The subject chooses at random from among the colours present in the problem instances, he has grasped the nature of the task but not the fact that an inference is possible to the correct solution. Between the extremes of correct and random responding come a number of patterns of response which are consistent but also indicate failure to grasp the fact that an inference is possible. It would be possible to choose one colour or a small number of colours consistently, though this pattern was not observed in the present study. It is possible to choose consistently whatever colour appears in a particular position and this pattern was observed for the position on the extreme left. A pattern of more interest (since it implies partial grasp of the correct solution procedure) is the consistent Type I error. Type I errors arise from a failure to distinguish between the procedure appropriate to sets of positive instances and that appropriate to sets of mixed, positive and negative instances. Most frequently subjects liable to Type I error deal correctly with sets of positive instances (extract the common subset of attributes) but carry over the same procedure to sets of mixed instances and consequently make errors. Sometimes the alternate case occurs where the subject deals correctly with sets of mixed instances (extracts the subset present in the positive instance but not in any negative instance) but carries over the procedure to sets of positive instances treating one (usually the first) as positive and the rest as negative.

Patterns of response indicating "correct", "random", "extreme left" and "Type I error" behaviour were observed in the present study as in the previous study with normal children.

Table 1 shows the results obtained and reproduces for comparison the results of the earlier study with normal children. All correct in both series (without and with knowledge of results) may be regarded as the normal adult pattern of behaviour. 11 out of 23 subjects in the group of older children showed this pattern but only one other subject did so. This one was a boy aged 9: 5 with a C.P.M. score of 19 (comparable in both respects with the subjects in the group of older children), whose Terman-Merrill I.Q. was only 74 but had been taken three and a half years previously. His Headmaster commented as follows: "Has recently improved quite dramatically in all his subjects and it may well be that the E.S.N. category will be inappropriate in the near future"!

TABLE I

Patterns of behaviour observed in four subject groups on a test of inductive reasoning capacity. (Data from Wetherick and Freeland (1969) included for comparison).

	E.S.N. Children	S.S.N. Adults	Young Normal Children	Older Normal Children
Age	7:5-9:9	11yrs.-42yrs.	4:8-6:6	7:9-10:5
C.P.M. Score	3-21	13-30	11-21	18-32
Corr./Corr.	1	—	—	11
Type I/Corr.	—	2	—	7
Type I/Type I (or Random)	—	7	5	2
Ext. Left/Ext. Left (or Random)	3	3	—	3
Random/Random	15	13	16	—
N =	19	25	21	23

Type I error in the first series followed by all correct in the second (with knowledge of results) indicates ability to deal with positive instances and to learn to deal with mixed instances. This pattern is typical of normal eight-year olds and accounts for a further 7 of the 23 older normal children. Two of the S.S.N. adults also showed this pattern. Their C.P.M. scores (20 and 25) are in the appropriate range. The Type I error pattern seems to be a necessary stage on the way to ability to deal with both positive and mixed instances since no subject progressed from a lower level pattern in the first series to all correct in the second though this was theoretically possible.

Type I error in the first series followed by Type I error or random choice in the second indicates that the subject can deal with positive instances but is not yet ready to learn to deal with mixed instances. 5 out of 21 young normal children showed this pattern as did 7 out of 25 S.S.N. adults. The 9 S.S.N. adults who showed this or a higher level pattern did not however differ significantly in intelligence from the rest of the S.S.N. group.

Extreme left in the first series followed by extreme left or random choice in the second is a non-rational pattern which allows the subject to respond without actually attempting to solve the problems. It indicates a withdrawal from the situation more complete than that of the random responder who may be trying out a variety of rational or semi-rational procedures. In the E.S.N. and S.S.N. groups the subjects who showed this pattern were in the middle of the distribution for intelligence but in the group of older normal children they were the three lowest.

Random choice in both series did not appear to result from any deliberate intention on the part of the subject to choose at random but from genuine participation in the task during which the subject tried a variety of (false) solution procedures one after the other. The group of older normal children included no random responder but three-quarters of the young normal and E.S.N. groups responded in this way as did half the adult S.S.N. group.

DISCUSSION

Active participation in the task was obtained from all subjects (with the possible exception of those who regularly chose the colour on the extreme left). It appears from the results obtained that subnormals may pass through the same developmental stages as the normal child but on a very much extended time scale. If this were the case it would be consistent with what we know of some other aspects of subnormality. The E.S.N. children did not reach the partially correct (Type I error) stage though a proportion of normal five and six year olds did so. Some of the S.S.N. adults reached this stage and two seemed to be at the transition stage typical of the normal eight year old. Performance on the test of inductive reasoning capacity seems to be a better indicator of subnormality than the intelligence test (C.P.M.) score obtained, in many cases the latter suggests performance at a normal nine or ten year old level which was not achieved either in general behaviour or on the task employed in this study.

It would however be premature to suggest that subnormals are lacking in inductive reasoning capacity. The comparison with normal children suggests that this may be the case but it also appeared quite clearly that subnormals lacked the capacity to master a discrimination learning task until Zeaman and House (1963) showed that once learning starts (which may only be after a very great many trials) the subnormal's learning curve is just like that of the normal. What the subnormal appeared to lack was the capacity to attend to relevant aspects of the stimulus situation. The high incidence of random behaviour in this study may indicate that here too a failure of attention is at the root of the subnormal's difficulties: not in the sense that he fails to "pay attention" to the task in hand but that he lacks even the normal child's capacity to distinguish relevant aspects of the situation from irrelevant.

SUMMARY

A previous study showed that in the normal child inductive reasoning capacity develops in stages between the age of five and ten. A sample of S.S.N. adults was selected covering the same range of scores on the Coloured Progressive Matrices to see how far their performance on a test of inductive reasoning resembled that of normal children. In most cases the performance of the subnormals resembled that of children much younger than their C.P.M. scores would have suggested as an appropriate comparison. In particular only two out of the twenty-five showed any capacity to improve their performance with knowledge of results. A sample of E.S.N. children between seven and nine years old showed, as expected, a lower level of performance.

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