THE PERFORMANCE OF NORMAL AND MENTALLY SUBNORMAL ZAMBIAN CHILDREN ON TWO INTELLIGENCE TESTS AND A CONSERVATION TEST

BY

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Abstract

This study evaluates the construct validity of three non-verbal tests - Panga Munthu, Porteus Maze and Nonverbal Conservation Tests - to be used in identifying and assessing the mentally sub-normal children in Zambia. The subjects for this study included average normal school children aged 7-8 years, 9-10 years and 11-12 years; 11-12 year-old Bright and Dull normal children, and 9-13 year-old moderately (MSN) and severely subnormal (SSN) children in Lusaka. The results show that the three tests differentiate the three age groups, and also the normal and the subnormal children. Panga Munthu and Porteus Maze tests differentiate the two subnormal groups but not the three groups of normal children. The conservation test separates the Dull from the Average and Bright children, but not the MSN from the SSN children. Since there is also some significant positive correlation among the tests, it is recommended that with some modifications the three tests may be included in a battery of clinical tests.

CHAPTER I

Background to the Research

Section 1 Introduction:

The identification of the mentally subnormal child and the assessment of his abilities are some of the tasks for which the clinical Psychologist may be consulted. When so consulted the tool he most frequently resorts to is the intelligence test. The aims of testing the child are to help confirm the provisional diagnosis of mental subnormality by comparing the child's performance with the range of performance of children of the same chronological age; and to enable the therapist decide on the child's needs.

Several studies have been reported which involved administration of intelligence tests to African adults e.g. those by Fick (1939); Bieusheuvel (1949, 1959), McFie (1961), Brimble (1963) and Vernon (1969). Reports of studies on African children include those by Scott (1950), Brimble (1963), Vernon (1967 & 1969) and Serpell (1974). Several other studies are listed by Klingelhofer (1967). Only one study has been reported involving administration of tests to African subnormal children (Haskell & Anderson (1969).

Section 2 Testing the Normal African

The earlier researchers who attempted to evaluate the intellectual abilities of the African used norms obtained outside this continent. Hence they fell into the "trap of equating the mentality of non-Western people with that of younger Western children" (Vernon 1969, p.18). This method of evaluating the African's intellectual level has long been shown to be unjustified since the meaning of intelligence varies from one society to another, and

within one society it may vary with level of Western type of education (Wober, 1973).

The great amount of heat generated by the nature - nurture controversy on intelligence, and the arguments on the interpretation of test results, results from the many different interpretations of the concept of intelligence. Several studies have shown that there are genetic as well as environmental factors in intelligence. The individual's environment include both intrauterine and postnatal environments. The phenotype, intelligence, results from the interaction between the individual's gene for intelligence and his intra - and extra-uterine environments. The intrauterine environment influences the individual's constitution e.g. the state of the nervous system, while the extrauterine environment provides the milieu in which the individual's genetic potential is developed. Wechsler (1944) defined intelligence as the "global capacity of the individual to act purposefully, to think rationally and to deal effectively with his environment."

Since both the physical and social environment of humans vary from one society to another, one would expect the requirements for purposeful action, rational thinking and effective dealing with the environment to vary from one culture to another. Yet it seems many psychologists who administered tests in cultures other than their own did not take this possibility into account when interpreting their results. Instead their conclusions depended on their own conception of intelligence based on their own experience in physical and cultural environments different from that of their subjects. Since intelligence develops differently in different

environments, Vernon (1969, p.10) suggests that, "it should be regarded as a name for all the various cognitive skills which are developed in and valued by the group." Intelligence tests designed to tap these skills should then include items relevant to the culture in which the tests are being administered.

Piagets theory of intellectual development seems attractive in this respect, since while the theory offers a reasonable explanation of the nature of intelligence, the tests of his theory can involve the manipulation of objects in the environment of individual being tested. For Piaget (1964) "Intelligence constitutes the state of equilibrium towards which tend all the successive adaptations of a sensori-motor and cognitive nature, as well as assimilatory and accomodatory interactions between the organism and his environment." Intelligence is cummulative hence the individual passes through different stages of intellectual growth-sensory motor, preoperational, concrete operational and formal operational stages - each with its own characteristics. As the individual progresses through these stages his thought processes tend to become independent of direct contact with the environment. Piaget is not interested in individual differences in intelligence as the Psychometricians but is interested in studying the nature of intelligence, and in the presence or absence of the intellectual factors he postulated in his theory, through observation of the way the individual manipulates the objects in his environment. Several cross-cultural studies (e.g. Bovet 1974, Price Williams, 1961) have confirmed the presence of these stages in the cultures studied but the ages at which each stage is reached differ from one culture to another. This difference however seems

to be related to the degree of familiarity with the items used. (Okonji, 1971)

Piaget's theory provides a good basis for the development of intelligence tests but surprisingly there are very few psychometric tests which incorporate some aspects of his theory. Several studies have examined the concrete operational stage at which stage the concept of conservation develops. These studies examine the ages at which the stage is found in different cultures and some aim to determine the validity of the concept by comparing the relations between scores on conservation tasks and scores on other measures of intelligence. One aim of this study however is to evaluate a test designed to measure conservation as a possible test of intelligence.

Section 3. Abilities involved in intelligent behaviour:

In Western culture important components of intelligence are the ability to grasp relations and the ability for the symbolic thinking. These are encouraged at school, work and probably daily life. These are also reflected in many Western intelligence tests which include verbal, mathematical, as well as extensive use of pictorial material of abstract figures. These abilities form the criteria for evaluating performance on intelligence tests.

The abilities called for in non-Western cultures may be quite different since the values of the societies may be different. This can be seen from the factors included in the concept of intelligence by subjects studied by Scott in Sudan, Wober in Uganda and Serpell in Zambia.

Scott (1950) asked some Sudanese primary school teachers to state what qualities they would expect an intelligent child to have. He then asked the teachers to estimate their children's intelligence. (The exact technique used for estimation was unfortunately not specified.) He then administered oral tests to the children aged 10 years and 16 years. (Instructions were given orally and the children wrote down their responses.) The results show correlation coefficients for the tests and teacher's ratings ranging from r = .20-.90. Such a wide range of correlation coefficients is not surprising. The test items were highly verbal and required that the subjects would have spent some years at school. Yet the teachers' estimation of the children's intelligence might have been based either on their inclusion of factors like "good manners, and obedience" besides "common sense, industry, and attainments" in their concepts of intelligence, which might result in low correlations with the tests; or on the children's academic performance which would result in high correlations. In spite of this, Scott has, twenty-five years ago, attempted what many intelligence test psychologists after him have not included in their evaluation of the African's intelligence.

Wober (1973) used a version of Osgood's Semantic Differential to map out something of the network of connotations for a concept which he considered the Kiganda equivalent to 'intelligence'. He interviewed three Buganda groups - village adults, village primary teachers and adult elite - all around (villagers) or in (elite) Kampala. He also interviewed a Batoro group who lived 250 miles away from Kampala in Western Uganda. A fifth group consisting of second year Medical students - which included Asians and other non-

Baganda Ugandans - in Kampala. His results indicate some significant differences between the items included in the concept of intelligence by uneducated villagers and the remaining educated groups. The villagers included concepts like happy, steady, safe, careful and friendly in their concept of intelligence while the educated groups did not emphasize these factors.

Serpell (1974) suggested that before one can meaningfully evaluate the intelligence of any group of people one needs to identify the meaning of that term in the society being considered. That is, one needs to determine what qualities the individual needs to successfully deal with his environment. Then one should design tests to measure those qualities and then standardize the test for use within that particular environment.

In a study whose primary objective was to identify the meaning of the concept of intelligence in rural Zambia, Serpell used an indirect approach: that is by means of interviews in which adults and peers, in a number of villages, were indirectly asked to rate children of the same sex and narrow age ranges. The rater was asked to say which child in the group he would pick to perform some relevant tasks in a hypothetical situation. (Serpell 1974, p.9)

The reasons given for selecting the children included terms like obedient and co-operative besides clever, sensible, responsible, trustworthy, prompt. The selected children were given four intelligence tests - three new tests developed by Serpell: Panga Munthu (make a person) test, Hand Position copying test, and General Verbal Test (Chi-Chewa); and one old test - the Queensland Test. Thus one verbal and three non-verbal tests were used. The low

correlations found between these tests and the adult ratings are not surprising since in evaluating the children's intelligence the adults included factors like obedience and co-operation which were not being measured by the mainly cognitive tests. Any test using rural adult estimates of intelligence as criteria for testing validity may have to incorporate items that can tap qualities like obedience and co-operation.

Section 4 Testing the Mentally Subnormal in Africa

Meanwhile one task that faces the Clinical Psychologist in Africa is to select from available ones, tests that are suitable for identifying and assessing the mentally subnormal children in this environment. Haskell and Anderson (1969) were faced with such a task in Uganda. They were charged with the responsibility of providing as full as possible a psychological assessment of pre-selected twenty cerebral-palsied and brain-damaged Ugandan children aged $2\frac{1}{2}$ to 9 years, for whom places would be available at a new special school. Their aim was not only to aid in the selection of the children but also to provide information about their abilities, defects and potentialities which would help their teachers and therapists and provide a base-line for the assessment of the children's future progress. At the time of writing there was neither a locally developed nor locally validated test for that age group. For their study then their subjects were the twenty mentally handicapped and for comparison, four non-handicapped children. The use of such a small number for comparison leaves much to be desired since they were not in any way a representative sample of the population from which the handicapped children were selected.

To these 24 children was administered a battery of non-verbal, relatively "culture-free" tests said to be suitable also for physically handicapped children. The battery consisted of 9 complete tests - Cattell Culture Fair Intelligence Test, Raven's Coloured Matrices, Goldstein-Sheerer Color Form Blocks Test, Koh's Blocks, Compound Series Test - Differential Test Battery (Morrisby) the Bender Visual Motor Gestalt Test, the Benton Memory Test, the Goodenough Draw-a-Man and the Frostig developmental test of visual perception; and 5 items selected from other tests - block tower item, stacking cubes into a box and putting the lid on, building a 3-cube and 6-cube pyramid, copying geometric shapes (circle, cross, square and triangle), and a locally made form board - which included two circles of different sizes, a square, a rectangle and a triangle. These items were administered to each child in the presence of a familiar adult.

Most of the tests are however not free from cultural influence. Jahoda (1956) found that Ghanaian children from literate homes performed significantly better than those from illiterate homes on the Goldstein Sheerer Cube test. Familiarity due to repeated practice have been shown to improve scores on the Raven's Matrice (Jahoda, 1956; Ombredane in Vernon, 1969, p.103). Performance on Koh's Block improved after a two year technical training (McFie, 1961). Draw-a-Man and Cattell Culture fair Intelligence Test are both pencil and paper and may not be suitable for young children who are not familiar with use of paper and pencil. Also Benton Memory Test and Bender-Gestalt Test both involve abstract geometric designs which may be very strange to the children being tested.

The writers did not state whether all the items were administered during the same session or different sessions, and also in what order; nor did they mention the length of time taken for administering the tests. These factors may influence the performance of these $2\frac{1}{2}$-9 year old children, since a very long testing session involving numerous items may lower their level of performance as a result of fatigue. They stated that the Goldstein-Sheerer, subtests 2 and 8 of Cattell, in a few cases Raven's Matrices and the last five items mentioned earlier proved useful but neither the criteria nor the norms used for reaching this decision was mentioned. Any conclusion based on this report should be treated with caution.

Before any of the available tests can be meaningfully used to assess the handicapped African children it should be administered to the normal population so that the handicapped child's performance can be compared with the performance of children raised in the same environment. An attempt to do this was made by Larsen (1971) who was a clinical Psychologist at Chainama Hills Psychiatric Hospital in Lusaka. Faced with the problem of selection of tests for use in assessing the patients at the hospital, Larsen administered selected items from Stanford Binet, Weschler's Intelligence Scale for children (WISC) and also a Picture completion test to small groups (N = 15, 27 and 143) of Zambian primary school children. The samples used were small and unrepresentative since they comprise mostly urban children. Methods of selecting the children and the items, and methods of administering the tests were not stated. Besides the use of the two tests - Stanford Binet and WISC cannot be justified since most of the items used, even though they were said to be non-verbal, are not

familiar to the Zambian children. Therefore the results from these studies cannot be relied on for clinical work.

The other tests available at the hospital include Draw-a-Man, Raven's Progressive Matrices and Leiter International Performance Scale. Zambian norms have not been obtained for these tests hence they cannot be meaningfully used in identifying and assessing the mentally subnormal children. Besides no locally developed test based on the definition of intelligence in this environment is available. Until such a test is available there is need to standardize the available tests which were developed elsewhere, or being developed here, in particular the relatively culture fair ones.

As an interim measure this study is meant to be a preliminary step towards the establishment of a battery of clinical tests, for use in assessing the mentally subnormal children in Zambia.

The three tests used in this study - Panga Munthu, Porteus Maze and a non-verbal conservation tests - are non-verbal performance tests. The preference of performance to verbal tests stems from the need to avoid the communication problems which arise from the multiplicity of languages in Zambia - problems which are also present in many other African countries. Since some of the subnormal subjects were denied school attendance because of their social and mental retardation or were removed from school because of lack of academic progress, it was considered desirable to use tests which need not be related to years of schooling. The tests can also be used for rural children.

These tests can be administered with minimum verbal communication between testee and tester. Besides these practical considerations,

the choice of these particular tests is also based on certain theoretically interesting considerations to be discussed in the next chapter under each test.

Section 5 Aims

The objectives of this study were determined by the need to select tests which will be used for identifying and assessing the mentally subnormal children in Zambia. It was expected that in order to be considered an intelligence test each of the tests chosen should differentiate children of different age groups since the ability to effectively deal with one's environment is expected to improve with age. The tests were also expected to differentiate children considered by society to be of different intellectual abilities, in particular the normal and subnormal children. In view of these requirements, the aims of this study are:-

(a) To compare the performance of children (i) of different ages from an average group in the normal population and (ii) of the same age group but of different abilities.

(b) To find the degree of correlations if any among the three tests and with the school grades. One would expect a moderate degree of positive correlation coefficients if the tests and school grades measure the same factor.

(c) To examine the relationship between the concept of conservation and intelligence and to evaluate the conservation task being used as a possible test of intelligence.

CHAPTER 2

METHOD

Section 1. The subjects:

A total of 213 children participated in this study. This comprised 192 primary school children aged 6-12 years and 21 subnormal children aged 9-13 years. The two sexes were equally represented in the primary school sample while the subnormal sample consisted of 13 males and 8 females.

An attempt was made to control socio-economic factors (Vernon, 1969, pp. 64-68) which might be a source of variance hence all the school subjects were selected from the former non-fee-paying schools. These are government primary schools which prior to 1971 offered free primary education. They were and are still being attended mostly by children from the lower socio-economic homes. Besides the population in these schools is relatively homogeneous with a very negligible, if any, number of non-Zambian children. The children tested were all Zambians. The subnormal children were from the same socio-economic background as normal children.

Selection of subjects

a. The subnormal children: All the children diagnosed as subnormal, aged between 9 years and 13 years were selected from both the Day Care Centre (DCC) and the children's ward of Chainama Hills Psychiatric Hospital. The 11-12 year-old subnormal children were so few that it became necessary to extend the age range selected.

The children at the DCC are moderately subnormal and referred to by the staff as "trainables". They are non-resident but attend the DCC daily (except at weekends) from their homes. They are relatively

independent in that they can feed and dress themselves. They are being taught and seem capable of learning simple tasks like basket making (for the boys), cookery, sewing and knitting (for the girls). The reasons for admission to DCC included retarded milestone development and impaired speech and communication. One child was admitted owing to very poor academic performance in primary school.

In the ward are the resident severely subnormal children who are referred to by the staff as "untrainables" (which seems to be a misnomer in view of results from studies using the conditioning technique with these children (Ullman, L.P. & Krasner, L. (1965)). They are dependent on the staff for their feeding and personal hygiene. Their speech and ~~and~~ language problems are more severe and in some it is difficult to establish meaningful language communication.

On the basis of this classification by the hospital staff the subnormal subjects were then placed into the two categories - moderately subnormal (MSN) and severely subnormal. (SSN)

b. The Normal Subjects: The three former non-fee-paying schools used were selected at random. All six year old children were selected from grade one, all seven year olds from grade two, all eight-year olds from grade three and so on up to twelve year-old children who were selected from grade six.

In each class, children of the appropriate age were selected from the register. Any child whose physical stature appeared to be grossly discrepant with the stated age was excluded from the sample. For example one grade one girl whose stated aged on the register was six years looked so big that, on further questioning both the teacher and the girl it was found the girl was ten years old, and hence was

disquilified. The class teacher was then requested to classify the selected children into very bright, very dull and average categories. This each teacher did on the basis of the children's school performance. Twenty-four children were then randomly selected in each class from the average children for the 7-8 years, 9-10 years and 11-12 years age comparisons. From the 11-12 year group twenty-four very bright and twenty-four very dull children were also randomly selected for the comparison of different intellectual levels. (Table 1)

Table 1

Number of Children of Different Age Groups and Intellectual Levels

	Intellectual levels					
Ages	Bright	Average	Dull	MSN	SSN	Total
11-12 years	24	48	24	10	11	117
9-10 years		48				48
7-8 years		48				48
Total	24	144	24	10	11	213

2. The Tests

The three tests - Panga Munthu Test (PM) non-verbal Conservation Test (CT) and Portues Maze Test (MT) - were administered to each child in that order since the first two involved the same medium, that is plasticine. The Experimenter (E) was assisted by a male Zambian, with a grade 7 certificate, who was specially trained for this project. All the instructions were crosstranslated to ensure that the exact meaning is conveyed through the local language - Cinyanja.

The children were tested individually in their usual school (or hospital) environment during the day - morning hours for those who went to school in the morning and afternoon hours for those who went to school in the afternoon. At the schools a classroom or an office was reserved for this purpose while at the hospital a spare-room at the ward or DCC was made available. E collected the subjects, two at a time, from the classroom with the teacher's permission. The children were told by the teacher (or nurse) that they were going to play some games with this visiting teacher (or sister in the case of the subnormal children) after which they would have some sweets and biscuits. The aims of this approach were to reduce anxiety which might hinder performance of the test (Anastasi, 1970, p.571) especially in the presence of strangers, and to sustain motivation and interest. The effect of this was very marked especially among the younger and subnormal children. Each time E went into the classroom to collect the selected subjects, all the children raised their hands requesting to be selected, and seemed disappointed when not chosen. The two SSN children who initially refused to go with E co-operated after being offered some sweets.

One might expect the children to rush through the tests to obtain their reward quickly but the instructions were such as to emphasize the individual's best performance, so no rush was observed.

a. Panga Munthu Test (PM): One difficulty one faces in choosing a culture fair test is that performance on the test may be greatly influenced by learning including perceptual learning (Serpell, 1972b). One feature of the environment one can consider present in every culture is the basic human form. Any test whose items are based on

the human form may then be considered culture fair. However cultural influences creep into the medium in which the human form is represented. One intelligence test whose items are based on the human form is the Draw-a-Man test (Harris, D.B., 1963). This however is a pencil and paper test and performance on this test requires prior knowledge of how to handle pencil and paper (Biesheuvel, 1949) which the present study hopes to avoid since the battery is also intended for non-school goers both in urban and rural Zambia. Also drawing of the human form with the proper perspective and proportions requires the ability to perceive pictures three dimensionally. Studies have shown that three dimensional perception is related to the degree of Western acculturation (Hudson, 1967) which involves familiarity with the capentered world with the right angled houses and pictures in books. In selecting tests for this study one desires to avoid any item that requires prior contact with the Western culture so that, as mentioned earlier, it can also be used with rural children.

One criterion for the validity of the Draw-a-Man test is age differentiation among Western educated population; but Harris's study (in Serpell 1974, p.12) in Rhodesia showed no improvement with age on this test. It then became of theoretical interest to consider a test which involves the representation of the human form in a medium other than pencil and paper, in this case moulding with plasticine.

The mode of representing the human form using plasticine in an intelligence test was introduced by Serpell (1972a, 1974) in Lusaka. The test is called Panga Munthu Test (PM) which translated means "make a person." In Serpell's (1972a) study children were asked to

copy human models in plasticine or wire (wire modelling is a favorite game among Lusaka boys). He found that in plasticine reproductions there was little difference between Lusaka and Manchester 8 year-olds. Lusaka boys excelled Manchester boys at wire modelling while Manchester boys were better at Draw-a-Man test. Lusaka boys also excelled Lusaka girls at wire modelling. Since clay modelling was found to be popular among Zambian boys and girls and Manchester and Lusaka boys scored about the same in plasticine reproduction, it was decided to use plasticine in this study. In a preliminary study Serpell (1973) reported that Zambian school children showed improvement with age on plasticine reproduction.

In using PM for the present study two modifications were made. The first was in the mode of administration. In the original test the child was shown a "crude" model of the human form for thirty seconds, the model was removed and the child asked to reproduce the model. In the present study there was no model for the child to copy. He was expected to freely produce the human form. The aim is, as probably with the Draw-a-Man test, not to restrict the child's perception, conception and reproduction of the human form which might occur if he were shown a model.

The other modification was in the scoring technique. The original test scored ten items which included nine on body parts and one on proportionality. In the present study there were twenty items to be scored - 12 body parts, 7 proportionalities and one score was reserved for any extra detail. The need for this modification arose from the result obtained by Serpell (1974, p.20) which showed that the distribution of scores among village boys tested, in the age range

9-14 years was negatively skewed so it was hoped that the present form of scoring would show a more normal distribution.

Administration of PM

Requirement: Plasticine and plasticine board.
A table
Two chairs
Stopwatch
Scoring sheet

Procedure:

The Assistant administered this test while E did the scoring. The child was seated on one side of the table, while the Assistant sat on the other chair opposite the child. The Assistant gave the child the plasticine and said, "I want you to use this clay to make me a person. Try to make the best person you can. Tell me when you have finished."

There was no time limit but the time the child took to complete the model was noted. Even though no model was presented, when testing the subnormal children it was sometimes necessary to present the child with a model before he showed some response. With some SSN children who appeared not to have understood the instruction, E rolled the plasticine on the board and encouraged the child to repeat the act. If after twenty trials the child succeeded in copying E, he was then shown the model and the instruction repeated.

When the child completed the model he was given a piece of biscuit to eat while E took away and scored the model using items on the scoring sheet (Appendix 1). Each item was scored one (1) or zero (0) depending on whether it was present on or absent from the model.

An interscorer reliability of .84 (N = 30) was obtained from a preliminary analysis hence E scored the subsequent models alone.

After an interval of five minutes the conservation test was administered.

b. Non-verbal Conservation Test (CT)

According to Piaget's theory of intellectual development the construct of conservation, that is, recognizing the invariant nature of an object in spite of changes in appearance, is a key element in intelligence (Piaget, 1964). One would expect a significant positive correlation between performance on conservation tasks and measures of intelligence. But results from studies on the relationship between ability to conserve and performance on measures of intelligence are equivocal (e.g. Heron, 1971; Bat-Haee, Mehryar, and Sabharwal, 1972.)

The technique being used in this study was first used by Furth (1964) to determine whether deaf children developed cognitive abilities without being impeded by their lack of language. This non-verbal technique was also used in Zambia by Heron and Simonsson (1969) to study "weight" conservation in Zambian children. The procedure to be described is similar to that used by Heron and Simonsson with some modifications which will be mentioned where appropriate. There were three stages. The first was a training session involving actual weights. The next stage was also a training or pretest phase involving plasticine, and finally the actual test in which the plasticine was transformed into different shapes.

Requirement: One table

Two chairs

Placed on the table were two each of weights 10 gram, 20 gram, 50 gram and 100 gram.

Plasticine - 2 equal, 1 smaller

A table-knife

Stopwatch

Scoring sheet.

Procedure:

Preparation of the child: The Assistant explained to the child before the procedure began: "You are going to play another game with this teacher (or Sister if the child was in the subnormal group). A rule of this game is, neither you nor the teacher is allowed to speak." During the training sessions encouragement was however given by a smile and a nod, or by the word "good" if the child did not look up; or by shaking the head and saying "No. Not good" if the wrong response was made.

Training Session: (1) E put a 50 gram weight on the palm of each hand, moved her hands in a horizontal fashion while encouraging the child to look on.

(2) E then gave the child the two 50 gram weights and encouraged the child to repeat the procedure either by horizontal movement of E's hands or by actively moving the child's hands horizontally if there was no response. Steps (1) and (2) were repeated once if necessary.

(3) E placed a 50 gram weight on one hand and a 10 gram weight on the other hand, held first both hands on a horizontal level, then lowered the arm with the 50 gram weight.

(4) Bringing the hands on a horizontal plane, E quickly exchanged the weights and lowered the hand with the 50 gram weight which before had the 10 gram weight.

(5) The child was then given a 10 gram weight on one palm and a 50 gram weight on the other palm and was expected to lower the hand holding the 50 gram weight.

(6) E then exchanged the weights on the child's palm and the child was expected to make the downward movement. If the child did not respond or just stared at E or the weights, E moved the child's hand to show the correct response.

This was a slight modification of Furth's order which was, using above numbers, 1, 3, 4, 1, 2, 5.

(7) After this the following 20 combinations were presented in the order below:

1.	100 gram	10 gram		11.	100 gram	20 gram	
2.	100 "	100 "		12.	20 "	20 "	
3.	10 "	100 "		13.	10 "	20 "	
4.	10 "	10 "		14.	20 "	10 "	
5.	100 "	10 "		15.	50 "	100 "	
6.	50 "	10 "		16.	100 "	50 "	
7.	10 "	50 "		17.	10 "	10 "	
8.	10 "	10 "		18.	20 "	10 "	
9.	50 "	50 "		19.	50 "	100 "	
10.	20 "	100 "		20.	10 "	20 "	

The criterion for learning was based on six successful consecutive trials. A minimum of the above twenty trials was given to all subjects.

If after the twenty trials the subject did not reach criterion the series was repeated. The subject was disqualified after 60 unsuccessful trials. All subjects who reached criterion went on to the pretest session. The number of trials to reach criterion was recorded.

Pretest. The weights were removed out of sight. The child was then shown three balls of plasticine, two of them exactly alike with a diameter of two inches, and the third obviously smaller with a diameter of one inch.

E handed to the child two balls one larger and heavier, the other smaller and lighter to see if the child lowered one hand, E helped if necessary. Comparison of the three plasticines was continued for ten trials in the following order:

1.	One large, one small	6.	One large, one small
2.	One small, one large	7.	Two equal balls
3.	Two equal balls	8.	One large, one small
4.	Two equal balls	9.	One small, one large
5.	One small, one large	10.	Two equal balls.

The criterion for transfer of learning was also six consecutive successful trials. If criterion was not reached by the end of the tenth trial, the series was repeated once making it a total of twenty trials maximum. All subjects who reached criterion in this pretest proceeded to the actual test. The number of trials the subject took to reach criterion was recorded.

The Test: The series consists of thirteen steps. The response sheet (Appendix 2) indicates the two objects handed over to the subject and the alternative responses he may make one of which is

correct. Transformation of the ball into other shapes was done on the table with the child watching E. If the child looked away, a slight tap on the table with the knife, or the word "look" usually restored his attention. (These had to be repeated often for the subnormal children.) The division in half was done with a knife, again in the view of the child. The thirteen steps were repeated once making it 26 trials with each child. In the Furth (1964) and Heron & Simonsson (1969) studies the series were repeated for only the hesitant children. The above modification was used to avoid any confusion that may arise from lack of an objective measure of "hesitant" behaviour.

The child's response on each of the first set of trials was marked with a horizontal line below the response on the response sheet. His response on each of the second set of trials was marked with a vertical line above the response on the response sheet.

At the end of the 26 trials E interviewed the child to find out what the hand movements meant to him. This was to find out what exactly the children were conserving - weight, size or volume. E said: "In this game you were moving your hands like this (horizontal movement without the balls). What does this mean?" The question was repeated for downward movement of one hand and the child's response was recorded.

At the end of this test, the child was given a sweet.

Scoring: Besides being a test for conservation this non-verbal technique was also viewed as a possible tool for assessing not only the present intellectual level of the child brought to the Clinical Psychologist, but also a tool for assessing his learning potential.

(Haynes, 1971; Haskell & Anderson, 1969). Performance on this test would reflect (a) the child's ability to learn the concept involved in the conservation task (training and pretest phases) (b) his ability to remember what was learnt (base items 1, 4, 7, 11, 13) (c) his ability to transfer what was learnt (dividing items 3, 6, 12) and (d) his ability to utilize the knowledge of the concept in dealing with the critical items (2, 5, 8, 9, 10).

With these points in mind, the scores on this test were arrived at as shown below:

1. Learning and pretest scores:

Trials before Criterion	Credits
0-12	5
13-24	4
25-36	3
37-48	2
49-60	1
61 and over	0

2. Test items scores:

Control	(Base items	5 x 2 = 10)	= 16
	(dividing	3 x 2 = 6)	
Critical items		5 x 2	= 10

Thus the maximum score on this test was 31 points for the psychometric assessment.

Criterion for Conservation: This was based on performance on the critical items. The two criteria used in this study were (a) a total of 5 out of 10 correct responses or (b) a total of 4 out of 5 correct responses during the second trial session.

After an interval of ten minutes the Porteus Maze Test was administered.

c. The Porteus Maze Test (MT)

The Porteus Maze Test has been used among many ethnic groups (Vernon 1969, p.142) and in several psychological clinics for diagnosing mental subnormality. It has also been shown to correlate positively with other intelligence tests (Porteus, 1965, p.19). It was first developed in 1914 by Stanley Porteus for use in selecting children for special school for the retarded.

The Mazes can be administered with non-verbal instructions by using the easier Mazes for instruction but in the present study the instructions recommended by Porteus were used after cross-translations into Cinyanja. The designs of the original version were used since they range from the three-year to adult level. The original test involves the use of pencil to trace the correct path through the maze. Since one aim of this study is to select tests which do not require pencil and paper, the designs on the paper test (shown at the Appendix) were all transferred onto wood which is coloured white with oil paint. The lines were replaced by wooden relief one centimeter high and 0.7 centimeter wide. The board is .5 cm thick. The smallest board is 35.5 cm long and 25.2 cm wide while the largest is 50.5 cm x 50-5 cm. The width of the Maze paths is 3.3 cm. A stick was used to trace the Maze path instead of pencil.

Requirement: 1. Year III to Adult 1 of the Vineland revision of the Porteus Mazes constructed on wood with relief.

2. A thirty centimeter long stick with diameter of one end not more than $\frac{1}{4}$ of the width of the maze path.

3. Two chairs

4. Two tables

5. A stopwatch

6. Scoring sheet.

Procedure:

The rules and instructions recommended by Porteus (1965) were adhered to. Any modifications made are noted below where appropriate.

The child was seated on the chair beside a table while E sat on the other chair opposite him. All the Maze boards were placed on another table with the Maze side facing downwards and all arranged in the order to be presented with Year III Maze on top and Adult 1 maze at the bottom. E gave the stick to the child, placed the board on the table with the Maze side upwards and then the Assistant gave the appropriate instruction in Cinyanya. At Chainama Hills Hospital the student nurses (all with O level G.C.E. and in their second year of training) assisted in translating the instructions into each child's language if the child did not understand Cinyanja.

Year III.E said:

"I want to see whether you can use this stick to go all round between these walls without touching the walls. You go like this." E then demonstrated by starting at the arrow and moving the stick between the wooden reliefs and then proceeding just around the first

angle. The child was then given the stick and told to start. Three trials were given and each trial was considered successful if the child touched the wall not more than three times.

Year IV. E said:

"Do this the same way. Begin here (indicating starting arrow) and go right round without touching any of the walls."

Three trials were allowed and if the child touched the wall during the second trial his attention was drawn. Each trial was scored successful if the wall was touched not more than three times.

Year V. E said:

"Kalulu[1] went in here (E took the stick and indicated the arrow, and moved the stick from the arrow to the first turn) to try and get some food from there (E pointed to the end of the maze). Now I want you to use this stick and show me which way Kalulu will go to find the food. You must be careful not to touch the walls with the stick. Do not go into any road that is blocked at the other end. If you go into any blocked road, you cannot turn around and come out. You must start from the beginning. One more thing you must remember, you can stop anywhere and look as long as you like, but try not to lift your stick off the road until you reach where Kalulu will get his food."

Two trials were allowed. A trial was considered successful if there was no entry into a blocked end.

Year VI. E said:

"This is another game like the last one. Begin here and show me with the stick the road Kalulu will take to get his food. Do

---

[1]Kalulu (the rabbit) is a folk hero in many Zambian children's stories.

not touch or jump over any walls. Also do not go into any blocked road."

Two trials were allowed. Each trial was scored as successful if there was no blind entry.

Year VII.E said:

"I want you to suppose that this is a township with many roads. There are short walls on each side of the roads. You can imagine that you are walking in here (E points to the starting point marked S) and you have to find your way out there (E pointed to the exit arrow). Use this stick and show me which road you will take to come out.

"You must be careful not to touch any of the walls and not to go into any blocked road because if you do so you cannot turn around and go backwards. If you go into a blocked road you must start from the beginning. You can stop anywhere as long as you like while you decide which way to go, but try not to lift the stick from the road and do not touch any wall. Start as soon as you are ready."

Two trials were allowed.

Year VIII, IX, X. E said:

"Begin here and find your way out" E pointed to the starting arrow, but not to the exit.)

Two trials were allowed.

Year XI. E said:

"Begin here in the center and find your way out."

Two trials were allowed.

Year XII, XIV, and Adult 1. E said:

"Begin here in the center and find your way out."

Four trials were allowed.

Scoring Procedure

Each trial was considered unsuccessful if the child lifted the stick or entered a blocked end. If he was unsuccessful in all the trials allowed for any year a failure was recorded; that is three unsuccessful trials for year III and IV, two for year V to year XI and four for Years XII, XIV and Adult 1 levels. Testing and scoring were discontinued after three failures anywhere in the series have been recorded or two successive failures in Year XI or above. There was no time limit. Each successful trial above 4 year level earned $\frac{1}{2}$ credit. There is a maximum of 17 credits, that is, test age of 17 years).

Of more relevance to this study is the quantitative scoring. However the qualitative errors were also recorded since they may be useful in assessing the behaviour of the subnormal children. The qualitative errors to be scored include blind entries occurring at the First Third (FT) of the maze, blind entries occuring at the Last Third (LT) of the maze, touching the wall (TW), Lifting the Stick (LS), jumping the wall (JW) and changing direction (CD). (Appendix 3)

d. School Marks:

The scores obtained by the children in their second term examination were obtained from the teachers. These scores were all converted to standard scores to make them comparable.

CHAPTER 3

RESULTS

Section 1. Analysis of Data: Steps a, b and c apply to each test while steps d and e apply to the conservation test.

(a) The frequency distributions of the scores for each of the age groups 7-8 years, 9-10 years and 11-12 years were plotted on the graph. The analysis of variance for a 2 x 3 factorial design and Duncan's multiple range test for equal numbers of samples (McNemar, 1969, ch. 16) were used to determine the effects of sex and age, to evaluate the significance of any differences between the means of the scores of the different age groups, and any interaction between age and sex. The significance of the differences between the two sexes in each age group was determined by means of t-tests.

(b) For the five intellectual groups - SSN, MSN, Dull, Average and Bright - the frequency distributions of scores were also plotted. A one way analysis of variance and Duncan's multiple range test for unequal samples were used to determine the significance of the intellectual factor and to evaluate the significance of the differences between the mean scores.

(c) The relationships among the three tests and school marks were evaluated by means of product moment correlations. Also multiple correlations between the tests and school marks were determined for different groups- 7-10-year-olds and 11-12 year-olds. Beta weights were noted. The

intercorrelations among the three tests were also determined for the subnormal children (N = 21) and the children in the five intellectual groups.

(d) The normal subjects were classified into conservers and non-conservers on the basis of the criteria mentioned earlier and their scores on PM, MT, CT and School Marks (as Z Scores) were compared by means of t-tests.

(e) Since the CT is being considered as a possible psychometric test, the correlations among its subtests-learning, control and critical - and also the total score were determined, as well as the Multiple correlations between these sub-tests and the total score. The beta weights were also noted.

The product moment correlations, and multiple correlations were done by University of Zambia computer center. The analysis of variance was done by E using portable Computer (Compucon).

Section 2. Panga Munthu Test (PM)

(a) Age differences: The distribution of scores for each group (of the average children) is shown on the graph on Figure 1. The means and standard deviations are shown on Table 2, (for the three tests used in this study). These show progressive increase in mean score from the youngest age group. The analysis of variance shown on Table 3 indicate a significant age effect with an F-ratio of 13.66, $p < .005$. Duncan's new multiple range test (Table 4) shows that the mean scores of the three age groups differ significantly at $p < .05$ level.

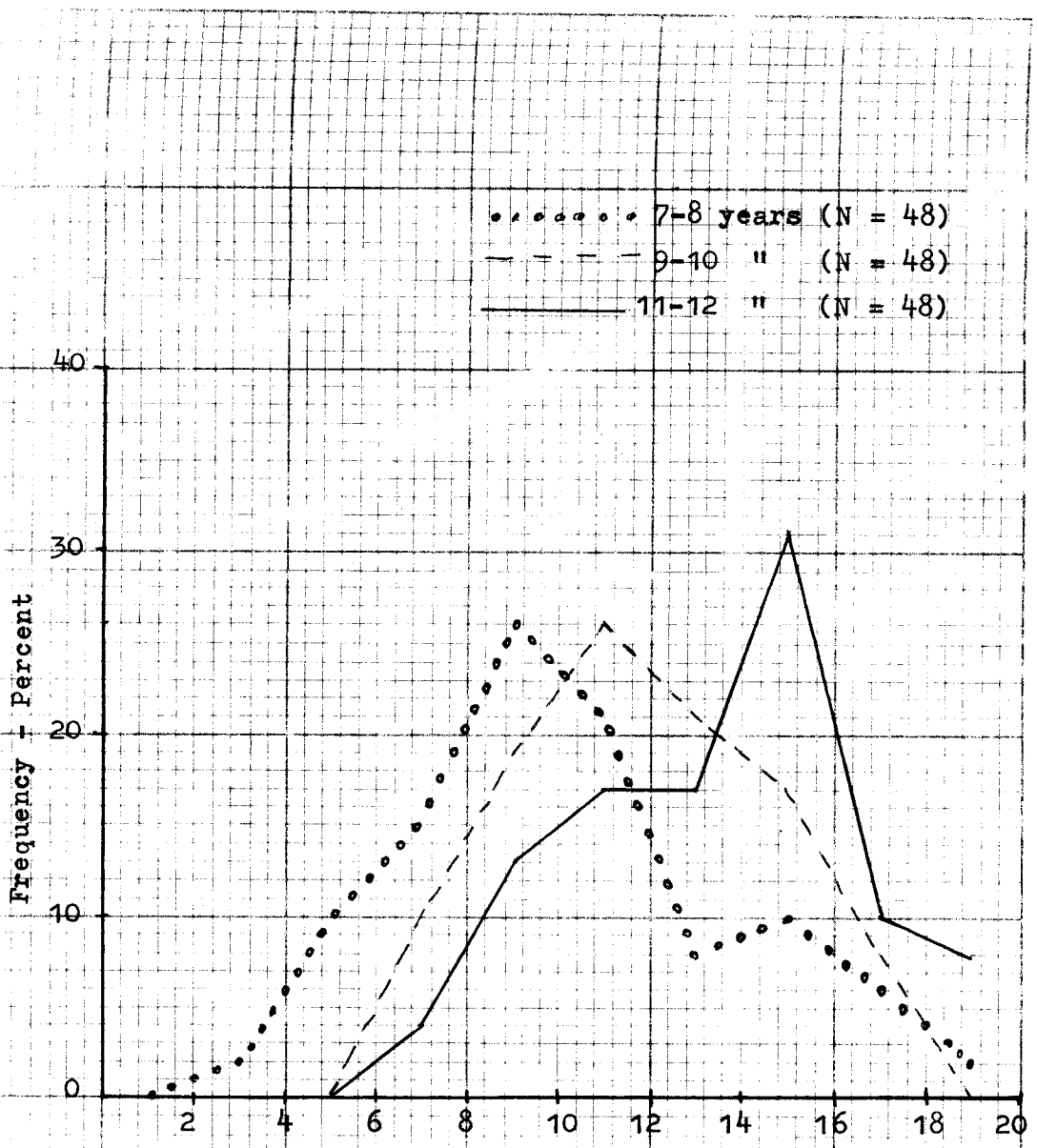

Fig. 1: Panga Munthu Test

Age differences

Table 2

Test scores for three age groups of children

		The Tests		
Age Group	N	PM	MT	CT
11-12 years	48			
Mean		13.90	12.42	26.35
SD		3.08	2.73	4.48
9-10 years	48			
Mean		12.40	10.19	21.22
SD		2.89	2.64	6.02
7-8 years	48			
Mean		10.63	8.23	18.04
SD		3.66	2.08	7.86
Maximum Score		20	17	31

Table 3

Analysis of variance for 2 x 3 (sex x age)

Factorial Design: PM

Source of Variation	Sum of Squares	df	Mean Squares	F
Sex	153.51	1	153.51	16.4
Age	257.39	2	128.69	13.66
Sex x age	11.5	2	5.75	<1
Within Treatment	1302.19	138	9.42	
Total	1724.6			

Table 4

Duncan's New Multiple Range Test Applied to

Differences between Age Means: PM

		7-8 yrs	9-10 yrs	11-12 yrs	Studentized Range			Shortest Significant Range
	Mean	10.62	12.39	13.89	at .05		Std. error	
7-8 yrs	10.62		1.77	3.06	2.772	x	.44	1.21
9-10 yrs	12.39			1.50	2.918	x	.44	1.27

7-8 years // 9-10 years // 11-12 years

b. Sex differences:

Analysis of variance (Table 3) also shows a significant sex effect with an F-ratio of 16.4, $p < .005$. A closer examination of the mean scores for the two sexes (Table 5; Fig. 2) reveals that males scored higher than females. The mean differences are significant at $< .025$ at age groups 7-8 years and 11-12 years, but at 9-10 years it is short of being significant, $p < .1 > .05$. These were determined by means of t-tests. The interaction between sex and age is insignificant (Table 3) with an F-ratio less than one and the lines on Fig. 2 tending to parallel.

C. Intellectual Groups:

Fig. 3 shows the distributions of the scores of the five groups - SSN, MSN, Dull, Average and Bright. There seems to be a great deal of overlap between the Dull, Average and Bright groups. There is clear separation of the scores of the normal sample and the subnormal children who scored lower. Within the subnormal sample there is clear separation of the MSN and SSN children with 73% of the latter

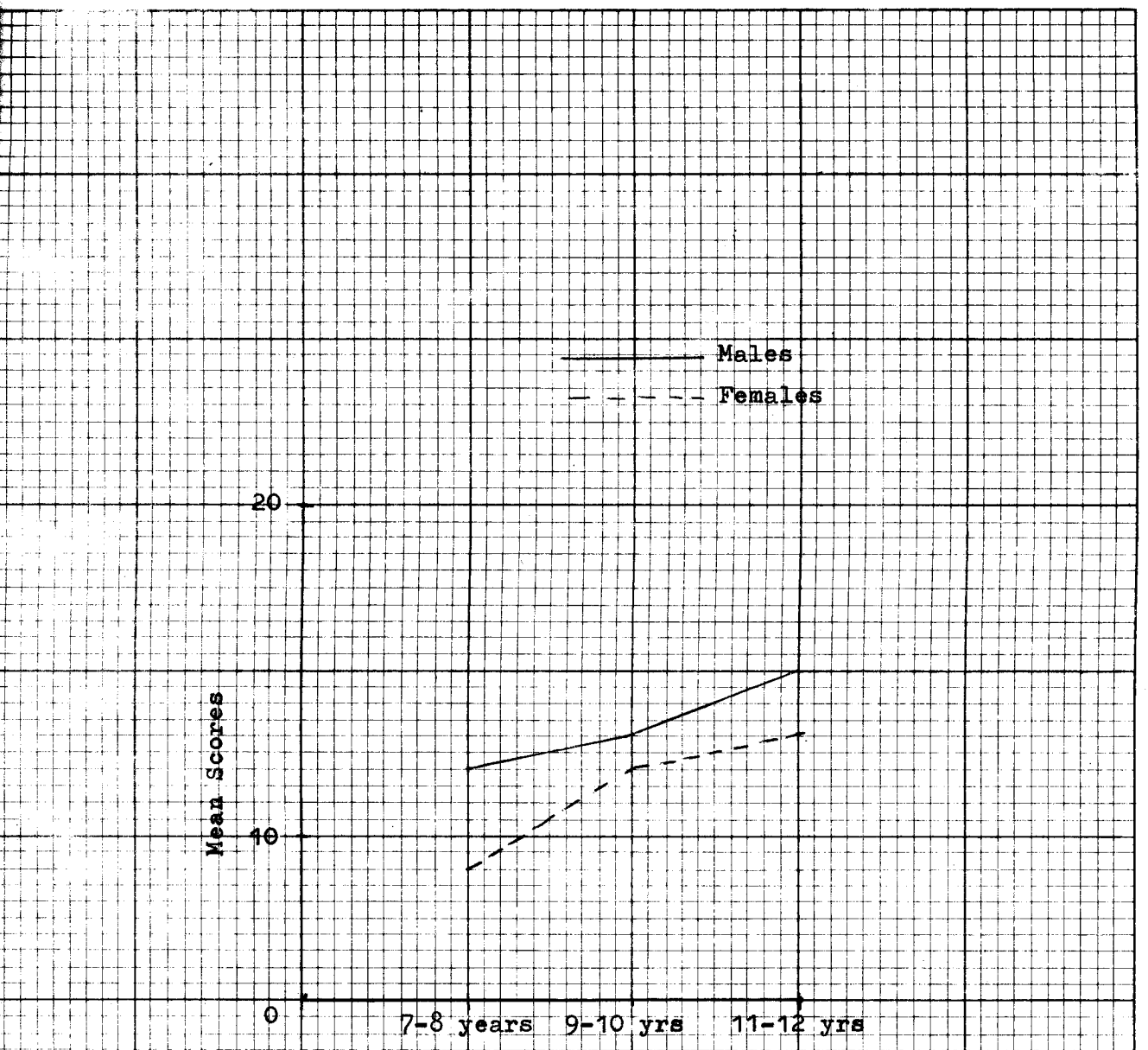

Fig. 2: Panga Munthu Test:
Age x Sex Interaction

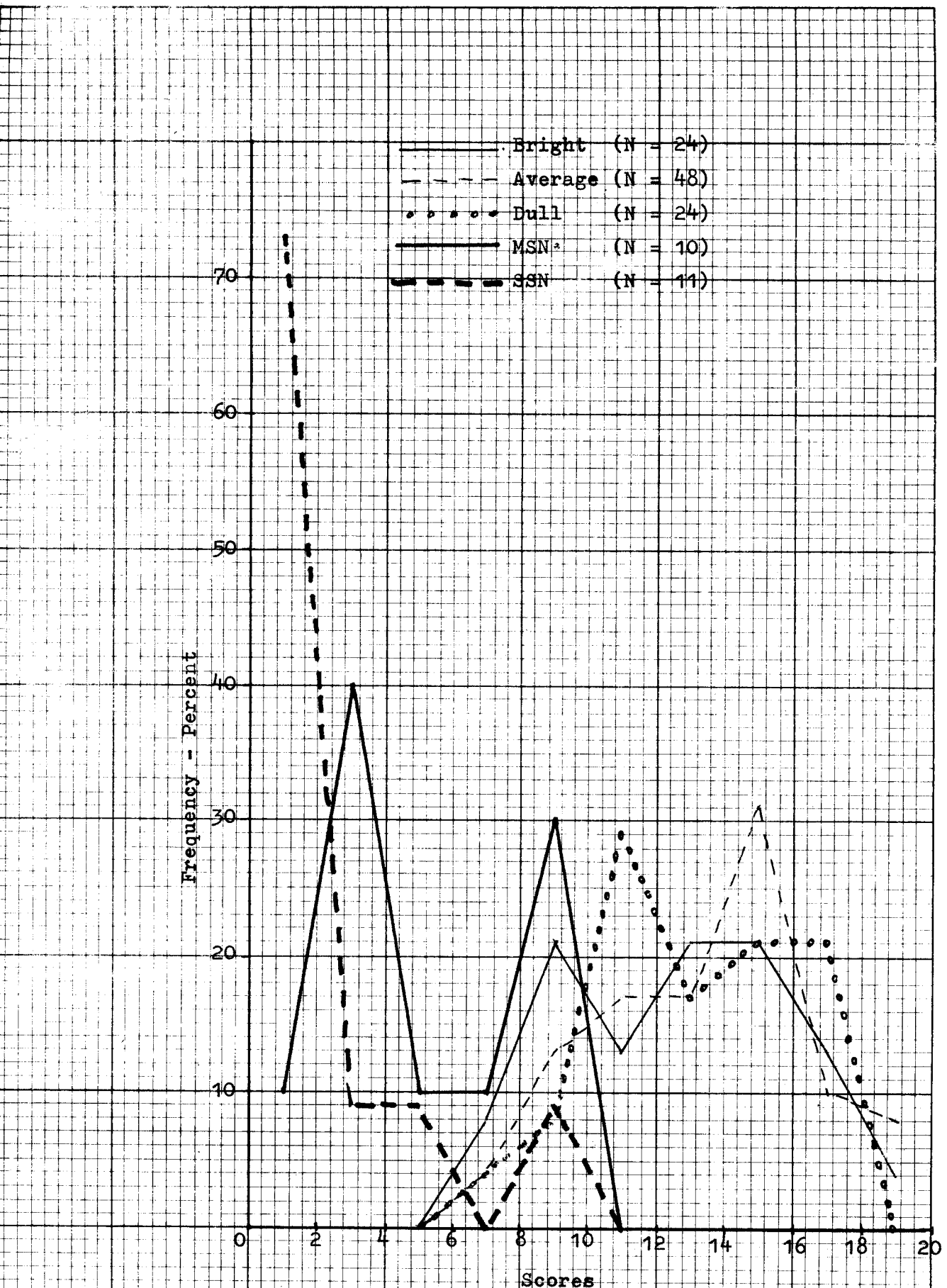

Fig. 3: Panga Munthu

Intellectual groups

Table 5

Mean, SD for 3 age groups & for Males and Females.

Also t value for difference between Male & Female Means PM.

Age group	Males & Females	Males	Females	t	p
11-12 years					
N	48	24	24		
Mean	13.90	14.96	12.83	2.39	$<.025$
SD	3.08	2.58	3.23		
9-10 years					
N	48	24	24		$<.1$
Mean	12.40	13.13	11.65	1.45	$>.05$
SD	2.89	3.25	2.32		
7-8 years					
N	48	24	24		
Mean	10.63	11.96	9.29	2.52	$<.025$
SD	3.66	3.96	2.82		
Maximum Score	20				

scoring zero as against 10% of the former. The mean scores and standard deviation for the groups are shown on Table 6. One way analysis of variance (Table 7) shows a significant between-group variation with $F = 47.71$, p .005. There are no significant differences between the means of the Dull, Average, and Bright children. The means of the MSN and SSN, and MSN and Dull differ significantly at .05 level (Table 8).

Table 6

Test Scores for the Five Different Intellectual Groups

Group	N	The Tests PM	MT	CT
Bright	24			
Mean		13.08	13.18	25.50
SD		3.44	2.36	5.44
Average	48			
Mean		13.89	12.42	26.35
SD		3.01	2.73	4.48
Dull	24			
Mean		14	11.72	21.16
SD		2.90	2.45	7.16
MSN	10			
Mean		5.80	5.75	3.60
SD		3.85	1.60	7.65
SSN	11			
Mean		1.54	1.54	.72
SD		2.98	2.25	2.41

Table 7

Analysis of Variance; SSN-Bright

5 Intellectual Levels - Panga Munthu Test

Source of Variances	Sums of Squares	df	Mean Square	F
Between Group	1899.19	4	474.79	47.71
Within Group	1114.81	112	9.95	
Total	3014.00	116		

d. Correlation with other tests and with school grades:

The product moment correlation coefficients between PM, MT, CT, and School Marks are shown on Tables 9 to 12 for different groups of subjects.

On Table 9 are the correlation coefficients(rs) for 90 normal children aged 7-10 years. For PM and MT is r = .36; between PM and School Marks r = .31. Both rs are low but significantly different from zero correlation at $p < .05$. Between PM and CT r = 0.17 and is insignificant, $p > .05$.

The beta weight of PM in the Multiple correlation between the tests and school grades is 0.31, the highest value of the three tests.

Table 10 shows the correlation coefficients rs for age group 11-12 years, (including dull, average and bright children, N = 89). Here the picture is different from that presented by the younger age group. The correlation coefficients between PM and other tests are very low and insignificant. The beta weight is very low, in fact the lowest of the three tests.

Table 11 shows correlation coefficients for the scores obtained by the five intellectual groups on the three tests. The correlations are high and significant. Between PM and MT r = .72, PM and CT r = 0.66. With the subnormal sample only (N = 21), between PM and PT, r = 0.82; with PM and CT, r = .41 - both significant at p = .05 (Table 12).

Table 8

Duncan's New Multiple Range Test Applied to

Differences between 5 unequal Means

Panga Munthu Test

		SSN		MSN		Bright		Average		Dull	
	Mean	1.54		5.80		13.08		13.89		14	
				*dbm	at .05 **ssr	dbm	ssr	dbm	ssr	dbm	ssr
SSN	1.54			4.26	2.61	11.54	2.29	12.35	2.23	12.46	2.37
MSN	5.8					7.28	2.38	8.09	2.33	8.20	2.47
Bright	13.08							.81	1.65	.92	1.90
Average	13.89									.11	1.65

*dbm = difference between means.

**ssr = shortest significant range.

SSN//MSN//Bright Average Dull

Table 9

Product Moment rs between three tests (& School Marks)

Administered to children aged 7-10 years (N = 90)

	PM	MT	CT	School Marks
PM	1.00			
MT	0.36*	1.00		
CT	0.17	0.31*	1.00	
Marks	0.31*	0.09	0.20**	1.00
Beta Wts.	0.31	-0.07	0.18	
Multiple r		0.35		

* $p < .005$

** $p < .05$

Table 10

Correlations between three tests, Marks of normal 11-12 year-old children (N = 89)

	PM	MT	CT	Marks
PM	1.00			
MT	0.12	1.00		
CT	-0.01	0.17	1.00	
Marks	0.02	0.17	0.27*	1.00
Beta Wts.	0.01	0.13	0.25	
Multiple r		0.30		

*p $<$ .005

Table 11

Correlations among the three tests; SSN-Bright (N = 117)

	PM	MT	CT
PM	1.00		
MT	0.72*	1.00	
CT	0.66*	0.73	

*p $<$ .005

Table 12

Correlations among three tests: MSN & SSN (N = 21)

	PM	MT	CT
PM	1.00		
MT	0.82*	1.00	
CT	0.41**	0.34	1.00

**p $<$ .05

e. Extra items included by subjects:

As mentioned earlier one score was reserved for any extra details included by the subjects which are not among the items on the scoring sheets. The following are the extra items included. Their frequencies of occurence among all the children tested are enclosed in brackets.

Hair	(24)	Penis	(1) (by a MSN child)
Breasts	(21)	Eyelashes	(1)
Fingers	(17)	Prominent lip	(1)
Umbilicus	(16)	Ear proportion i.e. relation of width to length	(3)
Eyebrow	(9)		
Toes	(7)		

Only details of the human form were considered in analysing the result. The following items of clothing were however observed - Hat (10), Shoes (1) Tie (1) and Skirt (1). Other items included shopping basket (1), footbal on foot as if being kicked (1) and baby being carried on back (1).

f. Panga Munthu and the subnormal:

Some observations made of the subnormal children are worth mentioning. Nine of the ten MSN children produced the human model. The only child who did not produce a model continued to roll the plasticine intermittently on the table. Of the eleven SSN children only three produced human models; one of these copied from a model presented to him by the tester. One of the remaining children imitated the rolling of the plasticine by the tester but failed to copy from a human model presented to him. The common response from the rest of the children, following the instruction, was to knock the plasticine on the table

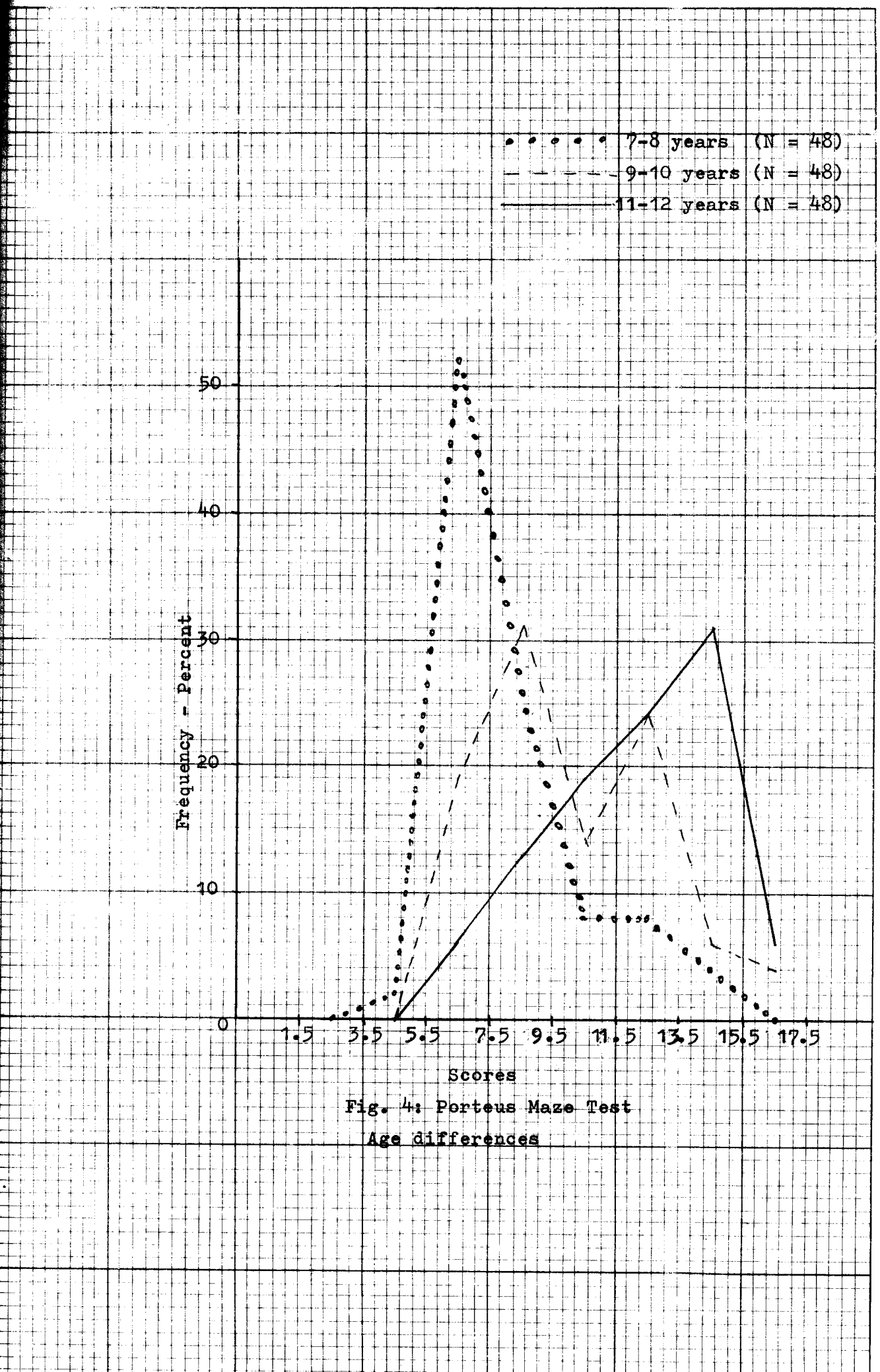

Fig. 4: Porteus Maze Test
Age differences

or roll it between the palms. One child put the plasticine into his mouth each time it was given to him. He neither attempted to imitate the rolling of plasticine nor made any human model. Hence eight out of eleven SSN children scored zero on this test.

Section 3. Porteus Maze Test (MT)

a. Age differences: Figure 4 and Table 2 show the age scores on this test. The age effect is significant (Table 13) with $F = 36.88$, $p < .05$. The differences between the mean scores of the three age groups are statistically significant, $p < .05$ (Table 14).

Table 13

2 x 3 Analysis of Variance, Porteus Maze

Source of Variances	Sum of Squares	df	Mean Square	F
Sex	99.17	1	99.17	17.90
Age	408.72	2	204.36	36.88
Sex x Age	12.75	2	6.37	1.14
Within Treatment	765.32	138	5.54	
Total	1285.96			

Table 14

Duncan's New Multiple Range Test Applied to

Differences between Age Means: Porteus Maze Tests

		7-8 yrs	9-10 yrs	11-12 yrs	Studentize Range		Shortest Significant Range
	Means	8.23	10.19	12.42	at .05	Std. error	
7-8 yrs	8.23		1.96	4.19	2.772 x	.34	0.94
9-10 yrs	10.19			2.23	2.918 x	.34	0.99

7-8 // 9-10 // 11-12

b. Sex differences:

There is also a significant sex effect with $F = 17.90$, $p < .05$ (Table 13). Through all the age groups the males obtained higher scores which are not significantly higher than the females scores at the 7-8 year group, but the differences are significant for the 9-10 year group and 11-12 year group, $p < .05$ (Table 15; Fig. 5). There is some interaction between sex and age but it is insignificant.

Table 15

Mean, SD for 3 age groups, Males & Females.

Also t for difference between Male & Female Means

Porteus Maze Test

Age Groups	Males & Females	Males	Females	t	p
11-12 years					
N	48	24	24		
Mean	12.42	13.69	11.17	3.19	< 0.01
SD	2.73	1.72	3.00		
9-12 years					
N	48	24	24		
Means	10.19	11.02	9.38	2.16	< 0.05
SD	2.64	2.38	2.68		
7-8 years					
N	48	24	24		
Mean	8.23	8.69	7.7	1.53	> 0.05
SD	2.08	1.94	2.15		
Maximum Scores	17				

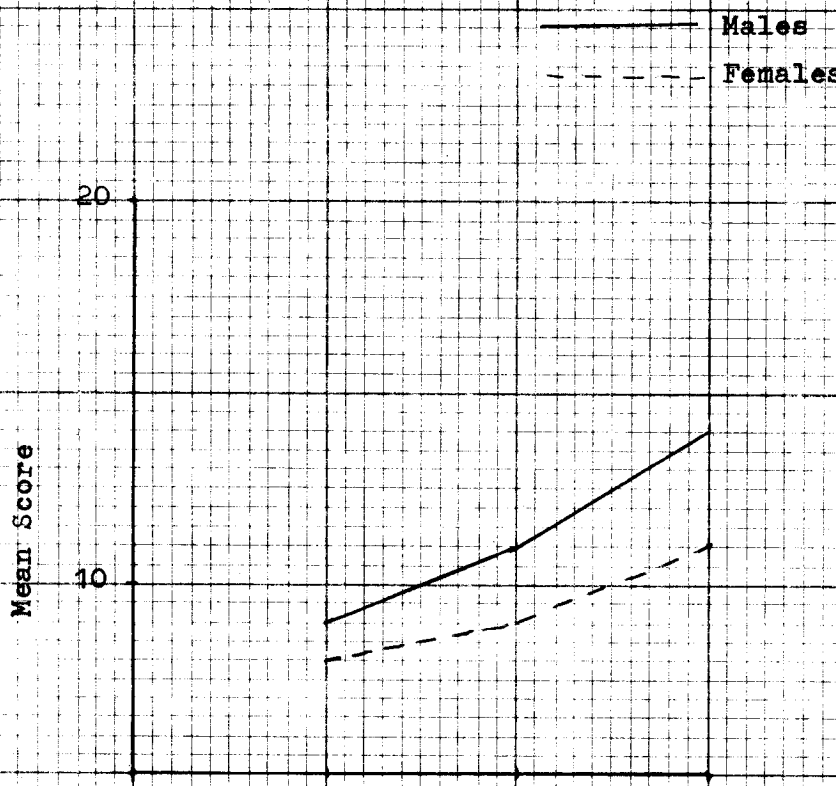

Fig. 5: Porteus Maze Test
Age x Sex Interaction

C. Intellectual groups:

Figure 6 shows the distribution of scores for the five intellectual groups. The mean scores and standard deviation for each group are shown on Table 6. The differences in the mean scores of the three groups from the normal population (Dull, Average and Bright) are not significant (Table 17). The significant between-group variation shown on Table 16, F = 57.71, p .05 is due to the differences between the Dull and MSN, and between MSN and SSN children.

Table 16

Analysis of Variance for 5 Intellectual levels

SSN-Bright; Porteus Maze Test

Source of Variation	Sums of Squares	df	Mean Square	F
Between Group	1477.56	4	369.39	57.71
Within Group	714.86	112	6.38	
Total	2192.42	116		

d. Correlations with other tests and with School Marks

As shown on Table 9, the correlations between MT and PM, and MT and CT at 7-10 years age group are low (r = .36, and r = .31 respectively) but significantly differ from zero at $p < .05$. MT correlates significantly with School Marks even though its beta weight is low at -0.07. At the upper age level, 11-12 years the correlations between MT and the other three variables are insignificant (Table 10). Also the beta weight is low. If however the scores of all the children (N = 117) in the five intellectual groups are considered, (Table 11) the correlation coefficients are high,

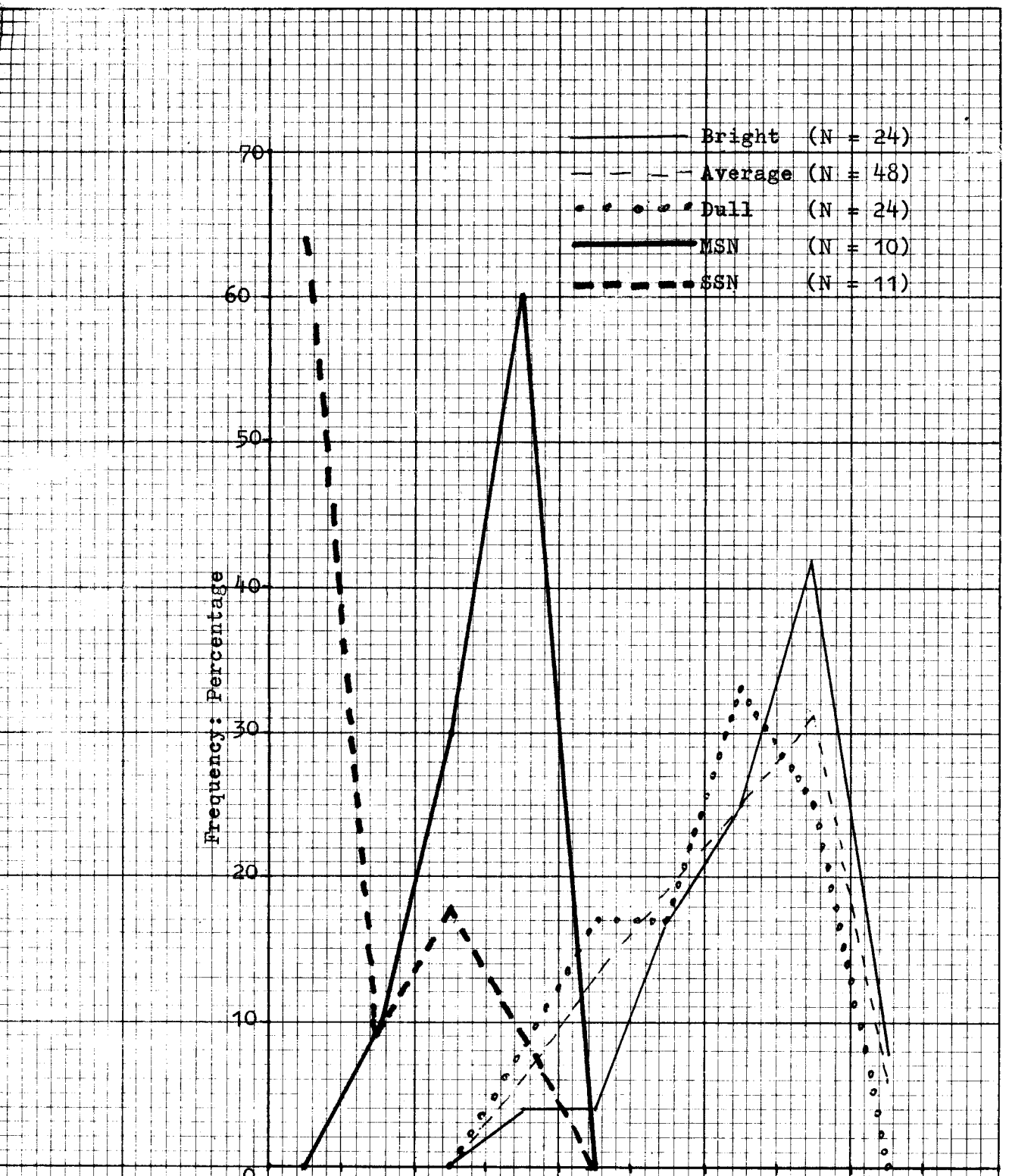

Fig. 6: Porteus Maze Test
Intellectual Groups

Table 17

Duncan's New Multiple Range Test Applied to

Differences between 5 unequal Means

Porteus Maze Test

		SSN		MSN		Dull		Average		Bright	
Mean		1.54		5.75		11.72		12.42		13.18	
				dbm*	at .05 ssr**	dbm	ssr	dbm	ssr	dbm	ssr
SSN	1.54			4.21	2.11	10.18	1.85	10.88	1.76	11.64	1.96
MSN	5.75					5.97	1.92	6.67	1.84	7.43	2.04
Dull	11.72							0.70	1.30	1.46	1.57
Average	12.42									0.76	1.33

* dbm = differences between means

** ssr = shortest significant range.

SSN// MSN// Dull Average Bright

hence for MT and PM, r = .72, and MT and CT, r = .73. Looking at the subnormal sample only (N = 21) MT correlates highly (r = .82) with PM, but with CT, r of .34 is low and insignificant (Table 12).

e. Qualitative Observation

With the normal sample the usual causes of unsuccessful trial were entering blocked path and lifting the stick. But the subnormal children exhibited some peculiar behaviour. Some SSN children made no response at all but gazed into space, refusing to handle the stick inspite of coaxing and offers of sweets and biscuits which they readily took. One SSN child took the stick but knocked it on the board and

then placed it back on the board in spite of repeated instructions by the nurse. (It was sometimes necessary to request the help of the ward staff who were familiar to the children). The commonest error among the subnormal children who started on the test was going over the relief, that is "jumping the wall" to enter the next path.

Section 4. Conservation (CT)

a. Age differences: The mean scores obtained by the three age groups on CT are shown on Table 2 while Figure 7 shows the distribution of scores for each age group. Like in the other two tests, mean scores on this test increase with age. The age effect is significant, $F = 23.22$, $p < .05$. The differences in the means of the the three age groups are significant at $p < .05$ level (Table 19).

Table 18

2 x 3 Analysis of Variances

Non-Verbal Conservation Test

Source of Variance	Sum of Squares	df	Mean Square	F
Sex	134.17	1	134.17	3.71
Age	1677.87	2	838.93	23.22
Sex x Age	49.28	2	24.64	.68
Within Treatment	4984.68	138	36.12	
Total	6845.44			

b. Sex effect: This is insignificant. Even though the males scored higher than the females in the three age groups t-test results show that the differences between the scores are insignificant (Table 20). The sex age interaction is small and insignificant (Table 18).

Table 19

Duncan's New Multiple Range Test Applied to

Differences between Age Means: CT

		7-8 yrs	9-10 yrs	11-12 yrs	Studentized Range	Shortest Significant Range
	Means	18.04	21.22	26.35	at .05 Std. error	2.48
7-8 yrs	18.04		3.18	8.31	2.772 x .86	
9-10yrs	21.22			5.13	2.918 x .86	2.51

7-8 years// 9-10 years // 11-12 years

Table 20

Mean, SD for 3 age groups, Males & Females; t for

Differences between Male & Female Means: CT

Age Group	Males & Females	Males	Females	t	p
11-12 years					
N	48	24	24		
Mean	26.35	27.54	25.17	1.84	Insignificant
SD	4.48	4.02	4.69		
9-10 years					
N	48	24	24		
Mean	21.22	21.58	20.88	0.40	Insignificant
SD	6.02	6.09	6.05		
7-8 years					
N	48	24	24		
Mean	18.04	19.58	16.46	1.36	Insignificant
SD	7.86	7.08	8.46		
Maximum Score 31					

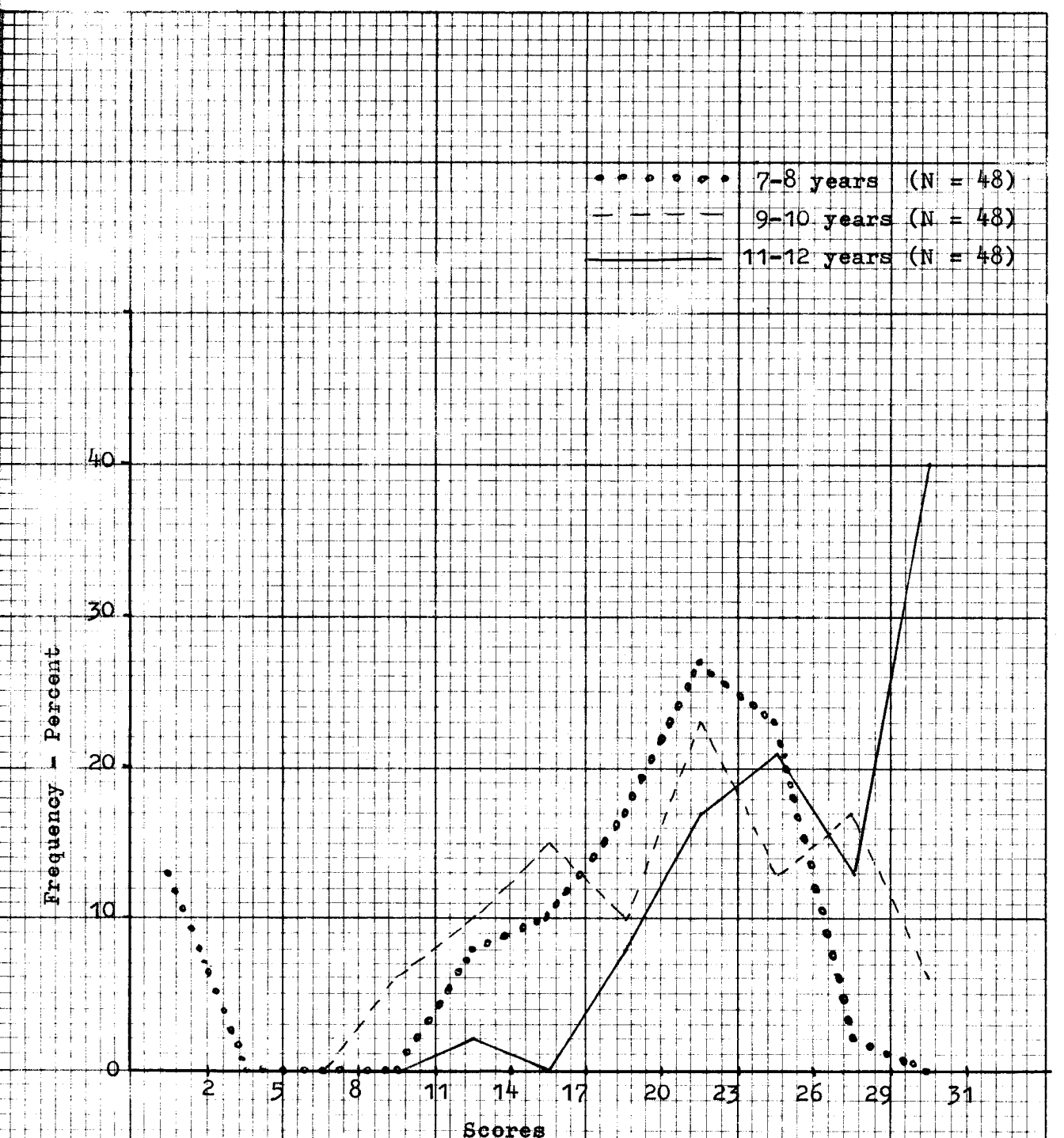

Fig. 7: Non-Verbal Conservation Test
Age Effect

Fig. 8. Non-Verbal Conservation Test
Age x Sex Interaction.

c. Intellectual Groups:

Results on this test differ from the other two tests considered. (Tables 6, 21, and 22) There is a significant between-group variation $F = 77.72$, $p < .05$ (Table 21). However the graph on Figure 9 shows a high degree of overlap of scores of the Average and Bright groups. The subnormal groups are clearly separated from the Dull group, and the Dull group is clearly separated from the average group. This same picture emerges from Duncan's multiple range tests which show no significant differences between the scores of Bright and Average children. But the differences between the MSN and Dull, and between Dull and Average children are significant at .05 level.

Table 21

Analysis of Variance for 5 Intellectual groups

SSN-Bright: CT

Source of Variation	Sums of Squares	df	Mean Square	F
Between Group	9404.39	4	2351.09	77.72
Within Group	3388.91	112	30.25	
Total	12793.30	116		

d. Correlations with other tests and school marks:

Some of these have been mentioned earlier. At the 7-10 years age level, correlations between CT and the other variables are very low. With PM r of .17 is insignificant; with MT, r is low .31 but significant at .05 level, while with School Marks it is very low r = .20 though significant at .05 level. Its beta weight is a low of .18 (Table 9).

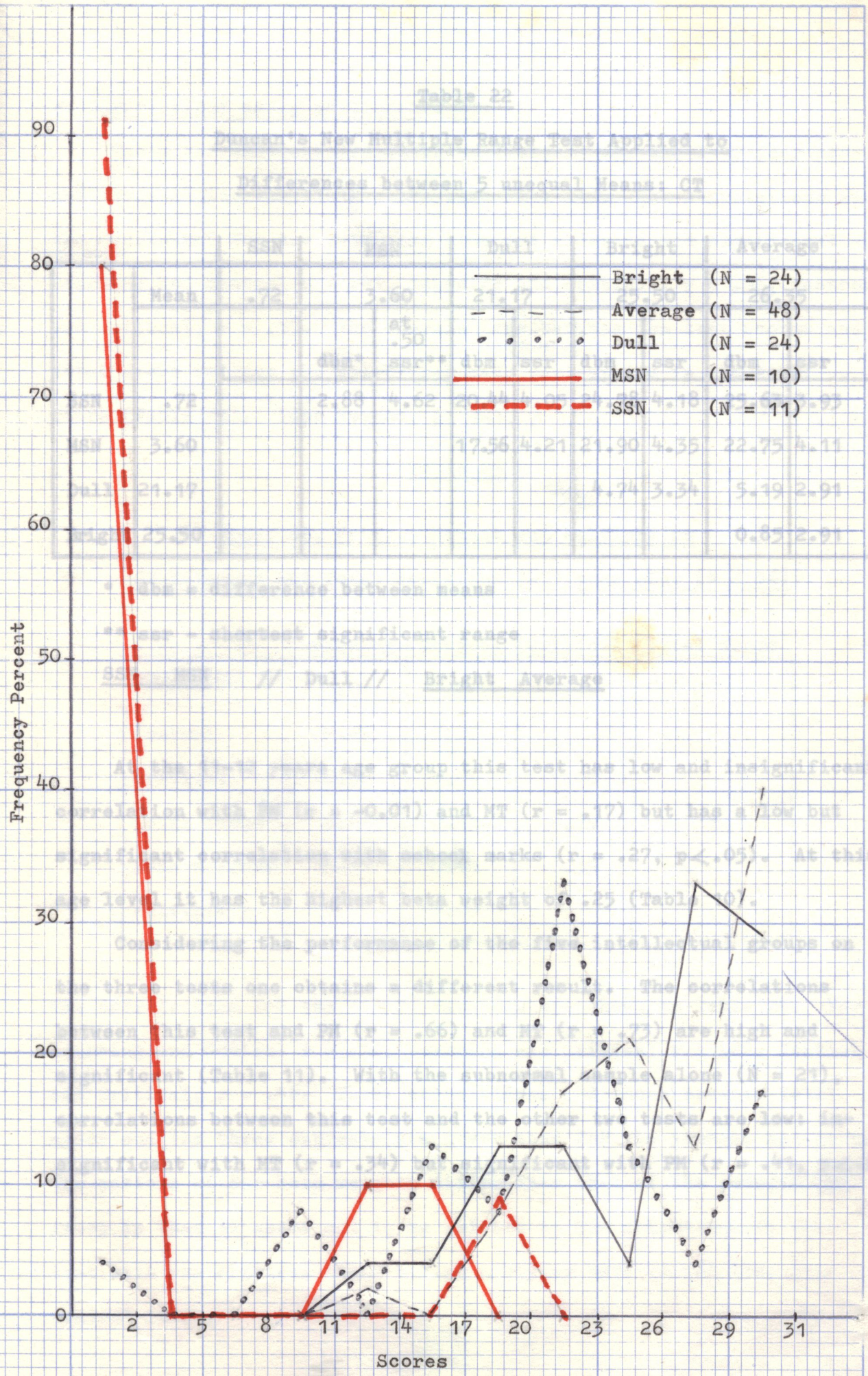

Fig. 9: Non-Verbal Conservation Test

Table 22

Duncan's New Multiple Range Test Applied to

Differences between 5 unequal Means: CT

		SSN	MSN		Dull		Bright		Average	
	Mean	.72	3.60		21.17		25.50		26.35	
			dbm*	at .50 ssr**	dbm	ssr	dbm	ssr	dbm	ssr
SSN	.72		2.88	4.62	20.44	4.05	24.78	4.18	25.63	3.93
MSN	3.60				17.56	4.21	21.90	4.35	22.75	4.11
Dull	21.17						4.74	3.34	5.19	2.91
Bright	25.50								0.85	2.91

* dbm = difference between means

** ssr - shortest significant range

SSN MSN // Dull // Bright Average

At the 11-12 years age group this test has low and insignificant correlation with PM (r = -0.01) and MT (r = .17) but has a low but significant correlation with school marks (r = .27, $p < .05$). At this age level it has the highest beta weight of .25 (Table 10).

Considering the performance of the five intellectual groups on the three tests one obtains a different result. The correlations between this test and PM (r = .66) and MT (r = .73) are high and significant (Table 11). With the subnormal sample alone (N = 21), correlations between this test and the other two tests are low: insignificant with MT (r = .34) but significant with PM (r = .41, $p < .05$).

e. Correlations among sections of CT:

These correlations are shown on Table 23 for the 7-10 year olds, and Table 24 for the 11-12 years olds (N = 96). The correlations among the "subtests" for the 7-10 year olds are moderate and significant - Learning and control r = .49, Learning and critical, r = .36, control and critical, r = .55. The correlations between the test scores and total score reflect the weightings each subtest had in the total score (Table 23). (See Method, p. 24).

Table 23

Mean, SD, Product Moment and Multiple rs

CT Subtests and Total Score for 7-10 year olds (N = 96)

	Learning	Control	Critical	Total Score
Learning	1.00			
Control	0.49	1.00		
Critical	0.36	0.55	1.00	
Total Score	0.65	0.92	0.79	1
Beta Weights	0.21	0.60	0.39	
Multiple r		1.00		

The correlations for the 11-12 year-olds are shown on Table 24. For Learning and Control r = .38, Learning and Critical r = .22, Control and Critical, r = .46. These correlations and those between total score and the three subtests are lower than for the younger age group. The pattern of the beta weights differ from that of the younger age group in that it seems not to be related to the weightings in the test with the critical items having a higher beta weight than the control items.

Table 24

Mean, SD, Product Moment and Multiple rs

CT Subtests and Total Score for 11-12 year olds

(N = 96)

	Learning	Control	Critical	Total Score
Learning	1.00			
Control	0.38	1.00		
Critical	0.22	0.46	1.00	
Total Score	0.46	0.75	0.77	1.00
Beta Weights	0.18	0.44	0.53	
Multiple r		.90		

f. Conservers/Non-Conservers.

Results from t-tests (df = 182) for the differences between the mean scores of conservers and on-conservers on PM, MT and School Marks show a significant difference for MT (t = 3.20) and School Marks (t = 2.55) p .05 but insignificant for PM (t = .62).

g. Conservation of what?:

The reasons given by the children to explain hand movements are shown on Table 25. The reasons include the concepts of weights, size, siz and weight, and size and shape.

Table 25

Reasons for Hand Movements

Reasons for hand movement	Conservers	Non-Conservers	Total
Weight - Heavy/Light	43	38	81
Size - Big/Small	31	27 *	58
Size & Weight - Big/Light or Small/Heavy	2	3	5
Size & Shape - Round/Small	0	1	1

CHAPTER 4

DISCUSSION

This study has aimed at validating three tests of intelligence - Panga Munthu Test (PM), Porteus Maze Test (MT) and Non-Verbal Conservation Test (CT). Three criteria were used: trainability, age and school performance. These have constituted the defining criteria for the layman's view of intelligence. Whether these tests measure intelligence in the groups considered will be determined by their ability (a) to differentiate MSN and SSN children who were classified on the basis of their trainability; (b) to differentiate the Dull, Average and Bright school children whose classification was based on school performance (c) to correlate positively with school performance and (d) to differentiate the three age groups 7-8 years, 9-10 years and 11-12 years.

Before the implications of the results are discussed, the characteristics of the tests will be examined.

Section 1. The Tests

a. Panga Munthu Test,(PM): This is a spatial perceptual-motor test requiring visually guided manipulative skill for the reproduction of the individual's concept of the human form. One would expect the amount and quality of detail included in the concept of the human form to be related to level of intellectual maturity (Bruner et. al., 1966, pp.22-25). One may then speculate that the amount of detail the individual perceives and abstracts from the human form may reflect the amount of detail he is capable of perceiving and abstracting from other aspects of his environment. So the validity of this test is based on its ability to differentiate

children of different levels of intellectual maturity, that is children of different ages, and children of different intellectual levels.

The reliability of this test was based on interscorer correlation coefficient which was found to be .84.

One other characteristic of this test worth mentioning is its ease of administration. The equipment is simple - a ball of plasticine about 8 centimetres in diameter, plasticine board, chairs and table if available. In the absence of plasticine, clay or thick mud can be used. In the schools visited there were lots of mud models of animals, humans and cooking utensils produced by the school children. The test can be done at the child's home if necessary. It takes an average of 15 minutes to administer.

b. Porteus Maze Test (MT): This test has beeen used in several psychological clinics outside Africa and from the results obtained in this study it seems a very promising tool for the Clinical Psychologist in Africa in general, and in Zambia in particular. It calls for spatial and motor abilities. The behaviours involved include "recognition of goal (escape from the maze), identification of sub-goals (landmarks along a successful track), short term memory for a preferred course of action, and finally, carrying out one's plan without slipping into a blind alley." (Docter, R.F. in Buros, 1972.) There is also a lot of learning going on within the context of a single administration of a set of mazes.

Porteus (1965) claims that the Maze test measures "foresight and planning". Such qualities are essential for effective dealing with the environment. But studies on the validity of the MT using

these concepts have not been reported. In this study, however, validity of this test is based on age differentiation and differentiation of intellectual levels. This test seems intrinsically motivating since the subject receives some feedback and tends to modify his strategy during the test. The smiles on the children's faces at successful and sometimes unsuccessful trials suggest that they enjoyed the "game".

Reliability: The nature of the MT makes use of the usual measures of reliability questionable. Test retest correlations may produce spuriously high correlation because of practice effect. Split half methods of estimating reliability are not applicable since the scores on parts of the total series completed are not comparable. The use of the extension series for alternate form reliability is considered unjustified in view of the low correlation coefficient (r = .50) obtained. (Docter, R.B. Ibid). Horn (in Buros 1972) suggests a reliability of about .75 obtained through an indirect method, by using the Knox Cube as validity criterion. He wrote "since the (Maze) test correlates about .75 with Knox Cubes, it can be reasoned that the reliability of the maze is probably not less than .75." The reliability coefficient is always expected to be greater than the validity coefficient (Anastasi, 1970, pp.121-122). Other validity coefficients, e.g. correlation with age, may thus be used to estimate the reliability of this MT.

This test is very easy to administer and score. It takes an average of 17 minutes to administer. With the bulk involved in the present wooden form, it can more conveniently be used only at the clinic. However this wooden form is advantageous when a tester is concerned with paper shortages or costs of producing the paper form.

Other factors in favour of the wooden maze have been discussed earlier.

c. Non-Verbal Conservation Test (CT): As mentioned earlier the psychometric view of this test requires the ability to learn the relevant concept needed to solve the conservation problems, ability to remember the concept and to transfer what is learnt to new situations, and the ability to conserve. The total score on this test should reflect the individual's level of intellectual maturity.

Even though the relationship between the concepts of learning and intelligence is not very clear, intuition suggests that survival in any environment requires that the individual should adapt his behaviour on the basis of the feedback from his environment. One would expect that any individual who has the capacity to effectively deal with his environment, as Wechsler defines intelligence, also has the capacity to modify his behaviour in order to benefit from that environment, hence a positive relationship between intelligence and learning.

Recently Psychologists have started advocating the incorporation of learning tasks into tests of intelligence. (Ortar, 1960; Jensen, 1961 & 1963; Haynes, 1971 and Biesheuvel, 1971) Ortar, Jensen and Haynes used the learning tasks to measure the learning ability of their subjects while Biesheuvel used a learning session to improve his subjects understanding of test procedure. In testing Israeli immigrant children Ortar introduced a period of practice and coaching between an initial testing and retest. He used non-verbal intelligence test items. He found that the final scores tended to be higher than initial scores and to correlate highly with future attainments.

Jensen (1961), using tests which measure a child's ability to learn found them better predictors of the children's potentialities than Stanford-Binet 1Q. He found that lower class children, both black and white did as well as middle class children.

Jensen (1963) has also shown that there is a significant association between Stanford-Binet 1Q and learning ability for seventh, eighth and ninth grade children classified into groups according to their 1Qs but some children classified as retarded learnt as fast as non-retarded children.

Haynes (1971) administered verbal learning tests among a battery of intelligence tests to Indian immigrant children in London and found that the learning tests predicted educational achievement better than the intelligence tests. She also found positive but low correlation between learning and intelligence tests (p.48).

In advocating his concept of adaptability testing instead of intelligence testing Biesheuvel suggests that the test should incorporate some learning session. In administering the General Adaptability battery which consisted of sorting (mechanical objects and Discs), cube construction and Tripod Assembly, the test session was preceded by film demonstration of the test procedure and what the subjects were required to do in the first test. He claimed predictive validity coefficients of .78-.94 between the subtests and job proficiency. He did not however state whether these validities would be different if the test was not preceded by the film.

The CT used in this study has incorporated concept learning and the results make it a promising tool for use in psychological clinics.

One would expect both short term memory ability and ability to utilize what is learnt in one situation in solving problems encountered in a new situation to reflect level of intellectual maturity. These abilities are required in tests like Wechsler's tests, Stanford-Binet test and Raven's Matrices, which are considered valid intelligence tests.

The relation between the concept of conservation and intelligence was mentioned earlier. For Piaget (1964) this is a key element in the concrete operational stage of intellectual development. Inclusion of items in a test of intelligence is therefore logical on theoretical grounds.

Validation of this test is also based on age differentiation and differentiation of groups of different levels. The evaluation of the reliability of this test was not included in this study. A test retest reliability may be suitable since the child does not get much feedback during the actual test trials which carry more weight than the training scores. (See Tables 23 and 24).

The test is easy to administer. The equipment required is simple and portable (weights, plasticine and table knife). It also takes an average of 15 minutes to administer. The only problem encountered during administration was the need to maintain the attention of some of the younger normal and of most of the subnormal children. With the normal children, a single tap on the table or the word "look" readily restored their attention, but with the subnormal children more effort was required.

Section 2. Age differentiation:

The results from the three tests are as expected.

a. Panga Munthu Test: Results obtained from Serpell's study (Serpell 1974, p.21) showed that older children scored higher than younger children of the same sex on PM. The significant increase in scores obtained in this study on PM, with increase in age suggests that this test measures a factor which matures with age.

b. Porteus Maze Test: The few studies on age effect show that MT differentiates age groups (Vernon, 1965, p.142). The study reported by Porteus and David (1966) involved an age range outside that used in this study, that is 31-70 years, and showed a decline in test age score with increase in age.

Porteus (1965) reported mean test age scores ranging from $7\frac{1}{2}$ years in Kalahari "bushmen" to $10\frac{1}{2}$ years in Australian Aborigines, "and normal or above" (exact test age scores not specified) in N. American Indians. He used such scores as evidence of the inferior intelligence of the people tested. He also noted that test age scores increased with increased familiarity with whites (Porteus, 1965, p.179). The validity of these findings seems doubtful since some of the samples were small and the method of their selection is not clear. Hence they might not have been representative of their ethnic groups. The ages of the subjects were not stated but from reading through the book one can infer that they were adults. The scores obtained by the children tested in this study makes the scores obtained by Porteus's adult subjects seem ridiculously low. The 7-8 year-old children obtained a mean test age score of 8.23 years, the 9-10 year-old children obtained 10.19 mean test years and the 11-12

year-old average children obtained 12.42 mean test years. These scores are closer to the scores obtained by Vernon (1969, p.185) in Uganda. He administered the paper form of this test to 12 year-old Ugandan school boys and obtained a mean test age score of between 12.5 and 13 years. The low scores reported by Porteus may be due to the fact that a paper and pencil form of the maze was given to adults who had probably not handled them before. The higher mean score reported for the group with greater contact with whites may be due to the possibility that the contact might have included some experience in using pencil and paper.

c. Non-Verbal Conservation Test: Since this is the first time this test is being considered as a psychometric test, no study has been reported on the effect of age on the total score. However it is known that scores on components of this test increase with age, learning is cumulative, and memory depends a great deal on neural maturation. Also ability to conserve is known to improve with age (Flavell, 1963, p.164.)

Section 3: Sex Differences:

The significant sex effect found with PM and MT is not surprising. Since they are both spatial tests, one would expect sex differences in favour of boys (Maccoby, 1967, p.26). The presence of a male Assistant might have been a contributory factor in lowering the scores obtained by the girls (Serpell, 1974, p.29).

The insignificant sex effect on CT is in line with the fact that no sex differences have been reported in learning, memory and abstract reasoning required for the test, for the age range used in this study. During this test, each child was left alone with E (a

female) after the male Assistant had given the initial instruction. The absence of the male assistant during this test might have made the females more relaxed with consequent relatively better performance. The influence on test scores of the sex of the tester is worth studying further.

Section 4. Intellectual Levels

Some aspects of the results obtained from the five groups - SSN, MSN, Dull, Average and Bright - were unexpected for it was felt that the tests should differentiate the groups classified by society. However a consideration of the criteria used by society to separate the groups compared with what the tests measure will help explain the results.

a. Normal children: The insignificant differences in the scores obtained by the Dull, Average and Bright groups on PM and MT may be due to the criteria by which they were classified. Since the teachers were more concerned with the children's academic performance, they tended to classify the children on the basis of their previous scores on Arithmetic, English and Social Studies - all of which are highly verbal subjects and performance on them does not require the same abilities that are required in doing the two tests. This suggests that PM and MT do not measure intelligence as defined by school performance.

The significant difference between the scores of the Dull and Average children on CT is a deviation from the pattern of the other two tests. This may be due to the fact that one of the children in the Dull group scored zero on the test since he failed to reach criterion during the training session.

All the tests discriminate the normal and subnormal children. As will be seen below, the subnormal children are deficient in the factors being measured by the tests.

b. The Mentally Subnormal Children: The concept of mental subnormality (or deficiency or retardation - the three terms are used interchangeably in the literature) brings together several syndromes with behavioural, aetiologic, developmental and prognostic implications. Even though the aetiological factors in mental subnormality are heterogeneous and include genetic, constitutional and environmental factors, there seem to be certain common characteristics that enable society to place certain individuals in the mentally subnormal group. The American Association on Mental Deficiency has incorporated these characteristics in its definition of mental subnormality as the "subaverage general intellectual functioning which originates during the developmental period and is associated with impairment in one or more of the following: (1) Maturation, (2) learning, and (3) social adjustment." (Doll, E.E., In Trapp & Himelstein, 1962, p.22.)

The mentally subnormal children have varying degrees of impairment in learning (Robinson and Robinson, 1965, pp. 316-340) and in many other cognitive functions involved in thinking such as familiarity with language, attention span, recognition of similarity, memory function and categorization skill (O'Connor & Hermelin, 1963). They have difficulty with attention to relevant stimuli (Zeaman & House, in Ellis, 1963, p.159), with discrimination and selective response to auditory and other material (Mittler, 1973). They are slower than normals in acquiring learning set (Cantor, in Trapp &

Himelstein, 1962, pp. 177-178). Short term memory has also been shown to be impaired (Herriot, Green & McConckey, 1973). All these factors are essential for good performance on the three tests used in this study.

The low scores of the subnormal children tested in this study may be due to inability to use the relevant strategies in solving the problems asked for in the tests, due to the deficits mentioned above.

Two of the tests, PM and MT show a clear distinction between the SSN and MSN children with the SSN group scoring significantly lower than the MSN group. These two groups are usually classified according to the severity of their impairment (Stevens, H.A., in Stevens & Heber, 1964, pp. 4-6). The results show that the criteria for separating the two groups are reflected in their test performance.

The conservation tests result is once more different, showing no significant difference between the SSN and MSN children. This may be attributed to the high percentage of both groups (90% for SSN, 80%, MSN) who scored zero on the test since they were unable to learn during the training phase. Since this was not a study primarily on the conceptual learning ability of the subnormal children, it was not considered desirable to spend a very long time on the training phase of this test. (Not more than 20 minutes was spent on each subnormal child during the training phase. The normal children took a maximum of 6 minutes to reach criterion.) If however more time (hours or days) were spent and more elaborate conditioning techniques used for the subnormals during the training phase, a different picture might have emerged showing better performance by these children than was obtained in this study (Bijou, S.W. in Krasner & Ullman, 1965, p.71).

This may on the other hand affect the result of the present study by obscuring the comparison being made between the normals and the subnormals, unless the same conditioning techniques were extended to the normal sample.

One criterion used by the hospital staff in classifying the children into SSN and MSN is whether or not they are trainable. The fact that the two groups performed equally badly on the training phase of the CT suggests that what the "trainable" MSN children are expected to learn in the two situations (test session and occupational therapy) are different. The CT requires that the child learns an abstract concept which calls for higher mental processes; while at the occupational therapy department the child learns simple manipulative skills. This test therefore is not suitable for classifying the different levels of mental subnormality.

Section 5. The relation among PM, MT, CT and School Marks:

Examination of Tables 10 and 11 (see Chapter 3) reveals a particular pattern as regards the correlation coefficients. The correlations between PM and MT, and between MT and CT are higher than that between PM and CT, even though with the 11-12 year-old children, the correlation coefficients are insignificant. This suggests that PM and MT have some factor in common while MT and CT have another factor in common. But PM and CT have not got much in common in the normal children. The factors common to PM and MT include visuo spatial and motor ability factors, PM and CT have learning and short term memory factors in common.

The high variability in the correlation coefficients from group to group is probably related to the hereogeneity of the samples in each group. The 11-12 year-old group seems to be the most

homogeneous since, even though the group consists of Dull, Average and Bright children, the tests used in this study seem unable to differentiate these intellectual levels, except the CT which discriminated between the Dull and Average groups. This inability to differentiate the intellectual groups is also reflected in the rather low and insignificant correlations between each test and School Marks, and also in the low multiple correlation (Multiple r = .30) between the three tests and school marks in this age group. This supports the notion that these tests do not measure intelligence as defined by school performance hence it seems unjustified to use the latter as a validity criterion.

The high correlation coefficients obtained for the three tests in the SSN - Bright group suggests that the tests are measuring some general factor that is lacking in the subnormal children. This may be termed the general intellectual factor whose subfactors include perceptuo-spatial, memory, learning and motor abilities which are being measured by the tests. Within the subnormal group there is little relationship between performance on CT and on the other two tests since both the MSN and SSN children scored low on the CT while MSN children scored higher than SSN children on both PM and MT.

On the basis of the results one can recommend the inclusion of the three tests in a battery of clinical tests. The only modification that need to be made apply to PM and CT. Considering the frequency of the extra items included in PM, the number of items may have to be increased to include items like hair, breasts, fingers, umbilicus, eyebrow and toes. The scoring of items of clothing is not recommended since they may introduce cultural bias.

With CT, a more elaborate training phase is recommended when using it for the subnormal children since their main difficulty was their inability to learn the concept, required for solving the problem, in the limited time.

Section 6. The Non-Verbal Conservation Test:

One assumption made by Furth (1964) and Heron and Simonsson (1969) who have used this technique is that the children were conserving weight. The result of the interview shown on Table 25 suggests that this is not necessarily the case. The responses of both conservers and non-conservers were based on both weight and size, perception of which requires different sensory modalities - proprioceptive and visuo-spatial respectively. Before any result from this test is considered as evidence of weight conservation the perception of size should be eliminated by some pretraining which will involve size/weight discrimination.

Since the concept used did not seem to influence the ability to make the appropriate response to the critical items in this study, the size/weight discrimination has been ignored instead the term "weight" has been dropped from the title of the test.

As mentioned earlier this test is being considered as a possible intelligence test validated on the basis of age differentiation and differentiation of different intellectual groups. It was considered of interest to examine the relationship between the different parts of this test namely learning phase, control items and critical items; and also to compare the scores obtained by conservers and non-conservers on PM, MT and School Marks.

From Tables 23 and 24 one can see that the critical items on which the evaluation of conservation is based and which call for

memory and transfer of learning correlate more with control items which test for memory than with the learning scores. This suggests that the ability to conserve is more related to memory and the abstract reasoning required in transfer of learning than to the learning ability itself. Only those subjects who were able to retain the essential code for the test were in a position to conserve.

Conservers and Non-Conservers: One point of difference between conservers and non-conservers is that the latter seem unable to use abstract reasoning to solve the conservation problem. Their reasoning is dominated by the perceptual characteristics of the objects. The significant difference between the higher scores of the conservers and the lower scores of the non-conservers on MT and School Marks can be explained by the fact that the abilities to conserve, to solve the maze and to score high marks all require some abstract reasoning to solve the specific problems, and they also require some learning and memory.

The lack of significant difference between the scores of conservers and non-conservers on PM may be because the test does not call for abstract reasoning ability but requires recall and reproduction of the subjects concept of the human form. As may be recalled PM scores show low correlations with CT scores.

Section 7. Conclusion:

This study has aimed at validating three tests of intelligence - Panga Munthu Test (PM), Porteus Maze Test (MT) and non-verbal Conservation Test (CT) against age differences, trainability and school performance - all criteria used by society in defining the concept of intelligence. Validity of these tests then is based on

(1) age differentiation, (2) differentiation of SSN and MSN (trainability) (3) differentiation of Dull, Average and Bright school children and (4) correlation with School Marks (the last two related to school performance).

The results show that PM and MT measure intelligence as defined by trainability and age differentiation but not as defined by school performance. CT measures intelligence as defined by age differentiation and to some degree school performance but not as defined by trainability, for trainability as used in the test is different from trainability as used by the hospital staff - the former dealing with abstract concepts, the latter with simple manipulative skills.

These results lead one to recommend that, with the modifications mentioned earlier, PM, MT (wooden form) and CT be used as parts of a battery of clinical tests for use in identifying the mentally subnormal children in Zambia. To obtain a clearer picture of the performance and other behavioural problems of the subnormal children, the tests should be administered to a larger sample than was available during this study.

For standardization purpose it is recommended that the tests be administered also to a larger sample of normal, both schooled and unschooled children in order to obtain norms for age and sex in view of the significant sex differences observed for PM and MT. This study has not separated the effect of education and age on the test scores. Serpell (1974) has shown that older children score higher on PM than younger children irrespective of education. Administration of MT and CT to unschooled rural children will help clarify this issue.

The results from this study also lend support to the notion that the concept of conservation is related in some respects to the concept of intelligence.

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APPENDIX I

PANGA MUNTHU - SCORING SHEET

Time taken to complete model

Score 1 or 0

1. Head and body distinguishable.
2. Head shorter than length of body (excluding neck).
3. Proportion of face - length of head greater than its width.
4. Ears Present: Any indication of ears.
5. Nose Present: Any clear method of representation.
6. Eyes Present: Two eyes must be shown.
7. Neck - definite extension of body between head and arms. Must be clearly thinner than head.
8. Proportion of trunk - length of trunk must be greater than breadth.
9. Arms - two arms on opposite sides of the body.
10. Proportion of arms - arms at least equal to the trunk in length. Tips of hands extend to the middle of hip but not to knee.
11. Shoulders: definite angle below neck where arms join trunk.
12. Elbows: second definite angle in arms.
13. Hands: either 3rd definite angle in arms, or some shaping to differentiate hands from forearms.
14. Two legs - at opposite end of body from head.
15. Proportion of legs: length of the legs not less than vertical measurement of trunk nor greater than twice than measurement.
16. Knees: definite angle in legs.
17. Feet: second definite angle in legs, in opposite direction from knee angles.
18. Proportion feet: the length of the foot must not be greater than its height from sole to instep.

(continued)

19. Mouth Present: Any clear representation.

20. Any remarkable detail: Record any extra detail included.

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APPENDIX 2

RESPONSE SHEET: CONSERVATION

Name: _____ Sex: _____ Age: _____ Grade: _____

Step	Items	Responses (a)	(b)	(c)
1	Two similar balls	One hand down		both horizontal
2	One ball - one ring	Ball hand down	Ring hand down	both horizontal
3	One ring - half a ball	Ring hand down	Half ball hand down	both horizontal
4	Two similar balls	One hand down		both horizontal
5	One whole ball- two halves of the other ball	Whole ball hand down	Two halves hand down	both horizontal
6	One whole ball - one half ball	Whole ball hand down	Half ball down	both horizontal
7	Two similar balls	One hand down		both horizontal
8.	One ball - one snake	Ball hand down	Snake hand down	both horizontal
9.	One disc - one ring	Disc hand down	Ring hand down	both horizontal
10	Half ring - half disc	Half ring hand down	Half disc hand down	both horizontal
11	Half ring - half disc in one hand and the same in the other	One hand down		both horizontal
12	One ball - half ring	Ball hand down	Ring hand down	both horizontal
13	Two similar balls	One hand down		both horizontal

Time taken

Interview Response:

Trials to Criterion 1

Pretest 2

APPENDIX 3

SCORING SHEET - PORTEUS MAZE TEST

Name: _____ Sex: _____ Age: _____ Grade: _____

Year	Trial	Qualitative Errors					
		FT	LT	TW	LS	JW	CD
III	1						
	2						
	3						
IV	1						
	2						
	3						
V	1						
	2						
VI	1						
	2						
VII	1						
	2						
VIII	1						
	2						

(continued)

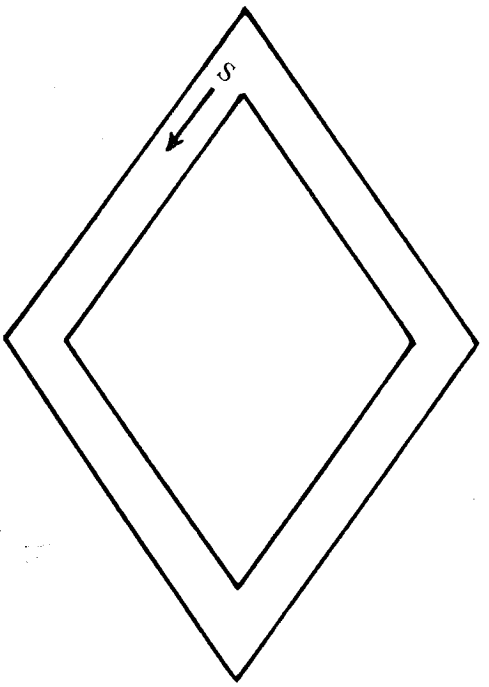
SCORING SHEET - PORTEUS MAZE TEST (continued)

Year	Trial	FT	LT	TW	LS	JW	CD
IX	1						
	2						
X	1						
	2						
XI	1						
	2						
XII	1						
	2						
	3						
	4						
XIV	1						
	2						
	3						
	4						
ADULT	1						
	2						
	3						
	4						

FT = Blind entry occuring at first third of maze.
LT = " " " " last third " " .
TW = Touching the wall.
LS = Lifting the stick.
JW = Jumping the wall.
CD = Changing direction.

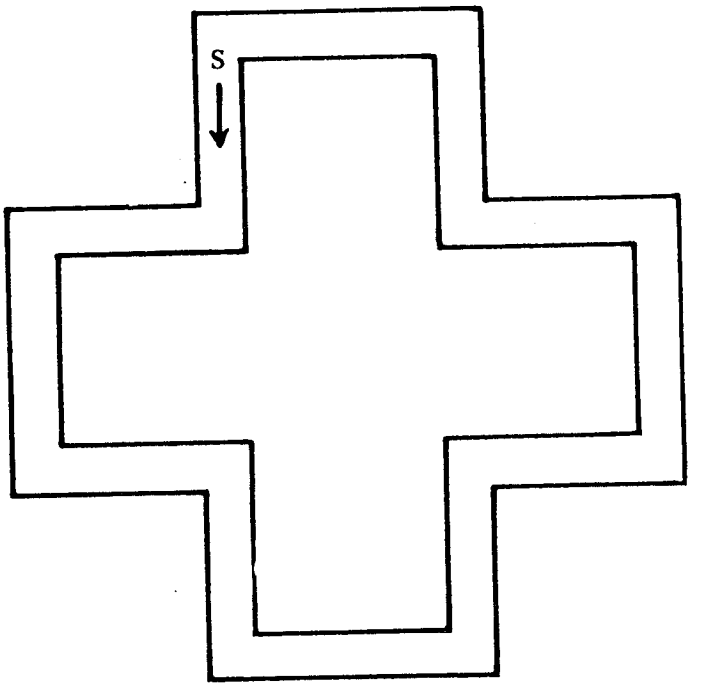
APPENDIX A-1

PORTEUS MAZE TESTS — VINELAND REVISION

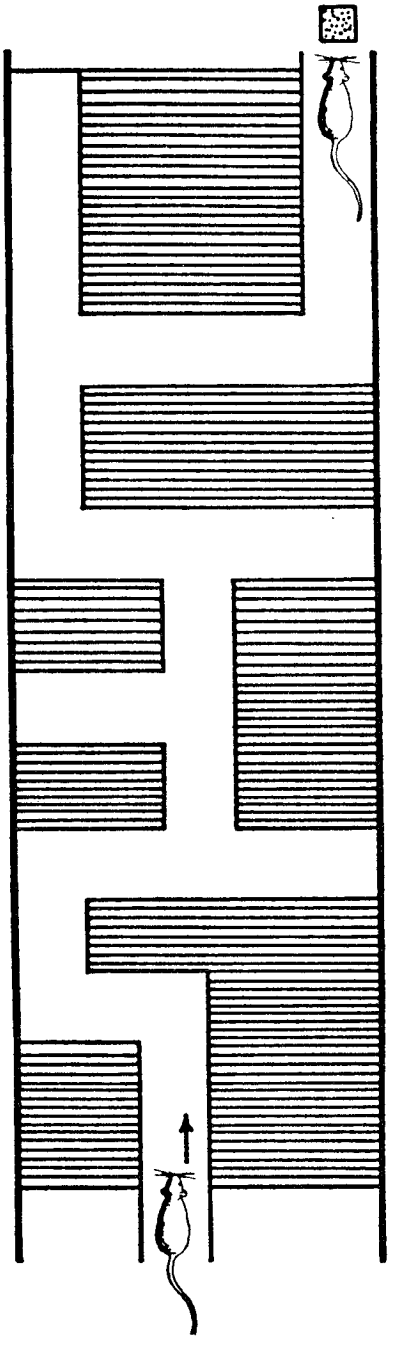


PORTEUS TESTS — VINELAND REVISION YEAR III

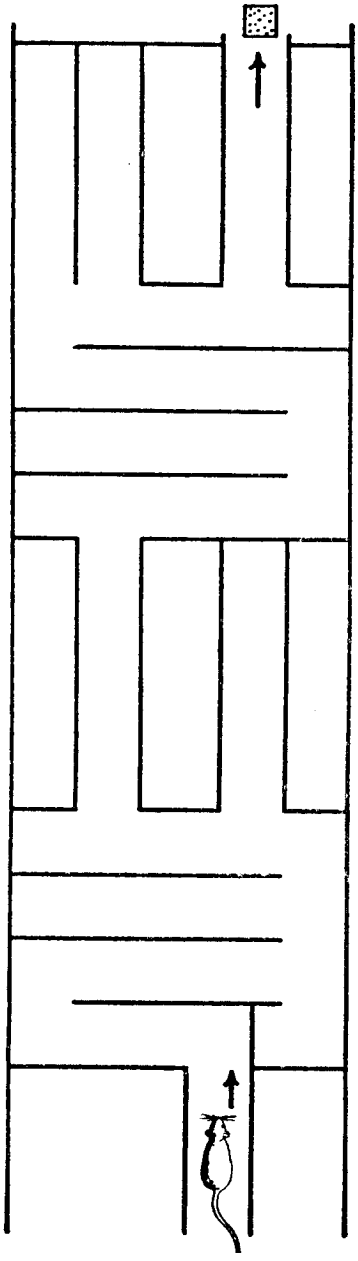
260 *Porteus Maze Test*



PORTEUS TESTS — VINELAND REVISION YEAR IV



PORTEUS TESTS — VINELAND REVISION YEAR V



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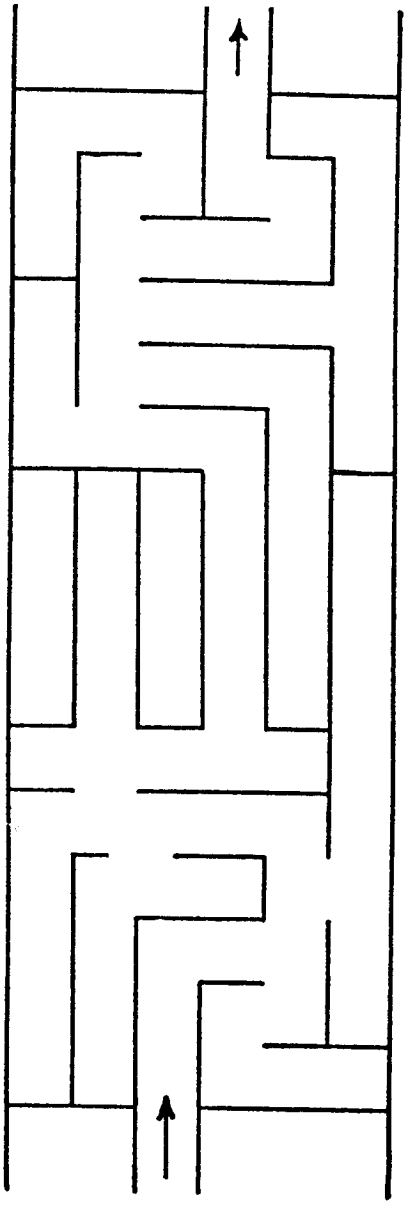
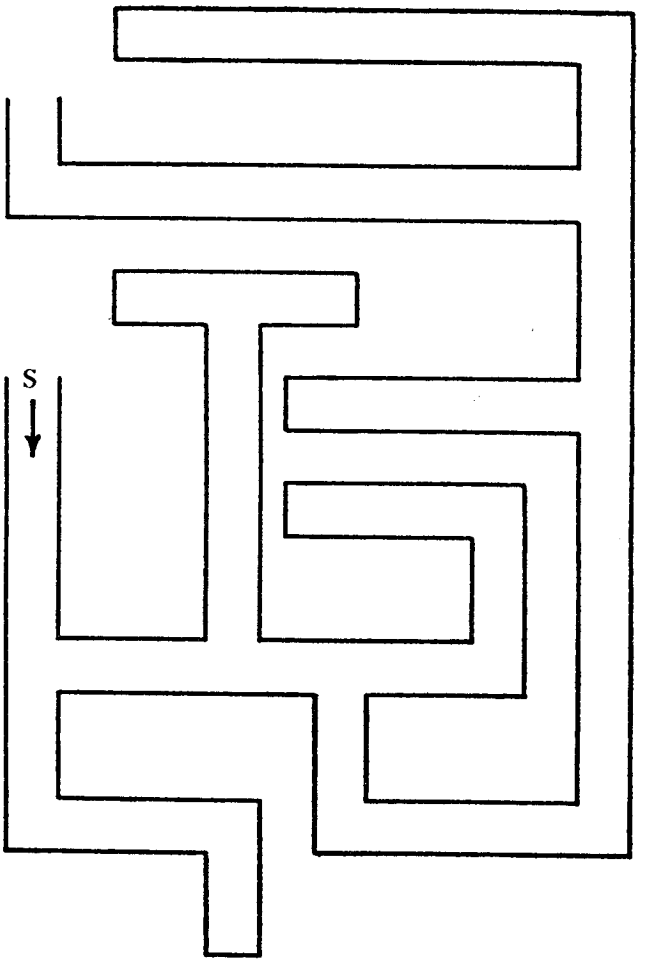
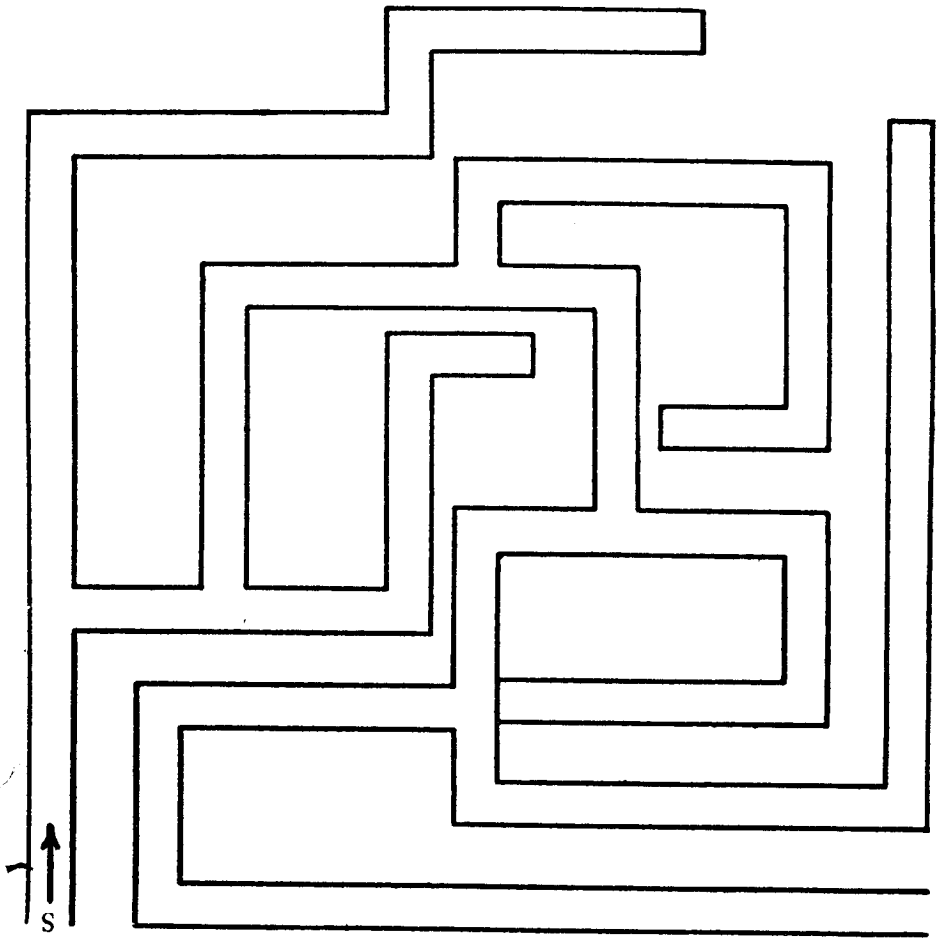


PORTEUS TESTS — VINELAND REVISION YEAR VII

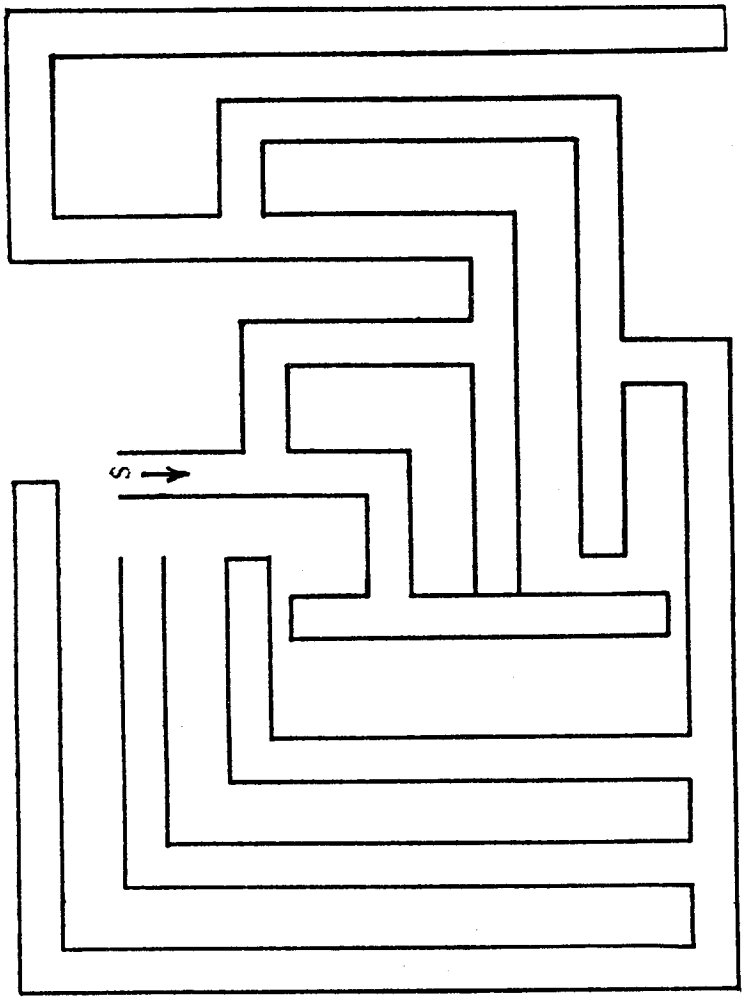
264 *Porteus Maze Test*



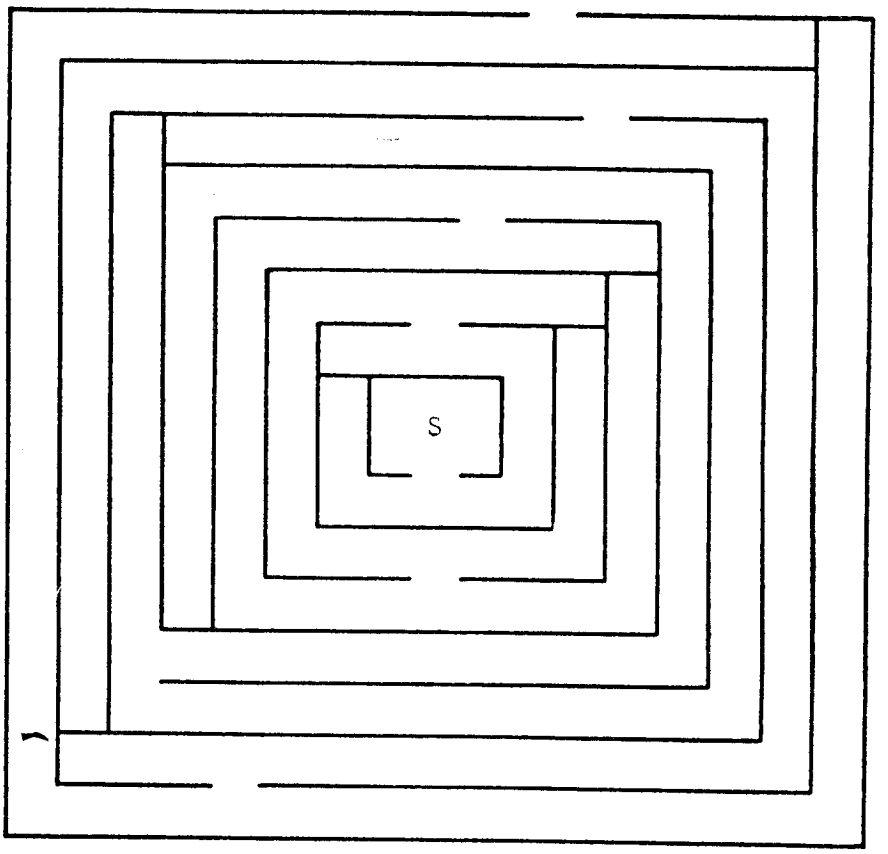
PORTEUS TESTS — VINELAND REVISION YEAR VIII



PORTEUS TESTS — VINELAND REVISION YEAR IX

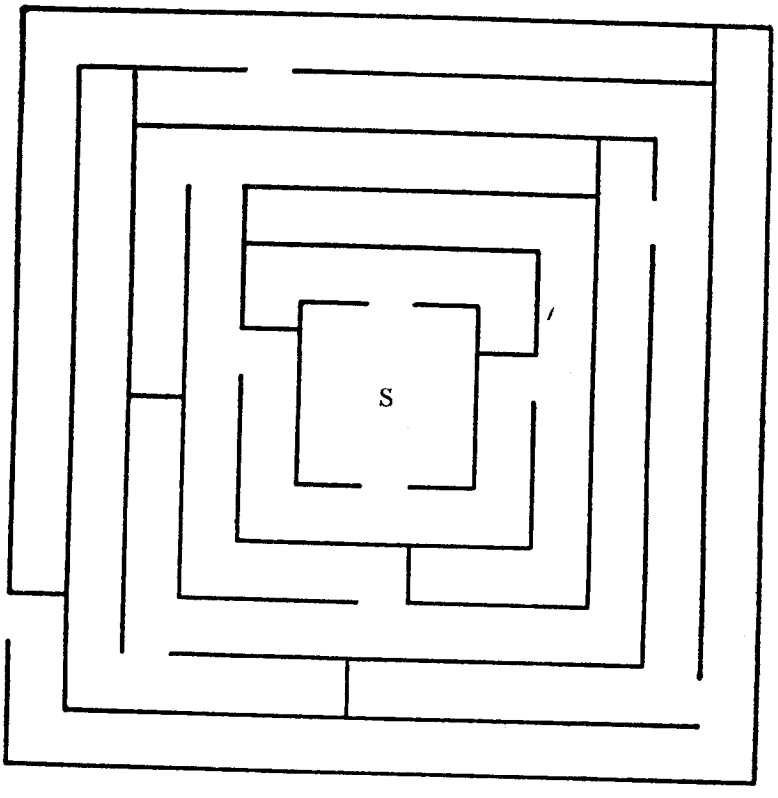


PORTEUS TESTS — VINELAND REVISION YEAR X

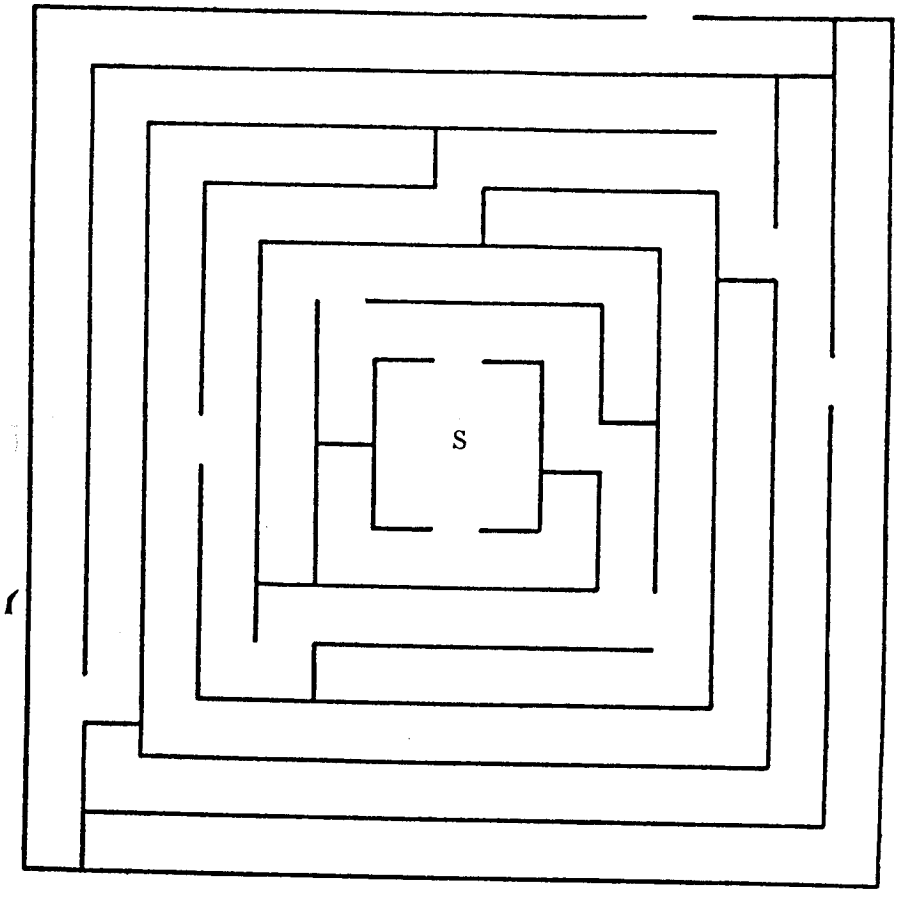


PORTEUS TESTS — VINELAND REVISION YEAR XI

268 *Porteus Maze Test*

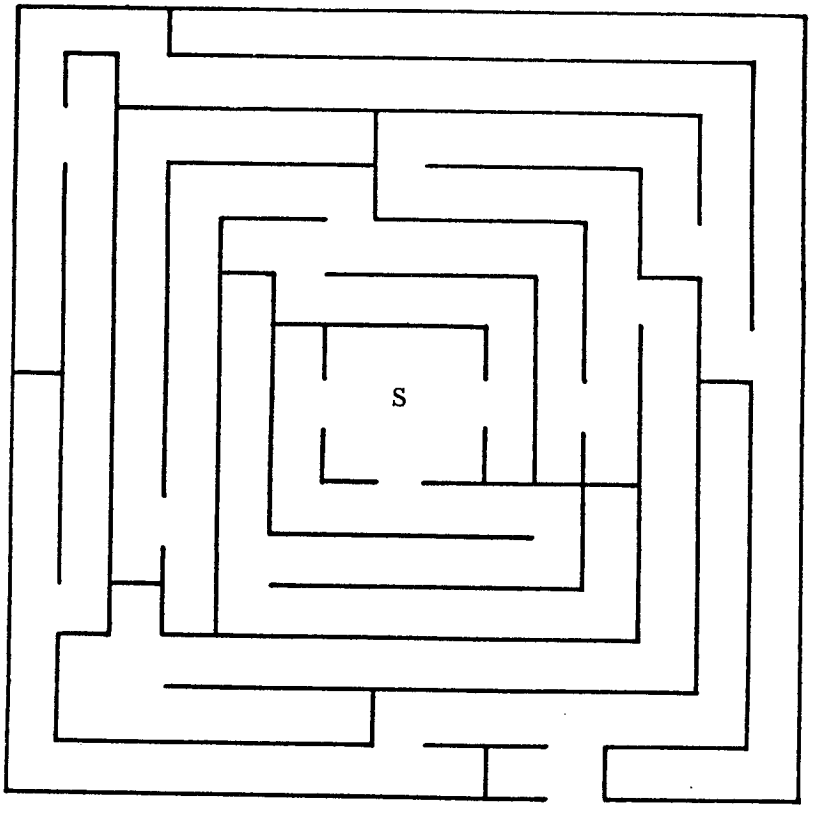


PORTEUS TESTS — VINELAND REVISION YEAR XII



PORTEUS TESTS — VINELAND REVISION YEAR XIV

270 *Porteus Maze Test*



PORTEUS TESTS — VINELAND REVISION ADULT I

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