DOCUMENT RESUME

ED 039 041 24 PS 003 400

AUTHOR Rall, Rachel S.
TITLE The Relation of Certain Home Environment Factors to the Thinking Abilities of Three-Year-Old Children. Final Report.
INSTITUTION Arizona State Univ., Tempe.
SPONS AGENCY Office of Education (DHEW), Washington, D.C. Bureau of Research.
BUREAU NO BR-8-I-100
PUB DATE Apr 70
GRANT OEG-9-8-081100-0135(010)
NOTE 51p.

EDRS PRICE EDRS Price MF-$0.25 HC-$2.65
DESCRIPTORS Cognitive Ability, *Cognitive Development, Convergent Thinking, Divergent Thinking, Educational Background, *Environmental Influences, Factor Analysis, Occupations, Parent Child Relationship, *Parent Influence, *Preschool Children, *Thought Processes

ABSTRACT

This study investigated (1) three kinds of mental operation in children: divergent production, convergent production, and cognitive thinking manifested in 3- to 4-year-olds and compared the results to results of a study of 4- to 5-year-olds, and (2) the relationship between children's abilities and their parents' level of education, children's sex and age, parents' occupations, the amount of time the father spends in the home and the mother spends reading and playing with her 3-year-old, and the type of nursery school attended. Mother interviews and test protocols were obtained for 416 children between the ages 3-0 and 3-11. Results indicated the most striking relationships between level of education, environmental experience, and aspects of thinking ability. Children with mothers at home full-time were less able in visual and spatial manipulation. Children with professional fathers showed less ability but scored higher in ideational fluency. Children of fathers who attended college were more able in convergent figural thinking. Mothers' education was related to verbal tasks as well as figural. Some geographic differences were found. It was evident that 3- and 4-year-olds showed "types" of thinking ability. (Author/DR)

FINAL REPORT
Project No. 8-I-100

Grant No. OEG-9-8-081100-0135-(010)

The Relation of Certain Home Environment Factors to the Thinking Abilities of Three-Year-Old Children

Rachel S. Ball
Arizona State University
April 1970

The research reported herein was performed pursuant to a grant from the U. S. Office of Education, Department of Health, Education and Welfare. However, the opinions expressed herein do not necessarily reflect the position or policy of the U. S. Office of Education, and no official endorsement by the U. S. Office of Education should be inferred.

U. S. DEPARTMENT OF
HEALTH, EDUCATION AND WELFARE
OFFICE OF EDUCATION
BUREAU OF RESEARCH

ACKNOWLEDGEMENTS

Although the investigator assumes full responsibility for the content of this report, she does wish to acknowledge gratefully the help and participation of many individuals in the various aspects of the project.

First, I wish to acknowledge with thanks the financial support of the Office of Education, U. S. Department of Health, Education, and Welfare which enabled me to carry out my research program.

I acknowledge my indebtedness to the Psychology Department of Arizona State University for providing office space, facilities, and vital assistance in carrying out the "Western" half of the project. Also contributing greatly to the success of my program was the Arizona State University Office of Research Grants and Contracts.

It is with gratitude that I acknowledge the assistance given by the Merrill-Palmer Institute in Detroit, particularly to Dr. J. William Rioux, President, and to the Business Office Staff for their part in making the Detroit program possible.

To my two consultants who gave generously of their time and effort, far beyond the minimal monetary compensation, and without whose help this research would have been impossible, I tender my deepest gratitude. Dr. Leland Stott supervised the collection of the Detroit material, lent his office and time to conferences in regard to the organization and evaluation of the research. Dr. Philip R. Merrifield provided not only technical advice as to the test organization and research program, but also supervised the computer programming and the analysis of the data.

I am extremely grateful to all those persons who so faithfully and efficiently coordinated the work or who actually did the testing at both the Western and Eastern centers. We appreciate the cooperation of the more than 400 mothers and their children, and to the directors and teachers of the nursery schools where they were found I owe a debt of gratitude.

Rachel S. Ball, Investigator

CONTENTS

SUMMARY

This research is a continuation of the earlier study of thinking ability of four-year old children and it is limited to a study of white three-year-old children from English speaking homes.

The project is designed to seek answers to the following questions:

1. Is it possible to identify and appraise differentially in a three-year-old child mental operations and responses similar to the ones found in four-year-old children in the first study? Are there similar findings in regard to the developmental picture of children in convergent productive thinking as contrased to divergent productive thinking?

2. As was true of four-year olds, is there a tendency for little growth during the entire year range for three-year-old children in divergent productive thinking? And is there a tendency in three-year olds to show more striking gains in convergent production during the year, with children showing progressively more mature responses with an increase in age, as was evident at the four-year-old level?

3. Do we also find that children whose mothers are college graduates show more ability in general reasoning, as was the case with our four-year-old sample?

Designed to help us answer the questions of relation of the environmental influences to test performance of these three-year olds, a questionnaire was asked of the mothers in an interview by the examiners. This questionnaire attempted to gain a glimpse of certain environmental aspects that might be related to the three-year-old child's ability to perform these operations.

This investigation involved the use of a test instrument for evaluating the thinking activities of young children. Some of the more difficult items for four-year olds were omitted, and other similar less difficult test items were added to give a balanced picture of the mental abilities to be sampled for three-year olds. Several of the test items that have been shown to have "factor invariance" in the thinking abilities in which we were interested were included in our test instrument.

Test protocols were obtained for 416 children between the ages 3-0 to 3-11. Approximately one-half of the tests were obtained from the Detroit metropolitan and the other half from the Phoenix-Tempe, Arizona, area. The collection of test protocols in Detroit was supervised by our consultant, Leland H. Stott, who was one of the two investigators in the previous study of four-year-old children.

The questionnaires were completed for 260 mothers of the three-year-old children, since this phase of the research was not initiated until the research funds were available. Since 156 test protocols were obtained earlier, it proved to be not feasible to get the related questionnaire data for these children.

The subjects were selected in such a manner as to insure a fair representation of three general levels of education of their mothers. One-fourth of the mothers were to be college graduates, one-half were high school graduates, and one-fourth were to have only ninth grade or less education. However, due to the difficulty of locating this last category of mothers, only 60 or less than one-sixth of the children had mothers who were at this lowest educational level.

The examiners who did the testing were all capable individuals with adequate training in psychology, with keen interest in the project, and with ability to work with children.

Scoring procedures were carefully worked out and the scoring of the protocols was done by the investigator. The scores were tabulated for computer card punching.

The programming and computer work was done under the direction of our consultant, Philip Merrifield, who also was responsible for the computer work done on the four-year olds. This study of three-year olds paralleled in large measure the earlier one. The work involved correlation and factor analysis.

Principal factors were extracted. Although these axes were machine rotated to the Varimax criterion, graphic rotations led to more meaningful simple structure and were used in factor interpretations. Factor scores were then computed.

Finally a correlational analysis was made of the children's thinking abilities (factor scores) and the environmental variables obtained through the questionnaire.

Findings: In the analysis of our data, six specific sorts of thinking ability were identified. Two of these were of the convergently productive sort, Convergent Figural Thinking (involving visual judgment) and Production of Figural Units (speediness in spatial modeling). Two of the abilities were of the divergent variety, Ideational Fluency - largely involving ideas expressed verbally; and Spontaneous Flexibility (originality). There was also one factor of General Reasoning (involving language comprehension and accuracy in following directions) and one factor which was labeled Dexterity - or fine muscular control. These factors parallel these found at the four-year-old level. There were a few test items which split with two significant factor loadings. This was true, also, of the tests for four-year olds, in our earlier study.

A correlational analysis was made including the six thinking ability factors and 11 items from the questionnaire. These were: age, sex, education of father and of mother, the occupation of father and of mother, the amount of time the father spends in the home, the type of nursery school, and the amount of time spent there, the amount of time per week that the mother spends reading to her three-year old, and, finally, an item to see if there were a difference in the two geographic centers.

The findings for the relationship of the questionnaire items with the factor scores for these three-year-old children were varied. There was no overall sex difference except for a slight superiority of girls over boys in ideational fluency. There was a consistent relationship between score and age with the exception of originality scores, which did

not increase to a comparable degree. This agrees with the four-year-old finding that originality does not increase throughout the four-year age range.

No relationship was found between the mothers who read to the child and those who did not, although most mothers read at least sometimes to the child. The time the father spent in the home was not related to the factor scores. No relationship was discovered with the type of child care program attended but the length of time spent in these programs was related to higher scores in Ideational Fluency and Originality.

The most striking relationships found were those between level of education, environmental experience, and some aspects of thinking ability. The children, whose mothers were full time in their home with no other job but that of homemaker, tended to show less ability in visual and spatial manipulation than do children whose mothers are not in the home full time. In other words, it is likely that these children are more protected and assisted in their manipulative problems than are the children who are more likely to be on their own. This trait is found, also, with children whose fathers are in business and professional pursuits. These children, however, have higher scores on Ideational Fluency, which may indicate that the home environment and expectation for these children are more oriented to verbal competence and less to mechanical or spatial problem solving.

From the point of view of the amount of education of the parents, those fathers who have had any amount of college experience at all had children whose scores were significantly higher in figural tasks (convergent figural thinking) than the fathers with less education. On the other hand, it is interesting that those mothers who had high school or college experience had children showing superiority in all factor scores except Psychomotor Dexterity in which the children of mothers who had no more than ninth grade education excelled.

From these findings, it would seem quite possible that socio-economic status is a contributing or at least a concomitant factor here. The whole environment seems set by the mother and her interests and pursuits.

The area in which these children lived seem to have some differentiating qualities, although it may be that the examiner differences or selection differences are the determing relationships, but at least it was found that the children from the Detroit area showed higher scores in general reasoning than did those from the Western sample. While the children from the Phoenix and California samples had higher scores in Convergent Production and in Originality, there was no regional difference in Ideational Fluency.

It was plainly evident, for three-year-old children as well as for four-year-old children, that there are types of thinking ability. Further study of this aspect of the research is to be continued in the two later research proposals.

The Relation of Certain Home Environmental Factors to the Thinking Abilities of Three-Year-Old Children

INTRODUCTION

Purposes and Objectives of the Overall Research Program

The investigation reported at this time is the third in a series concerned with mental functioning and its development in early childhood. Our overall program involves four main objectives. First, it seemed important to obtain a realistic view of the current mental testing situation with reference to young children.

Secondly, another major purpose was to investigate the "structural" nature of preschool mentality. Much was already known concerning the structural components of the young adult intellect (Guilford, 1967). A number of factor-analytic studies have also been made at various school age levels (McCartin and Meyers, 1966; Merrifield, Guilford and Gershon, 1963). However, there is a paucity of empirical evidence regarding the extent to which differentiation of specific mental functions has already taken place at age levels below six years. Our specific interest in our first study (Stott and Ball, 1965) was to determine what mental operations are involved in the children's responses to the widely used tests of intelligence. To what extent would different scales elicit the same pattern of abilities (show the same or different ability-factor content) at particular preschool age levels? To what extent would each particular test involve the same pattern of abilities in children at different age levels? These two major objectives were main concerns of the first project of our series.

The third objective devolved upon the fact that the earlier commonly used tests had been constructed in terms of outmoded conceptions of the structure of mentality and its development. In recent years, with the development of newer, more efficient techniques and facilities for statistical analysis, much has been learned about the structural nature of the human intellect. In the well known Guilford model (Guilford, 1967), for example, three equally important aspects of specific ability are postulated: process or operation, content or medium of the object of thought, and the nature and form of the object or product of thinking. Each ability is describable as the confluence of one kind of process, one kind of content, and one kind of product (Guilford, Green, Christensen, Hertzka and Kettner, 1954; Hoepfner, Guilford and Merrifield, 1964; Merrifield, in Klausmeier and Harris, 1966). We chose to differentiate kinds of process and particularly to contrast cognition, convergent productive thinking, and divergent productive thinking. Secondarily, we focused on the distinction between semantic (meaning of words) and figural (spatial configuration) kinds of content.

In order to determine more adquately whether and to what degree these various abilities have become differentiated in children at the range of preschool age levels, it was obviously necessary to obtain data derived from test items specifically designed to reveal the presence and the functional level of these abilities. To make a contribution in this area was a third research objective.

Fourthly, we were also much concerned with the questions of the extent to which cultural and home-environmental factors influence the differential development of mental functioning during these early years of childhood. More and more emphasis in recent years has been given among child development researchers to the importance of adequate and appropriate stimulation in early cognitive development. The assumption is that the amount and quality of mother-child interaction is a crucial factor (Bernstein, 1960; Deutsch, 1964; Hess, 1964; Hess and Shipman, 1965). To obtain some evidence on this important question was a further purpose of our research program.

A final objective as the result of these separately developed series of research studies is to develop and standardize tests for the measurement of the various specific mental functions and abilities which characterize the different preschool age levels (ages two to six years).

Analysis of the Present Project

Our specific purposes in this present study were (1) to investigate more thoroughly the three sorts of mental operation, or modes of thinking in young children, which have been labeled "divergent production,""convergent production" and "cognitive thinking" as they are manifest in three to four-year-old children and to compare these results with those obtained in our previous study of four to five-year-old children and (2) to investigate the relationship between children's abilities, and their mothers' and fathers' level of education, their age and sex, the occupation of their mothers and fathers, the amount of time the father spends in the home, the type of nursery school and the amount of time per week that the mother spends reading or playing with her three-year-old, and, finally, an item to see if there were any difference in the two geographic centers.

Divergently Productive Thinking

Situations commonly arise throughout life which call for a type of thinking which produces a variety of appropriate reactions, involving alternative courses of action. Volume of appropriate and meaningful output is often demanded. This particular category of thinking has been well identified and described as an aspect of human ability. Various divergently productive abilities have been described in a number of investigations of "creativity." In this connection, Guilford (1967) wrote:

> Certain hypotheses about abilities that should be of special relevance for creative thinking (Guilford, 1950) led to the search for abilities having to do with fluency of thinking and flexibility of thinking, abilities concerned with the ready flow of ideas and with readiness to change direction or to modify information. The first large factor analysis that was aimed at the investigation of these hypotheses (Wilson, et al, 1954), and others that have followed, have found not one kind of fluency factor but three, not one kind of flexibility factor but two, besides a factor that was called by the term originality. (p. 138)

From these and more recent studies, the category of divergent production abilities includes previously called fluency, flexibility, originality, and elaboration.

At least two of the specific abilities belonging to this category have been verified in six-year-old children (Orpet and Meyers, 1965; McCartin and Meyers, 1967) and at certain preschool levels (Stott and Ball, 1965). This divergent type of thinking is frequently observable in children during social and dramatic play. The tests included have been designed to standardize a sample of this type of activity.

Richness of imaginative production and wealth of ideas (flexibility and ideational fluency) vary widely even among preschool children, and, of course, a relatively high level of this divergent production ability marks the "leader" among children (Stott, 1962).

Convergent Productive Thinking

The second type of thinking activity with which we are concerned is convergently productive in its orientation. Throughout life, one must cope with situations which, in each case, require a particular correct solution. Early in the child's life, he is asked to perform specific functions and to follow specific directions. His effort and thinking in each case must "converge" - be directed toward a single desired end, or a particular correct answer. Again, individual differences are evident at any age level in this ability category.

It is interesting to note that, even though problem solving ability of convergent production is a very common kind of mental functioning, it is one of the least explored aspects of the intelligence of young children (Guilford, 1967, p. 171). In the few available studies, convergent production factors have been suggested at age 14 (El-Abd, 1963), at age six (McCartin and Meyers, 1966) and in certain tests at preschool ages (Stott and Ball, 1965).

As was stated above, little is known concerning the changing structure of mentality in early childhood in terms of hypothesized specific abilities. Few attempts have been made heretofore to provide testing procedures or measuring scales for the investigation of abilities of preschool children from the point of view of the "structure of intellect."

Cognition

Some of the test items were designed to call for a third kind of mental functioning which corresponded to the type Guilford labels cognition. "The factors of cognition," he says (p. 4, 1957), "have to do with the becoming aware of mental elements or constructs of one kind or another. In the tests of these factors, something must be comprehended, recognized, or discovered by the examinee." Guilford indicates that factors of certain kinds of verbal tests have analog factors dealing with figural and perceptual kinds of tests; that is, they tend to pair off according to the mental functioning required for the tests.

We hypothesized that the tasks involving this cognitive kind of ability in our series were the relations aspect of the Block Sorting test, the comprehension aspect of the Word Meaning test, the discovery aspect of the Hidden Figures test, and such tasks as the Little Pink Tower and the block building tests labeled Three and Six Cube Pyramids. These also involved production as well as comprehension and possibly could be more related to convergent production factors. This only our factor analysis of the data to be collected would clarify.

GENERAL PROCEDURES

The Research Instrument

Our first task was to revise the test items previously stepped down in difficulty for use with four-year-old children so that they would be suitable for three-year-old children. Most of the items could be retained with the understanding that they would be more difficult at the three-year level. It was necessary to eliminate those which were too difficult or to reduce their difficulty by different administration and scoring. For example, the test Round Things, which had proved difficult for four-year olds (since many of them obviously did not know the meaning of round), was revised by adding a sheet with eight drawings of familiar objects, four of which were round. Then each child was asked to point out the objects which were round. This gave an idea of whether the child of three years knew the meaning of round. Then he was requested to name other things which were round. The Action Agent and Agent Action items were revised by asking less difficult questions. Instead of asking the three-year olds to copy a star and a diamond, they were asked to copy a line, circle, and cross, much easier tasks.

Some items were eliminated because they seemed to be less valuable than we had hoped; others were changed because our experience with four-year olds showed us that changes would be desirable. Then more items were added to give substitutes for the omitted items. These were usually less difficult. One item added was the Nest of Cubes as part of the Following Directions test and the directions for placing the small cars were reduced in difficulty. A Face Completion test was added to the Drawing Completion tests. The Wallin Pegboard B, which had been shown in the Merrill-Palmer Scale to be interesting and valuable for three-year olds, was added. The Decroly Matching game, which preliminary tests for four-year olds had proved to be too easy, was added to the list for three-year olds. To the Block Building test we added the building of a Straight Tower, which we had previously found to be interesting even to two-year olds, but too easy for four-year olds. Finally, we added the Dot Test, which probably would have been satisfactory for four-year olds, and which we expected to introduce later into the four and five-year sequences if it proved satisfactory for three-year olds.

The list of items finally chosen for the study of three-year-old functioning is shown in Table 1. The hypothesized factor identifications for the different probable aspects of the items meaning in each case are also suggested. It was aimed to arrive at a test composite which was not too long or too fatiguing for the young child. The interest value of the tests was a factor in determining their retention and, if our experience

TABLE 1

List of Variables in Factor Analysis

Variable Number	Item Name
1	Little Pink Tower
2	Hidden Figures
3	Straight Tower
4	Three Cube Pyramid (time)
5	Six Cube Pyramid
6	Fist and Thumb
7	Thumb and Finger
8	Decroly Matching
9	Wallin Peg Board B (time)
10	Nest of Cubes
11	Direction Test, Part 1 - Naming of Objects
12	Food Naming
13	Drawing Completion A (moon face)
14	Copy Line, Circle, Cross
15	Drawing Completion B (block completion)
16	Drawing Completion C (cutting a pie)
17	Round Things
18	Block Sorting A
19	Block Sorting B
20	Block Sorting C
21	Word Meaning
22	Action Agent
23	Agent Action
24	Stick Test A (copying patterns)
25	Stick Test B
26	Ambiguous Forms (ideas)
27	Ambiguous Forms (elaboration)
28	Dot Test A
29	Dot Test B (following directions)

with four-year olds indicated some lack of interest value, even if they were possibly significant in their capacity for differentiation of ability, they were eliminated or altered to add interest value.

As can be noted in Table 1, some items were included which clearly involved cognitive thinking. It was intended to have an equal number of convergent productive and divergent productive types of test item, and a few others which were judged to involve cognitive thinking. Altogether, there were 18 test items, some of which had, potentially, combinations of convergent, divergent and cognitive components. Such test items were Stick Tests A and B, Round Things, Directions Test, and the Action Agent and Agent Action tests. While the list of items may seem long, each item required only a brief response time; thus, it was found to be possible to maintain the child's interest with a suitable combination of tasks for the three-year-old child.

For administration, the tests were assembled in a sequence which was judged to be favorable for maintaining the child's interest. A test record booklet was provided with adequate space for recording the child's verbal responses and comments as well as his behavior during the test.

A manual of instructions for administration of the tests was set up for the use of the examiners. (See Appendix I.)

Selection and Training of Project Personnel

A search was made for qualified individuals who were available to assist with the data collection. Some of those who had tested the four-year olds were still available, although, during the passage of time, several were no longer in the area. All of the persons chosen had at least a master's degree in psychology. It was desirable to find those with experience with young children and liking for them and with ability to gain rapport with them. We were fortunate in obtaining at each center a well qualified and interested person to serve as facilitator and coordinator who located sources of child subjects and made arrangements with mothers and nursery schools for the testing.

Selection of Subjects

In order to limit the problem somewhat in terms of number of variables, it was decided to control the factors of race by using only English speaking, white children in this particular study. No attempt was planned to control for or study the effects of social class per se, but, since the preschool child generally is in closest association with his mother, his cognitive development is largely shaped by the quality of stimulation his mother provides. Since it seemed possible that some part of this stimulation might depend upon the level of his mother's education, it was decided to include the mother's educational level as a selection criterion. Three levels of education were arbitrarily chosen - ninth grade or less, high school graduation, and college graduation.

Since there were two bases of operation of this project, we planned to select an equal number of subjects at each center. Table 2 gives the actual distribution of the subjects tested. As can be seen from this table, 227 boys and 189 girls, a total of 416 children, were included in this study.

Procedures for Scoring the Test Items

Certain of the test items were timed and offered no difficulty in scoring. However, many of the items required careful study to determine an appropriate method of scoring. This was done independently by the investigator and Leland E. Stott, a consultant, and the determination of the final scoring was arrived at through conference with the purpose of making it as noncomplicated and objective as possible. The 416 protocols were scored and checked. The data as collected and scored were transcribed from the original tabulation sheets to a form more convenient for the preparation of the punched cards.

In the early tabulation process, it was discovered that several of the time-to-completion distribution of scores were skewed, and they, therefore, were transformed by C scaling to more suitable distributions. Other scores were entered in their natural form.

In order to ascertain that the requirements of the Pearson-r were met, and to provide scores in a form appropriate to later use, a scheme was devised to transfer each measure into the closest possible approximation of a Gaussian five-category scale. Following the area transformation procedures typically used in developing C scale or stanine scores, five categories were defined as having their limits the following cumulative proportions:

Value	Limits (cp)	cn
1	.0000 - .0667	26
2	.0668 - .3084	119
3	.3085 - .6914	269
4	.6915 - .9331	360
5	.9332 - 1.0000	386

Even in so large a sample, it was not possible for every test to apportion the responses exactly in the frequencies shown. The rule was to assign persons to the five categories so that the overall deviation frequencies would be minimized.

TABLE 2

Distribution in Terms of Geographic Location,
Mothers' Educational Level, and Sex of Children Tested

Area	Mothers' Education	Boys	Girls	Totals
Midwestern sample	Ninth grade or less	23	8	31
	High school	56	56	112
	College	34	30	64
Subtotals		113	94	207
Western sample	Ninth grade or less	31	10	41
	High school	57	58	115
	College	26	27	53
Subtotals		114	95	209
Totals	All levels	227	189	416

Because of incomplete data, 30 cases were eliminated, reducing the number to 386.

ANALYSIS AND FINDINGS

The Factor Analysis

The intercorrelations among the scaled values for the 29 test item scores (N = 386) appear in Table 3. Principal factors were extracted using the Burroughs installation at the Computer Center, Kent State University (as were all other major computations). The details of the computations, including writing some new programs, were the primary responsibility of Louise Podojil, of the Graduate Staff of the Bureau of Educational Research, Kent State University. The initial estimates of communalities were the highest correlation of a variable with any other. The program used iterated until stable communalities were obtained for a specified number of factors, in this case, seven.

The seven principal factors obtained are presented in Table 4. It will be noted that the lowest eigenvalue (root) for these seven components is only .3957, quite a bit below the values frequently recommended. However, in this study, some logically distinct factors were represented by only two or three measures; thus, the choice to accept components with relatively small eigenvalues seems justified.

The sum of the eigenvalues for the first seven factors is very nearly the sum of the communalities. (This criterion is suggested by Harman, 1967.) It is analogous to retaining components with eigenvalues greater than one when one is the initial diagonal entry.

The first seven factors were rotated to meet the varimax criterion and then, after inspection, the second and seventh in Table 5 were rotated to provide more appropriate interpretation of the factors while retaining hyperplanar scope. The results, which appear to meet the intuitive notions of simple structure and to exhibit factors which are interpretable rather easily, are shown in Table 7, which is identical to Table 6 except for factors two and seven.

TABLE 3

Test Item Intercorrelation Matrix.

Item No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
1																													
2	-.153																												
3	-.029	.155																											
4	.205	-.220	-.133																										
5	-.205	.262	-.016	-.230																									
6	-.151	.158	.019	-.088	.101																								
7	-.186	.274	-.008	-.142	.282	.240																							
8	-.220	.430	.159	-.342	.315	.147	.314																						
9	.243	-.178	-.008	.195	-.150	-.167	-.103	-.174																					
10	.265	-.265	-.043	.177	-.248	-.136	-.196	-.299	.229																				
11	-.213	.398	.030	-.182	.281	.183	.312	.392	-.191	-.326																			
12	-.086	.305	.122	-.110	.146	.193	.155	.249	-.074	-.162	.348																		
13	-.137	.303	.152	-.178	.207	.162	.137	.376	-.158	-.182	.303	.156																	
14	-.174	.448	.174	-.264	.336	.210	.274	.417	-.219	-.267	.441	.380	.370																
15	-.153	.282	.107	-.269	.231	.114	.245	.356	-.200	-.199	.258	.196	.381	.340															
16	-.090	.157	.021	-.146	.232	.072	.124	.198	-.091	-.050	.174	.113	.162	.257	.305														
17	-.087	.294	.057	-.115	.232	.142	.197	.205	.039	-.088	.193	.181	.156	.182	.132	.111													
18	-.122	.259	.112	-.147	.088	.128	.120	.370	-.132	-.211	.256	.198	.277	.259	.163	.109	.002												
19	-.144	.173	.100	-.224	.165	.169	.051	.221	-.229	-.100	.223	.274	.177	.196	.116	.096	.025	.174											
20	-.096	.201	.134	-.169	.209	.155	.163	.242	-.133	-.053	.140	.114	.129	.218	.128	.189	.172	.060	.235										
21	-.166	.339	.141	-.203	.217	.224	.116	.324	-.148	-.214	.418	.371	.305	.300	.190	.090	.192	.247	.189	.050									
22	-.059	.364	.209	-.192	.229	.137	.134	.427	-.134	-.197	.369	.457	.314	.429	.258	.163	.121	.224	.207	.135	.482								
23	-.139	.359	.145	-.159	.161	.187	.200	.334	-.149	-.191	.391	.495	.296	.375	.235	.174	.214	.242	.202	.137	.544	.558							
24	-.257	.440	.151	-.337	.383	.143	.307	.431	-.223	-.237	.391	.270	.304	.462	.310	.226	.245	.229	.247	.240	.300	.353	.274						
25	-.107	.040	.193	.181	.062	.057	-.061	.080	.022	-.004	.051	.252	.100	.148	.021	.071	.017	.098	.172	.066	.180	.264	.222	.130					
26	-.040	.322	.127	-.125	.140	-.064	.229	.306	.146	-.147	.218	.290	.138	.248	.183	.487	.170	.155	-.005	.048	.311	.392	.359	.198	.095				
27	-.118	.311	.030	-.141	.177	.025	.248	.195	.010	-.114	.249	.195	.139	.183	.226	.157	.195	.082	.038	.079	.247	.260	.195	.139	.183	.226			
28	-.107	.151	.113	-.191	.106	.063	.010	.148	.039	-.060	.042	.100	.144	.077	.152	.141	.093	.026	.193	.148	.182	.176	.100	.144	.177	.152	.141		
29	-.095	.365	.155	-.279	.280	.070	.241	.388	-.110	-.211	.282	.242	.281	.370	.388	.236	.172	.161	.105	.151	.256	.323	.284	.331	.133	.283	.257	.372	

TABLE 4

Unrotated Factor Matrix (Principal Components)

Var.	Roots	Communality	1	2	3	4	5	6	7	8
1	0.3256	0.2958	-0.314	0.257	-0.042	0.168	0.058	0.234	0.152	0.133
2	1.1800	0.4259	0.627	-0.020	-0.136	0.071	-0.012	0.033	-0.081	0.158
3	0.9393	0.2943	0.228	0.157	0.239	0.081	0.083	0.202	-0.232	0.108
4	0.8356	0.2775	-0.417	0.178	-0.195	-0.070	-0.024	0.035	0.174	0.138
5	0.5920	0.3037	0.461	-0.256	-0.067	0.081	-0.124	-0.021	0.003	-0.132
6	0.4406	0.2005	0.281	-0.105	0.044	-0.233	-0.193	-0.039	0.130	0.174
7	0.3957	0.3241	0.408	-0.225	-0.306	0.055	-0.108	-0.010	0.009	0.056
8	0.3094	0.4934	0.662	-0.119	-0.014	0.037	0.149	0.050	-0.135	0.121
9	0.2278	0.2590	-0.288	0.264	-0.071	0.304	-0.078	0.026	-0.010	0.087
10	0.1997	0.2935	-0.401	0.167	0.103	0.156	-0.110	0.213	0.115	-0.014
11	0.1913	0.4459	0.610	-0.033	-0.180	-0.179	-0.018	-0.067	0.073	0.033
12	0.1598	0.4454	0.523	0.333	0.012	-0.134	-0.177	0.055	0.083	-0.053
13	0.1242	0.3654	0.497	-0.057	0.113	-0.054	0.285	0.054	0.136	0.111
14	0.0890	0.4863	0.665	-0.072	-0.026	-0.047	0.032	0.189	0.058	-0.026
15	0.0795	0.4041	0.503	-0.189	0.011	0.170	0.214	0.025	0.209	-0.061
16	0.0284	0.2526	0.323	-0.158	0.073	0.165	-0.028	0.111	0.255	-0.144
17	0.0199	0.3253	0.319	-0.020	-0.183	0.199	-0.363	-0.018	-0.057	0.118
18	-0.0070	0.2336	0.385	0.012	0.029	-0.183	0.214	0.042	-0.063	0.122
19	-0.0135	0.2995	0.347	-0.063	0.324	-0.220	-0.144	0.054	-0.018	-0.020
20	-0.0307	0.3149	0.310	-0.199	0.163	0.068	-0.256	0.235	-0.027	0.091
21	-0.0435	0.4977	0.583	0.303	0.001	-0.157	-0.028	-0.216	0.021	0.044
22	-0.0746	0.5627	0.643	0.370	0.053	-0.033	0.059	0.071	0.031	-0.069
23	-0.0882	0.5858	0.627	0.388	-0.042	-0.140	-0.077	-0.037	0.128	-0.018
24	-0.1162	0.4602	0.629	-0.201	-0.016	0.002	-0.059	0.113	-0.120	-0.083
25	-0.1540	0.2361	0.229	0.245	0.322	-0.013	-0.084	0.029	-0.102	-0.185
26	-0.1640	0.4502	0.432	0.322	-0.274	0.215	0.099	-0.009	-0.179	-0.059
27	-0.1946	0.2556	0.380	0.089	-0.263	0.180	-0.037	-0.035	0.003	-0.122
28	-0.2164	0.4998	0.256	0.022	0.480	0.326	-0.083	-0.303	0.056	0.133
29	-0.2514	0.4949	0.562	-0.037	0.093	0.375	0.117	-0.114	0.069	0.011

TABLE 5

Variances — Total Variance 10.70874

Factor	Column Total	Percent of Common Variance
1	2.0842	19.4630 A
2	2.5477	23.7905 B
3	0.8656	8.0827 C
4	1.9495	18.2045 D
5	1.4530	13.5682 E
6	0.8883	8.2953 F
7	0.9205	8.5959 G

TABLE 6. Factors Rotated to Varimax Criterion.

	Var.	I A	II B	III C	IV D	V E	VI F	VII G
Little Pink Tower (time)	1	-.004	.021	.119	.462	.113	.001	.186
Hidden Figures	2	.311	.277	.003	.309	.342	.197	.018
Block Building	3	.056	.168	.115	.014	.049	.439	-.038
Three Cube Pyramid (time)	4	.180	.046	.238*	.322	.102	.258	.093
Six Cube Pyramid (time)	5	.280	.023	.086	.278	.333	.066	.160
Fist and Thumb	6	.083	.154	.008	.161	.104	.067	.361
Thumb and Finger	7	.254	.020	-.108	.272	.413	-.024	.064
Decroly	8	.379	.218	.043	.430	.189	.289	.019
Peg Board (time)	9	.146	.031	-.054	.379	.083	.022	.285
Nest of Cubes (time)	10	.114	.131	-.006	.502	.101	-.017	.034
Boxes and Cars	11	.280	.358	-.100	.378	.246	-.015	.165
Food Naming	12	.130	.578*	.003	.035	.203	.121	.189
Drawing Completion A	13	.452	.241	.041	.272	-.104	.120	.066
-0+	14	.446	.287	-.055	.266	.203	.238	.194
Drawing B - no. lines right	15	.571	.093	.107	.228	.085	.039	.004
Drawing C - no. lines from center	16	.427	.022	.123	-.006	.133	.025	.153
Round things named	17	.060	.094	.078	.031	.534	.050	.066
Block Sorting A) color or shape	18	.192	.245	-.077	.308	-.082	.167	.047
Block Sorting B)	19	.067	.191	.162	.171	-.028	.203	.403
Block Sorting C (size)	20	.188	-.039	.116	.019	.233	.279	.325
Word Meaning	21	.104	.618	.101	.280	.114	.004	.057
Action Agent	22	.279	.633	.046	.122	.140	.237	.016
Agent Action	23	.203	.694	.002	.122	.192	.053	.109
Stick Test A	24	.320	.141	.026	.365	.303	.288	.192
Stick Test B	25	-.041	.306	.240	-.026	-.041	.261	.105
Ambiguous Forms (ideas)	26	.144	.392	-.054	.126	.315	.186	-.356
Ambiguous Forms (elab.)	27	.211	.220	-.029	.110	.359	.015	-.145
Dot Test A	28	.132	.126	.684	.036	.026	.037	.024
Dot Test B	29	.467*	.191	.351	.201	.220	.113	-.135

*Variables 1, 4, 9 and 10 are time scores and have been reflected in this matrix so that what was given as time is now indicated as level of success.

TABLE 7. Factors Rotated to Varimax Criterion.

	Var.	I A	II BB*	III C	IV D	V E	VI F	VII GG*
Little Pink Tower (time)	1	-.004	.17	.119	.462	.113	.001	-.08
Hidden Figures	2	.311	.17	.003	.309	.342	.197	.23
Block Building (straight - tower)	3	.056	.06	.115	.014	.049	.439	.17
Three Cube Pyramid (time)	4	.180	.10	.238*	.322	.102	.258	.00
Six Cube Pyramid (time)	5	.280	.14	.086	.278	.333	.066	-.07
Fist and Thumb	6	.083	.38	.008	.161	.104	.067	-.07
Thumb and Finger	7	.254	.06	-.108	.272	.413	-.024	-.01
Decroly	8	.379	.14	.043	.430	.189	.289	.17
Peg Board (time)	9	.146	.26	-.054	.379	.083	.022	-.13
Nest of Cubes (time)	10	.114	.10	-.006	.502	.101	-.017	.09
Boxes and Cars	11	.280	.34	-.100	.378	.246	-.015	.21
Food Naming	12	.130	.48*	.003	.035	.203	.121	.38
Drawing Completion A	13	.452	.19	.041	.272	-.104	.120	.17
-0+	14	.446	.32	-.055	.266	.203	.238	.14
Drawing B - no. lines right	15	.571	.05	.107	.228	.085	.039	.08
Drawing C - no. lines from center	16	.427	.13	.123	-.006	.133	.025	-.06
Round things named	17	.060	.11	.078	.031	.534	.050	.04
Block Sorting A) color or shape	18	.192	.18	-.077	.308	-.082	.167	.18
Block Sorting B)	19	.067	.44	.162	.171	-.028	.203	-.05
Block Sorting C (size)	20	.188	.25	.116	.019	.233	.279	-.21
Word Meaning	21	.104	.39	.101	.280	.114	.004	.49
Action Agent	22	.279	.36	.046	.122	.140	.237	.52
Agent Action	23	.203	.46	.002	.122	.192	.053	.52
Stick Test A	24	.320	.23	.026	.365	.303	.288	.02
Stick Test B	25	-.041	.26	.240	-.026	-.041	.261	.20
Ambiguous Forms (ideas)	26	.144	-.09	-.054	.126	.315	.186	-.52
Ambiguous Forms (elab.)	27	.211	-.01	-.029	.110	.359	.015	.26
Dot Test A	28	.132	.09	.684	.036	.026	.037	.10
Dot Test B	29	.467*	-.02	.351	.201	.220	.113	-.24

*Graphic rotations are substituted for Factors B and G (Table 6) in order to provide more appropriate interpretation while maintaining hyperplanar scope.

Factor Interpretation

The factors in the best seven-factor solutions, with their significant factor loadings, follow below. Loadings of .30 or more absolute value are included plus, in parentheses at the end of the list, those loadings for items which nearly approximate this minimum and which seem logically to bear relationship to the factor.

Factor A - Convergent Figural Thinking (NFS) 19% of variance

Loading	Variable No.	Task
.57	15	Drawing Completion B (block completion)
.47	29	Dot Test B (following directions)
.45	13	Drawing Completion A (moon face)
.45	14	Copy Line, Circle, Cross
.43	16	Drawing Completion C (cutting a pie)
.38	8	Decroly Matching (contours rather than labeling)
.32	24	Stick Test A (copying patterns)
.31	2	Hidden Figures

Hyperplane: 1, 3, 6, 17, 19, 25

Since the Drawing Completion tests A, B and C all have similar high loadings, it is indicated that the scores for the three items can be combined and, from these, a corrected average can be used for the final scoring of these items.

This group of measures was quite easily identified. All involve production of a clearly defined percept. Most percepts are sufficiently complex to warrant the category of systems, at least considering the age of the examinees. Perhaps a more popularly meaningful name for this factor is ability to organize spatial systems, a variety of convergently productive thinking. This factor is similar to Factor A in the preceding study of four-year-old children.

Factor B - Ideational Fluency (DMU) - Divergent Production of Semantic Units

The varimax solution yielded the loadings on this factor shown below. It is rather clearly divergent production in the semantic content domain, although it contains both units and implications.

Loading	Variable No.	Task
.69	3	Agent Action
.63	22	Action Agent
.62	21	Word Meaning
.58	12	Food Naming
.39	26	Ambiguous Forms (ideas)
.36	11	Boxes and cars (directions test, Part 1)
.31	25	Stick Test B
.29	14	Copy Line, Circle, Cross

Hyperplane: 1, 4, 5, 7, 9, 15, 16, 17, 20

Factor BB (DMU) - A Suggested Revision

In an attempt to add interpretability to this factor and to Factor G, a graphic rotation of the varimax positions of those two factors was made. The resulting Factor BB (DMU) is presented below:

Loading	Variable No.	Task
.48	12	Food Naming
.46	23	Agent Action
.44	19	Block Sorting B
.39	21	Word Meaning
.38	6	Fist and Thumb
.36	22	Action Agent
.32	14	Copy line, circle, cross

Hyperplane: 3, 4, 7, 10, 15, 26, 27, 28, 29

However, in comparing the two alternatives, the choice is difficult. The order in BB has some advantages, but one must still accept Fist and Thumb in lieu of Boxes and Cars, neither of which seems particularly related to Ideational Fluency. The choice with respect to Factor G is less ambiguous, as will be seen later.

The resultant factor is clearly Ideational Fluency in the classic form. It is simply the ability to produce a variety of ideas in words.

The similarity of this factor with the other divergent production Factor G implies that children who are verbally fluent may also be imaginative and original.

Factor C - Dot Test Special

Loading	Variable No.	Task
.68	28	Dot Test A
.35	29	Dot Test B
(.24	25	Stick Test B)

No interpretation other than specific task is made. This will not be included in the final factor naming.

Factor D - General Reasoning and Spatial Modeling

This factor can be broken up into two sections: (1) those involving timed tests for which the scores are reflections of time scores - the shorter the time, the higher the score; and (2) spatial modeling, following directions - scores on basis of adequacy of response.

	Loading	Variable No.	Task
(1)	.50	10	Nest of Cubes (time)
	.46	1	Little Pink Tower (time)
	.38	9	Wallin Peg Board B (time)
	.32	4	Three Cube Pyramid (time)
(2)	.43	8	Decroly Matching (following directions)
	.38	11	Boxes and Cars (directions test)
	.37	24	Stick Test A (following directions)
	.31	2	Hidden Figures (pointing out hidden objects)
	.31	18	Block Sorting A (highest loading on this item - following directions)
	(.28	21	Word Meaning)

Hyperplane: 3, 12, 16, 17, 20, 25, 28

It may be that the timed tasks (1, 4, 9, 10) involve a substantial amount of reasoning at age three. While this finding might be thought to support a "branching" model for intelligence, it might also suggest that we should devise simpler tasks for spatial modeling.

The hyperplane of this factor is broad, including representatives of most other factors.

The familiar label General Reasoning seems a useful name for this constellation of tasks. Following complicated directions and seeing relational alternatives are typical representatives.

The factor involving timed tests was separated from the spatial modeling - following directions tasks - in our study of four-year-old children. Typically, the Little Pink Tower is found in Factor NFU as it occurs in the previous study; its appearance in this grouping is one of the few divergences from the findings of that factor analysis.

Factor E - Production of Figural Units (NFU) 14% of variance

Loading	Variable No.	Task
.53	17	Round Things
.41	7	Thumb and Finger (making round with finger)
.36	27	Ambiguous Forms (elaboration B)
.34	2	Hidden Figures
.33	5	Six Cube Pyramid (compare with Three Cube Pyramid - Factor D) (It is not so much a reasoning task but a difficult perceptual task, failed by most three-year olds.)
.32	26	Ambiguous Ideas A
.30	24	Stick Test A

Hyperplane: 3, 9, 15, 18, 19, 25, 28

This factor seems something like Factor D in four-year olds in that their hyperplanes are similar. Note that the psychomotor component may be "necessary but not sufficient."

Developmental phenomena do not necessarily insist that the same task is evaluated the same at different age levels. For example, since the Six Cube Pyramid represents great difficulty at the three-year level and much more percentage of success at four and five years of age, it is to be expected that different factors may be involved.

The Round Things item does not appear to be a satisfactory test for three-year olds. It needs revision in scoring procedure, which will be done when the test results are combined for the three age levels - three, four and five years.

Factor F - Dexterity - Psychomotor Control

Loading	Variable No.	Task
.44	3	Straight Tower

For two-year olds, this item might have a different factor significance, but for three-year olds it represents skill in placing one block on top of another, making a tower. The higher the tower, the greater the skill in balancing and placing the blocks. While other tasks in this series involve dexterity, the psychomotor components are "necessary but not sufficient." (See Factor E.)

Hyperplane: 1, 5, 6, 7, 9, 10, 11, 15, 16, 17, 21, 23, 27, 28

This item is judged to be maturational in nature. Compare the psychomotor control tests at the four-year level. They are Thumb and Finger Opposition and Fist and Thumb, which are also maturational but are definitive for four-year olds, as shown in previous

studies (Stutsman, 1931). This is the clearest factor in terms of its separation from the other six in this battery, and its hyperplane includes a representative of each of the other factors.

Although this manipulative task involves control of fine muscles, it, too, requires mental operations, but apparently not in a differentiating way. Similarly, performance on "intellectual" tasks require motor skills for their execution; yet, in this sample, those skills, for example speech, are not differentiating. Nevertheless, it must be pointed out that, while many of the test items in this study are concerned with the manipulation of objects, it is obvious from the factor analytic findings that they cannot be simply regarded as purely motor tasks. The fact that those tests involving motor responses are in the same factors as those involving what are often labeled "intellectual" indicates the major mental activity is similar and independent of the mode of expression.

Factor G - The Varimax Rotation

The varimax solution yielded the following ambiguous results for Factor G:

Loading	Variable No.	Task
.40	19	Block Sorting B
.36	6	Fist and Thumb
.32	20	Block Sorting C
-.36	26	Ambiguous Forms (ideas)

Hyperplane: 2, 3, 4, 7, 8, 10, 13, 15, 17, 18, 21, 22, 28

Perhaps the easiest explanation for this collection of tasks is a technical one, based on the nature of scores rather than the nature of the tasks. Block Sorting C has Block Sorting B as a necessary precondition: if a child cannot sort blocks in two ways (thus receiving a score on B), he cannot sort three ways and, thus, cannot receive a score on C. It is possible that this experimental dependence may have induced an inflated correlation making this factor a kind of specific. But how, then, to rationalize Fist and Thumb? That task did not load Factor F, defined as Dexterity, so it would appear that some figural component is being tapped in this factor. The negative loading of Ambiguous Forms may reflect in part the frequent clear separation between semantic and figural aspects, or, since Ambiguous Forms (elaboration) is slightly experimentally dependent on this test, its communality may be somewhat inflated and has been allocated here. Task 26 correlates very near zero with Tasks 19, 20 and 6 - not negatively as might be expected from these loadings. All in all, the factor in the position shown above seems ambiguous, unless one regards it as a combination of artifact and chance, in which case it should simply be disregarded.

Factor GG (DMI) - A Suggested Revision

The graphic rotation produced improved results for Factor GG.

As noted in the discussion under Factor B, the varimax positions for Factors B and G were rotated to yield BB (discussed above as DMU) and GG, presented below and defined as DMI.

Loading	Variable No.	Task
.52	26	Ambiguous Forms (ideas)
.52	22	Action Agent
.52	23	Agent Action
.49	21	Word Meaning
.38	12	Food Naming

Hyperplane: 1, 4, 5, 6, 7, 10, 15, 16, 17, 19, 24, 28

The dependent Block Sorting tasks are no longer confused with other variables, a bi-polar factor is avoided, and some evidence is obtained to suggest a small differentiation between quantity of ideas and imaginativeness or extensions of ideas. The presence of an ability for producing semantic elaborations (from both figural and semantic stimuli) is indicated by the similarity of loading of the three higher test items. The commonly used name for this factor is elaboration.

The hyperplane is predominately representative of Factors A and E, both of which require convergent thinking. As in our factor analysis of the four-year-old children, the divergent production of implications (Factor F) is similar in content to the present Factor G.

While the separation of this factor from DMU is not as clear as one might hope, the inclusion of Ambiguous Forms suggests the exercise of imagination, which warrants the DMI interpretation.

Comparison of the Factor Analysis Results of the Study of Three-Year Olds with that of the Four-Year Olds

Factor A. NFS convergent figural thinking is almost identical at the two age levels.

Factor B. DMU, Ideational Fluency, is the same factor with many of the same test items occurring in both age level studies.

Factor C. Dot Test Special. This test is a new one which was not given to the four-year-old children.

Factor D. CMS, General Reasoning. This factor is similar to Factor C at the four-year-old level.

Factor E. NFU, Production of Figural Units. Many of the same factor contents were present in Factor F of the four-year olds.

Factor F. Psychomotor Control. Compares in content meaning with Factor E of the four-year-old test array.

Factor G. DMI, Originality. The similar factor content to this factor is found in Factor F at the four-year-old level.

Thus, it can be seen that, with the exception of the Dot Test, which was a new item for three-year olds, the meaning of the various factors is the same for both age levels.

Analysis of Contingencies of Factor Score and Questionnaire Items

Presented below for 11 selected items of the questionnaire are the number of children represented in each category of each item and a verbal description of the relationship of that distribution to the distribution of factor scores obtained by the children. Contingency tables were prepared showing the cross-plot of each category and four or five intervals for each factor score; in many cases, chi-squared values should not be computed from these tables because too many of the cells had theoretical frequencies too low to provide a reasonable estimate of the value of chi-squared.

Thus, each contingency table was reduced to a 2 x 2 table based on combinations of apparently similar categories from the questionnaire items and combinations of adjacent intervals in the factor score distributions. "Significant" results are thus based on the chi-squared statistic computed from a 2 x 2 table. Because of the difficulty of interpreting the varimax Factor G, it is not cited in the listing below although two significant chi-squared values were computed involving it, with items 5 and 11.

N varies from one questionnaire to another, as noted. There appeared to be no bias in the factor score distributions arising from this kind of self-selection on the questionnaire.

1. Mother reads to child N = 227

No	24
Yes	203

This item is related to no factor scores.

2. Occupation of mother N = 371

Part-time employed	33	
At home full time	245	(compared with all others in analysis)
Employed full time	80	
Student	8	
Deceased	5	

When at-home-full-time-mothered children were compared with all others, more of them have lower scores on Production of Figural Units than would be expected

by chance. As a conjecture, perhaps the at-home mothers talk to their children more and the children do not have as much opportunity to explore visually and spatially. Or perhaps the explanation of these lower scores lies in the possibility that the mothers who are at home do more for their children and expect less from them. In other words, these children may have less experience in dealing with objects and in visual and manipulative performances.

3. Occupation of father N = 364

Dead or unknown	11	
Unemployed	9	
Unskilled labor	34	
Mechanically skilled	78	
Business	126)	compared with all others in analysis
Professional	89)	
Part-time employed	2	
Student	11	
Army	4	

When children whose fathers were in business or a profession were compared with all other children, more of them had lower scores on convergent figural thinking than would be expected; on the other hand, more children with business or professional fathers had higher scores on ideational fluency than would have been expected were there no relationship. The finding that the fathers in business and professions have children who are less able in manipulation and visual problem solving is consistent with the above finding about children whose mothers are at home full time.

The high scores on Ideational Fluency on the other hand perhaps indicates that the home environment and expectation for these children is more oriented to verbal competence and less to mechanical or spatial problem solving. There is quite possibly a greater degree of verbal communication between these professional and business fathers and their three-year-old children than exists in the less favored homes. In the homes where the children are left to their own devices, where they must fend for themselves to a greater degree, there is a tendency for them to learn to manipulate objects for themselves and to solve their own spatial problems to a higher level of competence.

4. Time father at home N = 253

Daily	205
Some free time	13
Weekends	10
Occasional visit	6
Never	17
Deceased	2

This questionnaire item was related to no factor scores.

5. Age of child N = 370

Three years plus		
0 months	32	
1 month	25	
2 months	27	
3 months	35	
4 months	38	
5 months	28	Cumulative n = 185
6 months	37	
7 months	21	
8 months	21	
9 months	20	
10 months	31	
11 months	55	

When children were grouped into those of three years, five months or less, and three years, six months or more, age is related to convergent figural thinking, to ideational fluency, and to general reasoning. In all cases, for each month there is an average increase in score, although the prediction of ability from age would not be very accurate for an individual child. The phi coefficient of correlation ranged from .2 to .3, implying a rather large standard error of estimate.

Comparing this finding with the age scores for four-year olds, the convergent figural thinking and the psychomotor control scores at four years showed progressive development throughout the age range, but there was no evidence of concurrent growth in divergent productive thinking, either in originality or ideational fluency. This finding implied that the four-year old's environment is not generally conducive to growth in spontaneity and originality. However, the older the three-year old, the greater the verbal fluency, although this does not hold true for originality.

6. Type of nursery school N = 259
(Title on questionnaire is Nursery School Attendance.)

Not attending now	98
Play school	35
Real nursery school	80
Day nursery or other	24
Never attended	10
Sunday school	12

No combination of categories could produce a relation to any factor score. Some mothers of all three educational levels were working and used various kinds of child care arrangements while they were at work. By far the largest number

of mothers were at home full time. As can be seen from the distribution above, many children were sent to some kind of child care program even if their mothers were not working.

More children at the four-year level were in some sort of nursery school (72%), a larger number of these were in the Detroit portion of our sample. No record was made of the extent of nursery school attendance for the four-year olds as was done for three-year olds since the questionnaire used was much more extensive for this second study.

7. Previous months in nursery school N = 227

None	102
1, 2, 3 months	41
4, 5, 6 months	27
7, 8, 9 months	20
10, 11, 12 months	19
13 or more months	18

When all categories were considered, no significant relation could be found. However, when only the 125 children having some previous attendance were considered, more of those children attending seven months or more have higher scores on both ideational fluency and divergent production of implications (originality). The longer attendance in nursery school seems to enhance children's fluency and imagination with semantic material. However, since, in Item 5, the older child, the higher the score, it seems possible that longer nursery school attendance means older children. There may be some indication that nursery school attendance may affect favorably the divergent behavior of three-year-old children, but, since the relationship of age to attendance was not studied, this cannot be affirmed.

8. Education of mother N = 369

Ninth grade or less	58
High school	202
College	109

There seems to be little difference in distribution of factor scores for children whose mothers have high school or college experience. However, when children whose mothers completed no more than ninth grade were compared with the other children, the difference in scores were significant for all factors except dexterity. In every case, more children with less schooled mothers had lower scores than would be expected, and, of course, more children with more schooled mothers had higher scores.

It seems quite possible that socio-economic status is a contributing, or at least a concomitant, factor here although "occupation of father" was not as clearly related to as many factor scores. The whole home environment seems set by the mother - her interests and pursuits. On the other hand, extreme caution must

be invoked at predicting aptitudes from the mother's level of education. Although the chi-squared values are significant, the equivalent phi coefficients of correlation are so small that attempting to predict aptitude of the child from the mother's level of schooling would be rather ridiculous. The range of phi is from .1 to .2 at best. The possibility that heredity is a factor cannot be assumed.

9. Education of father N = 300

Dead or unknown	8
Less than high school	31
High school graduate	127
College attendance	87
M.A. or postgraduate	26
Ph.D. or higher	21

When children whose living fathers have completed no more than high school were compared with children whose fathers have had any college experience at all, more of the children of less schooled fathers had lower scores and, of course, more of the children of more schooled fathers had higher scores than would have been expected if education of the father had no relation to the following factors: convergent figural thinking and production of figural units.

It is interesting that the education of the father is related to figural tasks where that of the mother included verbal tasks as well as figural. This finding is intriguing considering the reverse on figural material for children whose fathers were in business or profession (Item 3) and presumably were better schooled. The contingency table suggests that most of the differentiation occurs in the upper quartile of the factor scores.

10. Sex of child N = 372

Boy	240
Girl	132

The sole relation here is with Ideational Fluency, with more girls having higher scores, consistent with the common observation at later ages.

11. Geographical location N = 384

Phoenix and vicinity	130
California areas	43
Detroit and vicinity	211

When Phoenix and California were combined for comparison to Detroit, apparent geographical differences were related to the following factor scores:

Convergent Figural Thinking
Production of Figural Units
Production of Semantic Implications
General Reasoning

For the three production factors, children from Phoenix and California had higher scores; for general reasoning, children from Detroit had higher scores. These differences might be related to examiner differences, selection differences, and just perhaps differences in the general ambience of the two areas. Again, however, prediction is not indicated as the highest phi coefficient is .24 from production of figural units, but the others are .15 approximately. It is to be noted that there are no differences in the two areas in ideational fluency.

Evidence of Thinking Types

Since the factors found for the three-year-old children are strikingly consistent with those found for the four-year olds, it was decided that the Q study carried out for the four-year-old children was sufficient evidence of thinking types. A summary of these findings indicating at least six different profile types is repeated as a basis for our consideration at the three-year level.

These ability-type patterns and relationships found at the four-year level may be summarized by means of the following scheme for representing dominant factor score ratings of the six profile groups.

Very high rating	+++	Low average	--
Superior	++	Very low	---
Average	+-	Varied	V

Factor Names:

A (NFS) Ability to Organize Spatial Systems
B (DMU) Ideational Fluency
C (CMS) General Reasoning
D (NFU) Speediness in Spatial Modeling
E Psychomotor Control (small muscle)
F (DMI) Originality

Factors / Patterns	A	B	C	D	E	F
1	---	++	V	+-	V	+++
2	+++	---	+++	V	+++	---
3	++	+++	---	V	+-	+-
4	+-	+-	++	--	+++	++
5	--	+++	---	---	++	++
6	+++	--	++	+-	+++	---

TABLE 8

Summary of Significant Relations of
Questionnaire Items to Factor Scores

(Three-Year Olds)

Item	N	A NFx	B DMU	D GR	E NFU	G ?	BB DMU	GG DMI
2	371	-	-	-	5.52	-	-	-
3	364	8.10	6.16	-	-	-	-	-
5	370	21.11	11.53	28.84	-	5.58	8.06	-
7	125	-	-	-	-	-	4.78	-
8	369	4.30	9.06	7.63	4.51	-	4.04	5.35
9	292	4.38	-	-	13.77	-	-	-
10	372	-	4.23	-	-	-	4.77	-
11	384	9.55	-	9.71	88.06	10.59	-	11.00

Cell entries are chi-squared values computed from 2 x 2 tables. For one degree of freedom, the following probabilities may be attached to chi-squared values:

Chi-squared	Probability less than
$\geq$ 3.84	.05
$\geq$ 6.635	.01

Thus, it may be seen that children falling in Type 1 are low in convergent production (not good at following directions and organizing spatial systems). They are average in ideational fluency, varied in general reasoning, and average or above in capacity for motor speed. They were varied in psychomotor control of small muscles, and high in originality.

Each of the other types has its own range of abilities; none of the group studied was excellent in every task, but showed a variation which should be clinically and educationally significant and helpful in diagnosis and planning for the child, once the research results are organized in a useful format which can be applied for that purpose. However, in the total test results, some children are found who are excellent and others who are very low in every area. These were not included in the "Q" type analysis for four-year olds. In both age groups, a few children of each of these two extreme types were found.

In our projected study of retests of four-year olds when they become five years old, it will be interesting to see how the type patterns for four-year olds hold up when they become five years of age. We also intend to evaluate the three-year olds who are being retested at the age of five years. In this way, we can determine the reliability of the evaluations from one age level to the next.

CONCLUSIONS AND IMPLICATIONS

The factor findings for the three-year-old children are consistent with those already reported for four-year olds as presented in the section "Comparison of the factor analysis results of the study of three-year olds with that of the four-year olds." These factors were identified as belonging to three different categories of "operations." In the convergently productive category are the ability to organize related units into spatial systems and the ability to reproduce with dispatch models from concrete elements, an ability to produce a clearly defined precept (speediness in spatial modeling). In the divergently productive category, "thinking" in the sense of a free flow of relevant ideas (ideational fluency) and "originality" were identified. In the cognitive domain is the ability to perceive relationships among parts and to understand and follow directions (general reasoning ability).

The sixth ability, which is judged to depend largely upon the child's general level of maturation, is the psychomotor control of the fine musculature. A seventh unnamed factor was found for the Dot Test item, which was not given to the four-year-old children, and which, since it was univocal in nature, was not given a factor name. It is being given to the five-year-old children, and the factor results of that study should give more definite clues as to its factor meaning.

Related to the factor scores were 11 categories of information gained from the questionnaire and face sheet questions which the examiner asked the mother or the father at the time the child was tested.

As in the findings at the four-year-old level, the three-year-old children showed a substantially significant but modest gain throughout the age range of 12 months in ideational fluency, originality and general reasoning.

There was a slight tendency for girls to excel in ideational fluency, and this is consistent to findings in other studies. However, no other sex difference was found.

The project had a definite intention of gaining a group of children whose mothers fell into educational categories of ninth grade or below (one-fourth of distribution), high school graduates (one-half of distribution), and college graduates (one-fourth of distribution). However, it proved to be so difficult to locate mothers who had ninth grade or less education that we failed to reach the goal set. However, there were 58 mothers found for the three-year olds in the combined Detroit and Phoenix areas. There was found little difference in the distribution of factor scores for children whose mothers had attained high school or college education, but the children of mothers who had completed no more than ninth grade were significantly lower for all factors except dexterity (psychomotor control).

The children whose fathers' education level was no more than high school were lower than those whose fathers had any college education at all (41%) in the following factors: convergent figural thinking and production of figural units. It is interesting that the education of the father is related to figural tasks while that of the mother is related to verbal tasks as well as figural.

Two-thirds of the mothers were full time at home and, compared with all the others, their children had lower scores on production of figural units than would be expected by chance, tending to indicate the possibility that the mothers talk more to their children and do more for them, expecting less in the way of visual and spatial performance from them.

Also, when children whose fathers were in business or in a profession (56%) were compared with all other children, more had lower scores on production of figural units. A companion finding is shown with the above educational level of the fathers, and also with the finding about children whose mothers are at home full time. On the other hand, these perhaps more protected children have higher scores on ideational fluency than the children of fathers of other occupational levels.

The amount of time the father spent in the home had no relation to the factor scores, and the question of whether the mother takes time to read to the child also had no relation to the scores made by the children.

Less than 3% of the children had never attended any kind of nursery or church school, although 38% were not attending nursery school during the period when the test was administered. No relationship between the scores and nursery school attendance was found. However, children who had attended nursery school for seven months or longer had higher scores on both divergent production factors. This may be simply in line with the findings that the older children have higher scores. But since the divergent production factors seem to be more affected by this attendance, it may imply that nursery school attendance enhances children's fluency and originality.

There was a geographical differentiation found for these three-year olds from the two widely separated areas. The Detroit children were better in the cognitive area of general reasoning, and the Phoenix and California children were better in production of semantic implications (originality) and in the convergent production factors. There was no difference between the two areas in ideational fluency.

Again our findings in this report support the point of view that environmental stimulation is an important factor in the development of the intellect in the preschool child.

REFERENCES

Berger, R. M., Guilford, J. P., and Christensen, P. R. A factor-analytic study of planning. Psychol. Monogr., 1957, 71, No. 6 (Whole of No. 435).

Bernstein, B. Language and social class. Brit. J. Sociol., 1960, 11, 271-276.

Deutsch, M. P. The disadvantaged child and the learning process: some social, psychological and developmental considerations. In A. H. Passow (ed.) Education in depressed areas. New York: Teachers College, 1963.

Fruchter, B. The nature of verbal fluency. Educ. Psychol. Measmt., 1948, 8, 33-47.

Guilford, J. P. Creativity. Amer. Psychologist, 1954, 14, 469-479.

Guilford, J. P. The nature of human intelligence. New York: McGraw-Hill, 1967.

Guilford, J. P., and Hoepfner, R. Current summary of structure-of-intellect factors and suggested tests. Rep. Psychol. Lab. Univer. Southern Calif., 1963, No. 30.

Harman, H. H. Modern factor analysis. Chicago: Univer. of Chicago Press, 1960.

Hess, R. D. Educability and rehabilitation: the future of the welfare class. J. Marr. and Fam. Living, 1964, 26, 422-429.

Hess, R. D., and Shipman, Virginia C. Early experiences and the socialization of cognitive modes in children. Child. Develpm., 1965, 36, 869-886.

Hoepfner, R., Guilford, J. P., and Merrifield, P. R. A factor analysis of the symbolic-evaluation abilities. Rep. Psychol. Lab. Univer. Southern Calif., 1964, No. 33.

Lesser, Gerald S., Filfer, Gordon, and Clark, Donald H. Mental abilities of children from different social-class and cultural groups. Mon. Soc. for Res. in Child Developm., 1965, Vol. 36, No. 4.

McCartin, Sister Rose Amata, and Meyers, C. E. An exploration of six semantic factors at first grade. Multiv. Behav. Res., 1966, 1, 74-94.

Merrifield, P. R. An analysis of concepts from the point of view of the structure of intellect. In H. J. Klausmeier and C. W. Harris (eds.) Analyses of conceptual learning. New York: Academic Press, Inc., 1966.

Merrifield, P. R., Guilford, J. P., and Gershon, A. The differentiation of divergent-production abilities at the sixth-grade level. Rep. Psychol. Lab. Univer. Southern Calif., 1963, No. 27.

Orpet, R. E., and Meyers, C. E. A study of eight structure-of-intellect hypotheses in six-year-old children. Rep. NIMH Grant No. MH 08666-01 Univer. Southern Calif., 1965.

Schmadel, Elnora, Merrifield, Philip R., and Bonsall, Marcella R. A comparison of performances of gifted and nongifted children on selected measures of creativity. Calif. J. of Educ. Res., 1965, Vol. XVI, No. 3, pp. 123-128.

Sigel, Irving R., Hanesian, Jarman and Helen. Styles of categorization and their intellectual and personality correlates in young children. 1967, Human Develop., Vol. 10, No. 1.

Sitkei, E. F., and Meyers, C. E. Comparative structure of intellect in middle- and lower-class four-year-olds of two ethnic groups. Developmental Psychology, 1969, 1, 592-604.

Stott, L. H. Personality at age four. Child Develpm., 1962, 33, 287-311.

Stott, Leland H. Child Development, an individual longitudinal approach, 1967, Holt, Rinehart.

Stott, L. H., and Ball, Rachel S. Infant and Preschool mental tests; review and evaluation. Monogr. Soc. Res. Child Develpm., 1965, 30, No. 3.

Stutsman, Rachel S. Ball. Mental measurement of preschool children. New York: World Book Co., 1931.

Taylor, C. W. A factorial study of fluency in writing. Psychometrika, 1947, 12, 239-262.

Wilson, R. C., Guilford, J. P., Christensen, P. R., and Lewis, D. J. A factor-analytic study of creative thinking abilities. Psychometrika, 1954, 19, 297-311.

DIRECTIONS FOR ADMINISTERING AND SCORING THE TEST OF THINKING

General Directions

The testing should be done at a little table with small chairs. The child should be seated so that his elbows are even with the table. The examiner should sit opposite the child and see that the test materials are placed so that the child can manipulate them easily. The room where the testing is done should be as free as possible from distracting objects, such as toys, and from distracting noises. Observers, such as parents or other children, are to be present in the room only when in the judgment of the examiner it will facilitate the testing situation. If present, the observer should remain discretely silent.

The examiner should talk freely with the child and use various verbal devices to challenge his interest. The tests should be called "games" and should be presented as "surprises" and with a calculated intent to intrigue the child's curiosity.

The Face Sheet will be filled out as far as possible beforehand by the coordinator, but the examiner is responsible for seeing that it is completed. As much detail as possible is to be recorded about the child's performance and reactions to the test. All verbal responses should be recorded completely. The order of tests may be varied if it seems desirable to introduce one that has much appeal if the child's interest seems to be lagging.

It is important that there be a complete and accurate record. As soon as possible after a child has been tested, the completed test record should be returned to the coordinator.

If the child has a bad cold or shows other symptoms of not feeling well, the test should not be begun, or, if started, should be discontinued.

Directions for the Specific Test Items

Little Pink Tower

Materials: Five pink blocks varying in size from 3/8" to 2". Build the pink tower behind a screen, and then place it in front of the child. Then say, "See this pretty pink tower? See how it is built with the biggest block at the bottom, then the next biggest, and on up to this little baby block at the top. (Pointing to the blocks.) Do you think, if I knock the tower down, you can build it again just the same way, with the big block on the bottom and the little block on the top?" Whatever the response, tear the tower down, taking care to have the blocks near together in easy reach and thoroughly mixed.

Recording: If the tower is not built correctly, mark failure and do not record the time. Simply record "OK" and the time in seconds if order is correct. Start timing when the child picks up the first block and stop time when the last one is placed. Describe any further adjustments he may make. When he stops, ask, "Are you finished?" The raw score is the number of seconds required to build the tower in the correct order.

Hidden Figures

A. Materials: Three pictures: (1) Mary's kittens, (2) mamma rabbit, and (3) pretty balls on the grocery store shelves.

Place picture #1, Mary's kittens, directly in front of the child, saying, "Here is a picture of Mary. She has some kittens. She has lost her kittens. Look all over the picture to see if you can find her kittens."

Praise may be given for correct responses, such as, "That is good. Now find some more kittens," encouraging the child to examine the picture carefully.

Have child put his finger on the parts he identifies as kittens. If you are not sure of his identification, insist that he show you the kitten by putting his finger directly on it. Count only the number of correct identifications and record. Also indicate if he points to the same object more than once, but count only the one correct identification. The examiner does not illustrate by pointing to a kitten.

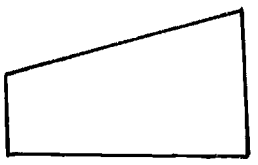
Even if the child fails picture #1, repeat the procedure for picture #2, mamma rabbit, saying, "Here is a picture of mamma rabbit. The baby rabbits are hiding from mamma rabbit. See if you can find them for her." The score is the number of baby rabbits the child identifies. No sample selection of rabbits is permitted.

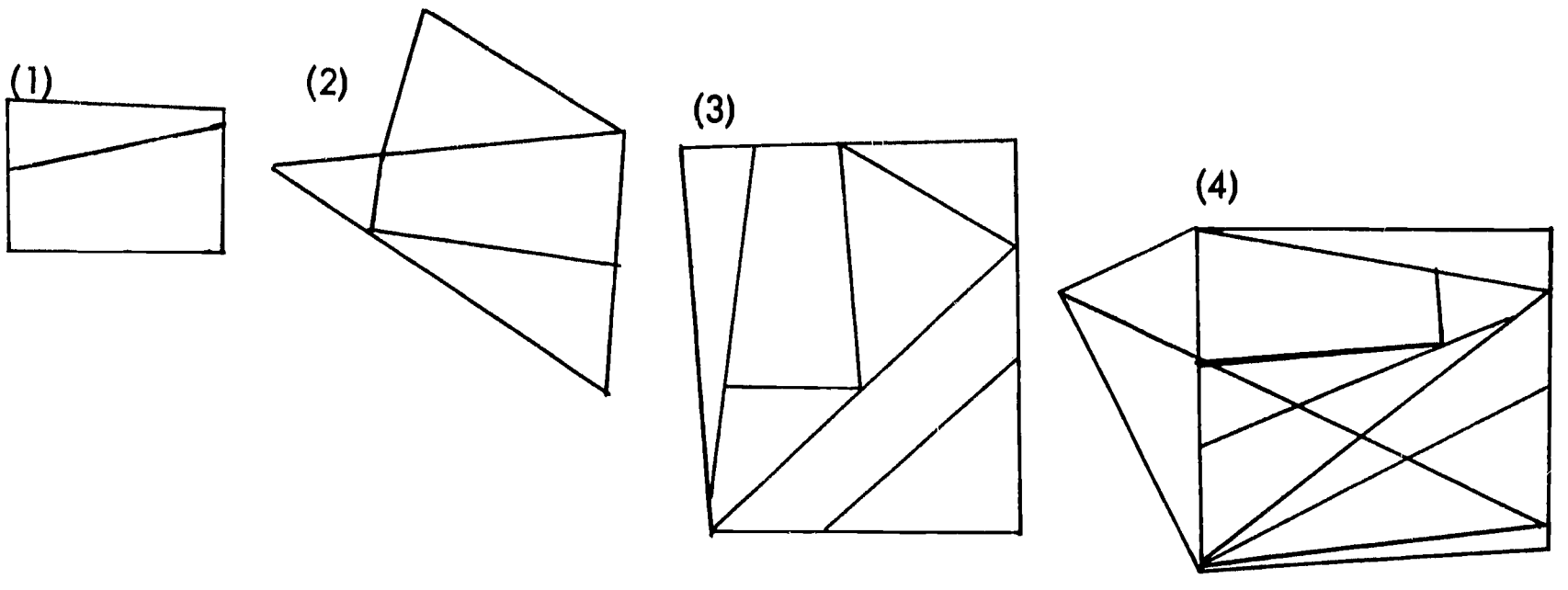
Repeat again for picture #3, grocery store pretty balls, saying, "In this grocery store there are some pretty balls hidden among these groceries. See if you can find them." Score is the number of balls correctly identified. Do not count any other object, such as grapefruit, even if it is round and looks like a ball. Note: The balls are easily identified as having sections marked in black and white. No example can be shown by examiner.

Score is total of objects correctly selected for all three pictures.

B. Geometrical abstraction: (5 year level)

Look at this figure. Can you find one like it in these drawings below? Mark it in each of the drawings.





Score = number of figures correctly selected and marked.

Block Building

Materials: Box of 12 straight, unpainted, or one color, one-inch cubes.

A. Straight Tower. Place the cubes on the table in front of the child. Pile up the blocks one upon another, using one block as a base, until you have a structure several cubes high. "See how high you can build these blocks." Tear these down. Start the child to building upon one or two blocks, urging him to build the tower as high as he can. "Let us see how high you can make it."

The score is the number of blocks placed in the tower, less the last one placed that caused the tower to topple over.

B. Three Cube Pyramid Directions. With three of the cubes, build a pyramid on the table directly in front of the child. This consists of two blocks slightly separated with another resting on top of the two, evenly covering the open space. Enough room is left between the model and the edge of the table for the child's copy. Say as you work, "See what I am making? I wonder if you can make one just like it? Make it out of these and make it right there," first pointing to the other three blocks that are placed on the table to the child's left and then to the space immediately in front of the child. Start the stopwatch as soon as the child picks up one of the cubes to start his building. Do not permit the child to destroy the model pyramid if it can be avoided. Say emphatically, "No, you make one like this. Make it out of these, right here," pointing out again what the child is to do. Stop the watch as soon as the child has achieved a pyramid, whether or not he has removed his hand from it. Score is time for a correct response. Mark all others failure without recording time.

Draw a picture of the child's response ( ). The degree of space between the blocks is immaterial. Record comments which the child makes as well as the pattern of performance. Break down the building, placing all the cubes together again, and proceed with the next test.

C. Six Cube Pyramid Directions. Say, "Now see what I am going to make this time, a bigger one. I wonder if you can make one like this? Make it right here, out of these," (pointing to the space in front of the child and the remaining cubes). "Make it just like this one." Do not permit the child to tear down the model if this can be avoided.

Record a picture of the response as directed above. Record comments and other observations that can be made of this performance. The score is time taken to build the pyramid correctly. No time is recorded for failure to make a satisfactory copy.

Ambiguous Forms

Materials: Three ambiguous form cards.

Hand Form 1 directly to the child with the small block number on the right-hand corner. Ask, "What is this?" Record whatever he says. Then ask, "What else can you see?" and urge him for further responses by asking, "Can you see anything else?" Record verbatim everything the child says. Repeat this procedure for each of the other two cards. This test is scored in two ways: (1) for ideas or whole objects; (2) for elaboration.

(Example: (1) donkey, (2) tail, ear, or parts of object.) Record examiner's evaluation of 1 and 2 by number of items mentioned for all three cards combined.

Word Meaning

A series of ten questions comprise this test.

1. What is this? (Pencil.) Hold the pencil out in front of the child.
2. What is it for?
3. What is this? (Chair.) Examiner puts her hand on the back of the child's chair, making sure that it is the chair itself that is meant.
4. What is it for?
5. What is this? (Show horse.)
6. What is it for?
7. What is this? (Show dog.)
8. What is it for?
9. What is a house for?
10. What is a clock for?

Record the child's exact reply to each question. Ask the questions one at a time in sequence. Hold up a pencil to the child for questions 1 and 2. For 3 and 4, touch the chair on which the child is sitting. For 5 and 6, show the horse, and for 7 and 8 show the dog. Do not show the clock. If there is one in the room, do not point to it. Allow time for child to think what he will reply and urge for responses if necessary.

(N.B. It is important that the child's complete reply is recorded. If there is a speech problem, record as nearly as possible the sound pattern of the reply. Also note any resistance to this item.)

Score is number of questions answered correctly.

Round Things

A. Materials: Card with eight simple drawings.

Say, "Show me the round things in the picture." Urge child to name the objects. If the child does not point correctly, say, "No, I will show you things that are round."

Ball Circle Plate Moon Face

Record the number of objects correctly pointed out. If child does not point to the right objects, mark his response 0.

B. "Tell me other things that are round." Do not give examples. If he gives one or more round things, praise him and say, "Tell me some more things that are round." Keep urging to get all the responses possible. Record all responses whether they are correct or not, giving exact wording. One point for each object named that is round, such as basketball, glass, eggs, apples, telephone pole, doorknob, cup.

Stick Tests

Materials: Small yellow box of 30 sticks. A drawn square, a drawn triangle.

Part A

Procedure: (1) Remove the two cards and dump the sticks on the table. Say, "See this box of sticks? See what I make. See if you can make one like this." Make a sample pattern with three sticks as you talk to the child, putting the pattern you build in front of the child, and giving the child three sticks out of the pile. The pattern is two parallel sticks with one stick perpendicular and between the other, an H on its side (⊏⊐). Draw in the space on the record sheet whatever the child makes, using a short, straight line to represent each stick. Next make a chair pattern (⊢┐) giving the child five sticks out of the pile. Draw a record of the child's response.

Replace sticks into the pile of sticks on the table. Present the □ and Δ cards in turn, giving the child six sticks from the pile. The child may mistakenly copy the rectangular card instead of producing the square. If the Δ is produced as another □, examiner should say, "No," and trace the pattern of the Δ on the card and say, "Make one like this." Score is number of objects copied correctly.

Part B

Give child eight sticks. "Now see what you can make out of these. Make something different." Then give eight more sticks, encouraging different things. Draw the child's response on paper representing each stick with a short straight line. If the child names his production, be sure to record it, and also give any comments he makes as he makes it. Repeat two more times, giving the child eight more sticks for each trial, leaving the sticks already used as the child placed them. Draw each production. Do not ask what it is, but, if child names it spontaneously, or talks as he makes it, record what he says.

Score A = production of some combination of the sticks. All do not have to be used, but, if the child simply makes the patterns he copied in Part A, allow no credit for the attempt. Score B = credit one point for each production named.

A. Fist and Thumb

Directions: Place your right hand in front of the child, resting your elbow on the table. When you are sure of the child's attention, close your hand, holding the thumb straight up, and say, "See how I can make my thumb wiggle? Now first shut your hand just as I do. Now see if you can make your thumb wiggle like mine." Record the hand used by the child and the degree of success. No credit if fingers move with thumb. Score is one point for success.

B. Thumb-Finger Opposition

Directions: Face in the same direction as child is facing so that, when you extend your right hand, it is in the same relative position as the child's right hand. While you spread your fingers wide apart, holding your hand with the palm facing the child, say, "Now watch me and see if you can do this. Hold your hand out like this and keep your fingers wide apart." See that child spreads his fingers properly. Then say, "Now touch your thumb to each finger this way." Demonstrate several times, starting with the first finger and on to the fourth, touching each finger in succession. "Now you do it." Three trials may be given. Record the degree of success, remembering that only the touching

of all four fingers in succession with the fingers spread apart is credited as success. One point credit for at least one success.

C. The Thumb and Finger Test - Two Hands (5 year level)

Examiner demonstrates as follows: "Now I want to see if you can do this." Put the two thumbs together touching ends. Then separate and join the two first fingers, separate and join the middle fingers, separate, and join the ring fingers, and finally the little fingers, each time separating the preceding finger junction. Score is one point for success.

Decroly Matching

Materials: Two large cards, each containing four silhouette pictures. Each of the pictures is duplicated on a small card. There are eight of these.

Directions: Place the large cards side by side in front of the child, with the bottom of the cards nearest the child. Then spread the small cards on the table below, and on each side of the large cards so that each picture is visible. No system of arranging these small cards need be observed exactly, but the ball should be placed immediately in front of the child below the large cards and the small cards should not be placed contiguous to the pictures they match on the large card.

Say, "Do you see these pictures?" pointing to the large cards. "Each one of them has another picture among these," pointing to small card which is exactly like it. "Let us see how quickly you can put the two pictures together, the little card on the big one." If the child does not understand, continue, "Show me the ball. Good! Now find me a ball among these. That's right, now put this ball on top of the other ball." If the child does not place the ball correctly, show him where it belongs. Continue, "Now find the other pictures that are alike and put them together, the little card on top of the big one." Record whether or not the ball needs to be demonstrated and the number correctly placed. After the ball has been demonstrated, if the child places the small cards incorrectly, make no comment. Score = one point for each card correctly placed, allowing no point for the ball if it needs to be demonstrated.

Action Agent Test

Materials: Six action questions with the accompanying elaborative questions for each. The six questions are as follows:

"What runs?"
"What bites?"
"What melts?"
"What stings?"
"What explodes?"
"What smiles?"

Method: Ask the child, "What runs?" Whether or not he answers correctly, give him some more answers, like "boys," "girls," "dogs," etc. Then proceed with other action questions. If he gives only one or two answers in each case, urge him to give more answers. Give no more illustrations.

Record all replies for each question. If the child does not know an answer to the first question, continue for at least three other action questions before discontinuing. Score: total number of answers given to all six questions.

Wallin Peg Board B (3 year level)

Materials: The Wallin Peg Board B.

Remove pegs from board in full view of child and place them in a row beside the board next to child. Say, "See if you can put them back in their holes," pointing to pegs, then to board; continue pointing to pegs and the board, saying, "Put them back," until child grasps idea, or until failure is obvious. Do not demonstrate. Place no emphasis on speed. Encourage child to continue. Give three trials, if child is successful in first trial. Give time score, only on completely successful trials. Score is the time in seconds for the best performance in the three trials.

Food Naming (4 and 5 year level)

"Now we are going to talk about food. Tell me all the things that people eat." Urge child to give more answers and record complete responses in order.

Record all answers. No credit for giving food for an answer. Score one point for each correctly named food.

Agent Action

Ask the five questions with a supplementary question for each.

1. What can you do with a ball?
   What else can you do with it?
2. What can you do with a wagon?
   What else can you do with it?
3. What can you do with a piece of paper?
   What else can you do with it?
4. What can you do with a knife?
   What else can you do with it?
5. What can you do with a bottle?
   What else can you do with it?

If the child cannot give an answer to the first question, give two illustrations such as "you can throw it" and "you can roll it." In each case, keep asking, "What else?" until the child gives no more answers.

Record in detail all the child's answers. Ask all five of them even if he fails the ones before. Score = number of correct answers to all five questions. There may be many more than five answers.

Drawing Test A

A. Copy Line, Circle, Cross

Materials: A horizontal line, one inch in length, on a 3 x 3 inch card; a circle one inch in diameter on a 3 x 3 inch card; and a cross consisting of two moderately heavy

lines one inch long bisecting each other perpendicularly drawn on 3 x 3 inch card.

Directions: (1) Place the paper on which the line is to be drawn in front of the child and give him a pencil. Place the card with the line in horizontal position directly above the section of the sheet on which the child is to draw. Say, "See how nicely you can make one like this." If the child fails the first try, have him try again. If he starts to draw the line on the card, say, "No, make it on this sheet of paper."

(2) Place the card with the circle directly in front of the child and above the center of the sheet as before. Say, "Now see if you can make one like this." If the result is a moderately good circle, continue with the cross. If, however, the result is questionable, ask him to make another, covering up the first drawing with the model card.

(3) The method is the same as for the copying circle test, using the card on which the cross is drawn. Give a second trial if the first is failed or questionable.

Score for three-year olds = one point for each success.

B. Copy Star and Diamond

Materials: Two 3" x 3" cards with a star (✳) drawn on one and a diamond on the other. The star consists of three 1" lines bisecting each other at angles of 60 degrees. The diamond has a longer diagonal of 1 1/2", the shorter diagonal 1", and all four sides are 1".

Directions: The method for giving these two tasks is exactly the same as for drawing the line, circle and cross in the preceding test. Try not to be concerned if the child fails either or both of these difficult tasks, but simply say sympathetically, "That is a hard one to do, isn't it?" if he indicates he is unhappy about his results.

Score for four and five-year olds = one point for each success.

Following Directions

Materials: A nest of cubes and four different colored small cars - yellow, green, red and blue.

Part A

Show the nest of cubes to the child and then take it apart, calling the child's attention to the process, placing the separate cubes on the table with the open ends up in mixed order rather than in order of size. Before allowing child to have the cubes, put them together in the correct nest arrangement, making sure that the child is attending carefully to the process. The order of demonstration is to place the smallest cube in the next larger, and these two in the next larger, and all three in the largest cube. Talk to the child in some such manner as this: "See this one will go in here, and this one goes in here, and this one goes in here, and then we put this one in here, and they all fit together like this. Now we take them apart and put them on the table again." Then separate the cubes again and arrange them in haphazard position directly in front of the child. Continue, "Now you put the boxes together just as I did."

Start the stopwatch the instant the child touches the cubes preparatory to arranging them. Suggestions as to method are permissible only during the demonstration and are

not necessarily confined to any formula. Make the test as interesting and as intelligible to the child as possible without actually doing it for him.

Record time credit for any successful performance. If all the cubes are nested together, with none of the three smaller ones projecting outside the fourth, consider the result a success, even though one or more of the cubes are turned in the wrong direction. Score = time for completion if successful. Indicate when task is failed.

Part B

Directions: Place the boxes (may be called garages) to one side. Select one box and one car for the first four parts of this test item, and place them in front of the child, the car near the child, the box further back. Then give the first direction: (1) Put the car on the box.

If this is not done, demonstrate what is wanted by placing the car on top of the box. Record the response. Put the car back in front of the child. Then give directions 2, 3 and 4. Without further demonstration, following the order of directions as given, each time removing the car and placing it in front of the child.

(2) Put the car in the box.
(3) Put the car in front of the box.
(4) Put the car behind the box.

For the directions 5 through 8, the four cars are placed in front of the child in a row, and he is asked to carry out the four color discrimination directions:

(5) Show me the red car.
(6) Show me the blue car.
(7) Show me the green car.
(8) Show me the yellow car.

Record success, or whatever response the child gives for each of these.

For directions 9 through 11, the boxes are spread out in order of size in front of the child with the largest box to his right, and approximately two inches apart. The directions are given in order asking the child to put his finger on the box if he tends to point ambiguously.

(9) Show me the biggest box.
(10) Show me the littlest box.
(11) Show me the box that is almost as big as the biggest box.

Record response for each discrimination.

Part C

Directions: With the cars and boxes arranged as in B, give the following directions one at a time, recording response and each time returning the car back to its original place before giving the next direction. The directions to be given:

(1) Put the green car on the littlest box.
(2) Put the blue car behind the pink box.
(3) Put the yellow car in the blue box.

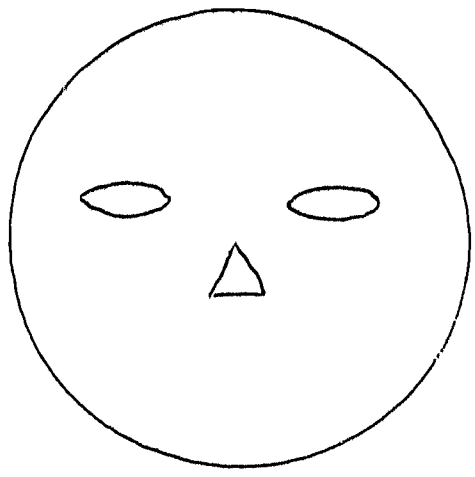
(4) Put the red and green cars in front of the box that is almost as big as the biggest box.

(You may let the child play with these cars and boxes for a brief time while the next two items are being asked, interrupting his activity if he seems to be too absorbed to attend to the question, saying, "Now tell me this, first.") Score = one point for each correct response.

Drawing Completion

A. Face Completion

"Here is a face. It has a nose and two eyes. See, it has no mouth. See if you can make the mouth where it belongs."



Score = one point for success in placing mouth in relatively correct place.

B. Block Completion

Place the sheet with the partially completed block in front of the child, with the uncompleted "A" facing him, saying, "Here is a toy block. See if you can finish it. I will draw one line and then you make some more to make it look more like a toy block." Then, with the pencil, complete the line for the upper right-hand corner. Make no marks on the drawing other than the one demonstration line. Allow the child to draw freely whatever he wishes. Do not insist that he draw lines only on the block.

Score = one point for each correctly added line or completed line.

C. Pie Completion

Place the paper with the pie completion drawing in front of the child, saying, "Here is a pie. Let us cut it up into pieces. See, I'll finish cutting this piece. You finish the pieces started and see if you can make some more slices."

Complete the line starting at the center to the edge of the pie. Draw only this one line, leaving the other partially drawn lines for the child to complete. Praise the child as he works and urge him to make more slices. Be careful to preserve the drawing just as he makes it. Do not add any more lines than the one you make to demonstrate.

Score = one point for each line drawn from the center to the circumference of the pie.

Scores for B and C are combined.

D. Dot Test

"Do you see these dots? I am going to connect them like this." (Draw the connecting line.)

"Now here are some dots. You draw lines connecting them any way you wish."

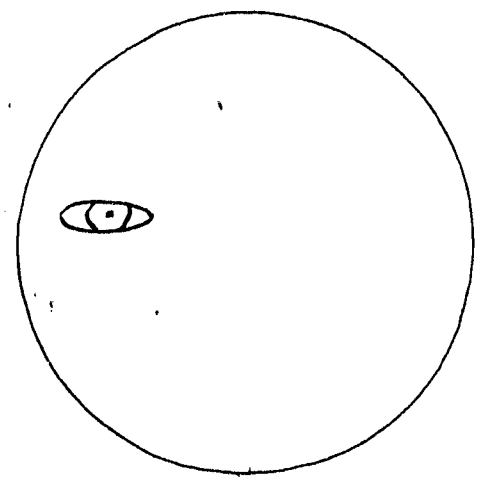
Scoring Key =

A. Originality
- 0 - No deviation - all the same - can be a perfect performance; scribbling, or failure.
- 1 - Piecemeal - poor in execution, scribbling around dots, dots unconnected.
- 2 - One divergence.
- 3 - Two divergences or unusual plan not well worked out.
- 4 - Unusual plan, two obviously planned patterns, unusual features added.
- 5 - Three patterns or strikingly original with intent to connect the dots. Unusual plans well worked out.

B. Following Directions
- 0 - Failure - no evidence of following directions, scribbling with no plan.
- 1 - Not all dots connected, some scribbling.
- 2 - Evidence of intent to follow directions, but poor execution. Not more than two dots omitted.
- 3 - All dots connected, execution only fair.
- 4 - Excellence in carrying out directions, lines well drawn.

E. Face Completion (5 year level)

"Here is a face. It has an eye. See if you can finish this face."



Score = one point for each correct addition to the face, including ears, hair, etc.

Block Sorting

Directions: Say, "Here are some pretty blocks. I'm going to put one block in each box."

Place one of the largest blocks in each of the four boxes. This will give one block of a different color in each box. Place the remaining blocks, each one flat and separate, in front of the child, saying, "Put all the rest of these blocks in the boxes where they belong." Record number of blocks placed correctly for each sorting and type of sorting made.

Trial 1. Color_____: Pink_____ Blue_____ Green_____ Yellow_____
Shape_____: Square_____ Diamond_____ Circle_____ Triangle_____

Score = one point for either color or shape with not more than two errors.

Repeat with the same starting blocks and say, "Now, do it a different way."

Trial 2. Color_____: Pink_____ Blue_____ Green_____ Yellow_____
Shape_____: Square_____ Diamond_____ Circle_____ Triangle_____

If the child starts to repeat his sorting method, say, "No, do them a different way." If he is confused and does not understand, say, "Let me give you a hint," and place the second row of whichever category he is expected to do.

Score = one point for either color or shape, if this response is different from Trial 1. No credit for repeating same sorting method used in Trial 1.

Empty boxes again, and this time place each square block in a separate box. Say, "Now put all the blocks in the boxes where they belong." Check choice of sorting category and record the number of blocks correctly placed in each box.

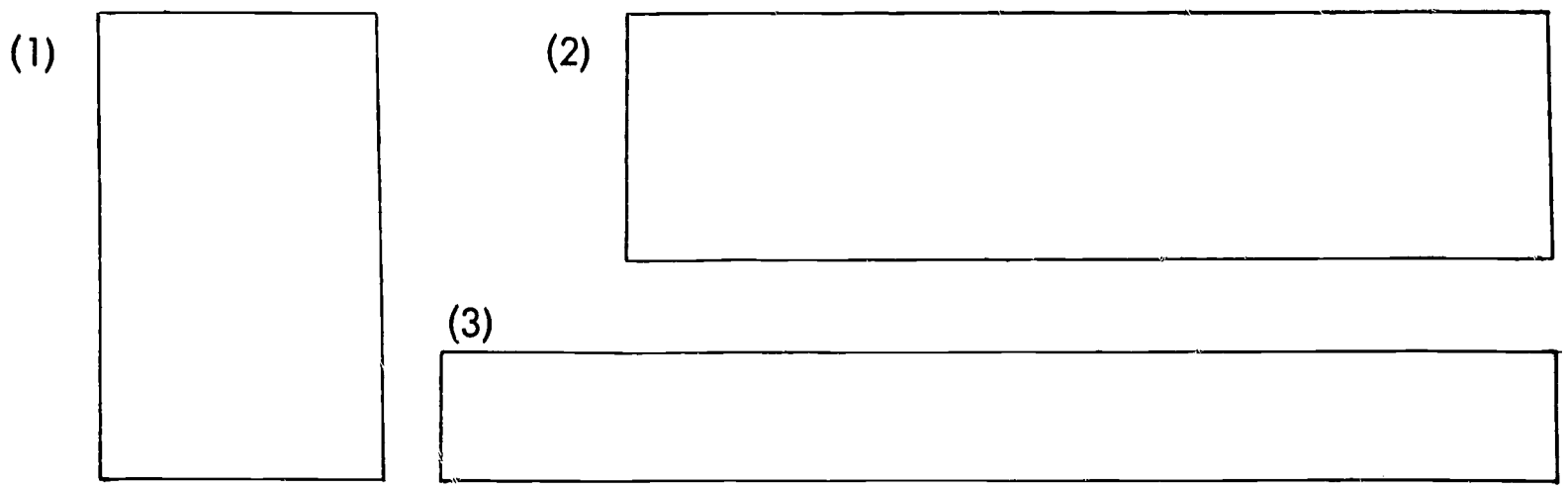
Trial 3. Color_____: Pink_____ Blue_____ Green_____ Yellow_____
Size_____: Largest_____ Next_____ Next_____ Smallest_____

If child repeats color sorting, say, "No, a different way." If he does not understand and begins haphazard placing, say, "No, I'll give you a hint," and place the next level of sizes across all four boxes.

Score = one point for correctly following directions for Trial 3.

Score for Trials 2 and 3 are combined - a flexibility score.

The Pretend Candy Bars



1. "Let's pretend these are pieces of candy. You want to give Mother a piece of this candy bar and keep a piece for yourself. Draw a line to show how you could cut it so that the two pieces are the same size."

2. "Now, cut this long bar into four pieces, each the same size."

3. "Cut this candy stick into two pieces."

4. "Are all these pieces the same size?" If answer is yes, do not ask the next two questions:

   "Which piece is smallest?"
   "Which piece is biggest?"

Score = one point for each piece of candy cut into the correct number of sections. They do not have to be equal in size.

The last question is a conservation question and is scored separately.