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PRODUCTIVE THINKING IN RETARDED AND NONRETARDED CHILDREN.

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*PRODUCTIVE THINKING, *VERBAL TESTS, *RECORDINGS (PHONO-TAPE); *CLASSROOM RESEARCH, COGNITIVE DEVELOPMENT, THOUGHT PROCESSES; VERBAL LEARNING, COMPARATIVE ANALYSIS, LEARNING PROCESSES; MENTAL RETARDATION, HANDICAPPED CHILDREN, SPECIAL CLASSES; *OBSERVATION (RESEARCH), CONNECTICUT, STORRS

THIS COMPARATIVE ANALYSIS OF PRODUCTIVE THINKING IN RETARDED AND NONRETARDED CHILDREN USED DATA FROM A SAMPLE OF 78 PUBLIC SCHOOL CHILDREN DIVIDED INTO THREE GROUPS--(1) MENTALLY RETARDED CHILDREN IN SPECIAL CLASSES, (2) RETARDED CHILDREN IN REGULAR CLASSES, AND (3) NONRETARDED CHILDREN IN REGULAR CLASSES. THE GROUPS WERE SELECTED SO THAT THERE WAS NO SIGNIFICANT DIFFERENCE WITHIN THE GROUP BETWEEN THEIR MENTAL AGES AS MEASURED BY THE CALIFORNIA TEST OF MENTAL MATURITY. FIRST A BATTERY OF PRODUCTIVE THINKING TESTS WAS ADMINISTERED TO EACH SUBJECT CONSISTING OF--(1) VERBAL STIMULI REQUIRING VERBAL RESPONSES; (2) NONVERBAL STIMULI REQUIRING VERBAL RESPONSES, AND (3) NONVERBAL STIMULI REQUIRING NONVERBAL RESPONSES. THE SECOND PART OF THE STUDY WAS AN ANALYSIS OF THE THOUGHT PROCESSES CONTAINED IN VERBAL INTERACTION IN THE CLASSROOM. DATA WERE GATHERED VIA RECORDINGS IN CLASSROOMS DURING ARITHMETIC, SCIENCE, AND SOCIAL STUDIES LESSONS. THOUGHT PROCESSES WERE THEN CLASSIFIED INTO SUCH CATEGORIES AS ROUTINE, COGNITIVE-MEMORY, CONVERGENT THINKING, EVALUATIVE THINKING, AND DIVERGENT THINKING. THE RESULTS WERE THAT COGNITIVE MEMORY ACCOUNTS FOR APPROXIMATELY ONE-HALF OF THOUGHT PROCESSES CONTAINED IN VERBAL INTERACTION. IRRESPECTIVE OF THE PRESENCE OF MENTAL RETARDATION, WHEN COMBINED WITH ROUTINE, NEARLY 80 PERCENT OF THE THOUGHT PROCESSES IN CLASSROOM VERBAL INTERACTION WERE ACCOUNTED FOR. OCCURRENCE OF EVALUATIVE THINKING AND DIVERGENT THINKING WAS INFREQUENT IN THE OBSERVED DATA. (GC)

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INTRODUCTION

Throughout a considerable portion of our present century, mentally retarded children have been perceived as "poor learners," concrete thinkers, and lacking in abstract or creative ability. It appears to be, without question, that the high correlation between intelligence and academic achievement is one of the major reasons for generalizations such as those indicated above. In effect, those who seemed more fully endowed were able to perform at a more satisfactory level in school and were assigned all the positive traits associated with said status; the inverse apparently was accepted.

Within the past decade, however, research has been conducted in which the performance of mentally retarded, average and above average children has been compared on a variety of tasks. This research has often employed a paradigm which called for comparisons among groups of children who demonstrated considerable similarity in developmental status, or mental age. A reasonable, although limited conclusion, appears to be that if children of different intellectual levels are contrasted with children of equal mental ages, greater similarity exists in their performance than was previously acknowledged. This should not infer that differences in performance will be eliminated if the developmental status between groups is equated; it does infer that the discrepancies are not as great and that our generalizations pertinent to the mentally retarded are in need of further clarification. The relevance of this issue to school programming is obvious when one considers the fact that teachers are encouraged to work with the child at his developmental level in order that instructional practices might be based upon individual needs and characteristics.

Many of the tasks which continue to differentiate the mentally retarded from average and above average children appear to be those which are directly affected

by instructional practices and curriculum. A perusal of selected curriculum guides for teachers of retarded and non-retarded children indicates that concrete and limited experiences are consistently advocated for use with the retarded, while non-mentally retarded children are encouraged to explore many avenues to learning and problem solving. Specifically, retarded children are shown how to perform a task, practice the task and recall the stimuli with which they have been confronted, without emphasis on the understandings and principles which ought to be derived from such an activity. On the other hand, non-mentally retarded children develop algorisms, seek out new and unusual solutions and utilize numerous modes of expression. In short, it appears that mentally retarded children are trained to be convergent thinkers, whereas non-mentally retarded children are urged to demonstrate greater use of flexibility and originality in their thinking patterns.

In recent years, research focusing upon the relationship between productive thinking and intelligence has produced controversial results, while at the same time an analysis of the classroom as a variable in the development of productive thinking in children has been the focal point of some research. It was these factors, the controversy between intelligence and productive thinking and an interest in the nature of the thought processes contained in the verbal interaction of the classroom, which precipitated the present study.

Literature

There exists a fair amount of literature which has a generalized relationship to the topics under discussion, much of it stemming from the efforts of Guilford (1950). The specific literature is not so nearly abundant.

Within the framework of creativity, Getzels and Jackson (1962) obtained samples consisting of 24 students who were classified as high in creativity and low in IQ and 28 students classified as low in creativity and high in IQ. In reality, both groups exhibited mean IQ's which are considerably higher than those found in the population of adolescents. The authors note that despite striking differences in mean IQ, the two samples were equally superior in school achievement. They note that high IQ adolescents tend to favor convergent modes of problem solving, whereas high creativity youngsters tend to favor divergent processes. In another project (Clark, Veldman and Thorpe, 1965), the convergent and divergent thinking abilities of 192 adolescents, with a mean IQ of 125, were studied. In certain areas of attainment, among them being Reading and Word Fluency, the high-divergent-group had significantly greater scores than the low-divergent-group.

Torrance (1962), upon whose measures the present study was developed, discusses, at length, the characteristics of creative teachers and he suggests modifications in the teacher-education program which might bring about maximum creativity in teachers. The role of the teacher appears important and there is research in the area of mental retardation which strongly suggests that instructional practices can be developed which will positively influence the productive thinking abilities of mentally retarded children. Tisdall (1962) compared a group of retarded children enrolled in regular classes, a group of mentally retarded children in special classes and a group of average children on a variety of productive thinking tasks. The results showed that special class retarded children and average children in regular classes performed significantly higher than retardates in regular classes on verbal tasks; no differences were found on

non-verbal tasks. The experimental teachers of the special class mentally retarded consistently employed a discovery method of teaching, and encouraged their students to formulate ideas, dramatize these ideas and participate actively in the presentation of new thoughts and notions.

Additional data has been obtained from an experiment which studied the effects of a training program on the productive thinking of mentally handicapped children (Rouse, 1965). Experimental subjects were presented with a training sequence which included 30 lessons of approximately thirty minutes each. Assessment of the effectiveness of the program was undertaken via pre- and post-test comparisons of experimental and control groups on the Product Improvement and Circles Tasks of the Minnesota Tests of Creative Thinking. The mean gain for the experimental groups was substantially greater than that for controls.

Teacher-pupil interaction has been the subject of a recent review of educational research (Amidon and Simon, 1965). Inter-personal relationships and cognition appear to be among the broad categories under which teacher-pupil interaction has been studied. Amidon and Flanders (1963) have developed a procedure designed to assist teachers to improve their classroom behavior. The manual describes one approach to an analysis of classroom verbal interaction in which all statements that occur in the classroom are categorized into one of three major sections: (1) teacher-talk, (2) student-talk, and (3) silence or confusion.

Aschner (1959) conducted an in depth analysis of classroom discourse, the purpose of which was to develop a method of focusing observation and analysis upon the logical aspects of teaching. This analysis utilized two major categories of discourse: episodes and monologues. The discourse includes all the verbal behavior occurring during a class period; the monologue is an extended unit of discourse, spoken by an individual which does not exhibit episodic form. Aschner notes that classroom discussion is shaped by a number of factors. Among these are subject matter and pattern classroom organization.

Taba (1963) reported on selected procedures used to analyze patterns and levels of thinking in elementary class discussion sequences. Taba trained teachers to raise the level of thought processes used by students in their classes, even to the point that some children of low IQ, performed on the same level of abstraction as children with high IQ's (Taba, 1964 cited by Amidon and Sewin, 1965). Taba's "scoring" enabled the (1) cognitive tasks to be identified as follows: (a) grouping and classification, (b) interpretation and inference, and (c) application of facts and principles for the purpose of hypothesizing: (2) designation, or source of the thought unit to be identified and also to determine whether the individual is seeking information or giving it: (3) the research worker to note the functions, or how the thought unit functions in the context of the discussion.

Gallagher's study of Productive Thinking of Gifted Children (1965) appears to be the most comprehensive work which has relevance to the present project. Gallagher was able to assess numerous aspects of classroom verbal interaction beyond those related to the frequency of the thoughts contained therein. Various subject matter was treated independently, the interactions of the teachers were viewed separately from the students, boys and girls were tabulated by sex and the various classes in which the youngsters were enrolled were cited. Gallagher noted that teachers vary considerably in the sytle of question making in their classroom and that the teacher appeared to be the major source of variance in the expression of different kinds of thought processes by children.

The literature relevant to the present study indicates that (1) productive thinking can be nurtured in retarded and average children, (2) instructional practices tend to influence the expression of productive thinking in children, (3) children of low IQ can perform toward an abstract level of thinking, (4) verbal interaction can be classified into various thought processes consistent with the model selected by the investigator.

PROCEDURE

The nature of this project is such that the procedural section is separated into two parts. Part I focuses upon the procedures used to assess and compare the productive thinking abilities of retarded and average children. Part II includes an analysis of the thought processes contained in the verbal interaction of the classroom.

PART I

Productive Thinking in Children

A total of 78 children participated in this project. This population was composed of a sample of mentally retarded children enrolled in special classes in public schools and a sample of retarded children enrolled in regular classes and a sample of non-retarded children enrolled in regular classes in public schools. The characteristics of the three samples are presented in Table 1. Although differences in intelligence quotients are noted, the major criterion, mental age, is shown to be a non-significantly differentiating characteristic among the three groups, as determined by the California Test of Mental Maturity.

On an individual basis, a battery of productive thinking tests (Torrance, 1962) was administered to each subject. These tests are listed as follows:

1. Verbal Stimuli Requiring Verbal Responses

   a. Unusual Uses Problems (Tin Cans)
   b. Improvement Task
   c. Mother Hubbard Problem

2. Non-Verbal Stimuli Requiring Verbal Responses

   a. The-Ask-And-Guess-Test
   b. Product Improvement Task (Toy Dog)
   c. Unusual Uses (Monkey)

3. Non-Verbal Stimuli Requiring Non-Verbal Responses

   a. Incomplete Figures Task
   b. Circles Test
   c. Picture Construction Task (Triangle)

TABLE 1

Characteristics of Subjects in Present Study:
Intelligence Quotients and Mental Ages

		Special Class Retarded (N=26)	Regular Class Retarded (N=26)	Regular Class Non-Retarded (N=26)
Intelligence Quotient	$\bar{X}$	64.92	71.73	93.50
	Range	60-77	58-80	89-102
Mental Age in Months	$\bar{X}$	111.69	114.96	110.19
	Range	103-124	92-125	103-119

Comparison of Class Group Means on IQ and MA

	Intelligence Quotient "t"	Significance Level	Mental Age "t"	Significance Level
SCR - RCR	.84	N. S.	.28	N. S.
SCR - NRRC	4.17*	$P < .01$	.15	N. S.
RCR - NRRC	2.86*	$P < .01$	.46	N. S.

* Statistically Significant

Special Class Retarded = SCR

Regular Class Retarded = RCR

Non-Retarded Regular Class = NRRC

Verbal responses were recorded by the examiner and tabulated. Responses to non-verbal tasks were also acquired and tabulated. All scoring was accomplished in accordance with the procedures advocated by the developers of the test materials.

PART II

Classroom Verbal Interaction

Classes were visited and a recording made of the verbal interaction in each classroom during an arithmetic lesson, a science lesson, and a social studies lesson. The classes included special classes for the mentally retarded, classes in which mentally retarded children were enrolled and classes in which there were no mentally retarded children. The classes were from the same schools which enrolled the subjects who participated in Part I.

The original proposal called for three 45-minute recordings of each class, but due to the nature of individual approaches to a given subject, the length of time varied considerably. In order to adjust to the differences in time, it was decided to conduct the analysis of verbal interaction on a basis of 85 teacher-pupil interactions, acknowledging that these varied in length. After each tape had been transcribed the analysis of the thought processes contained in the verbal interaction was conducted via the model and scale developed by Aschner, Gallagher, (1961). This extended system enables one to classify the thought processes of the classroom into the following categories:

1. Routine
2. Cognitive-Memory
3. Convergent Thinking
4. Evaluative Thinking
5. Divergent Thinking

A brief description of these categories is summarized from the reference scale:

Routine: This category includes routine classroom procedural matters such as management of the classroom, structuring of the class discussion and approval or disapproval of the idea or the person.

Cognitive-Memory: represents the simple reproduction of facts, formulas and other items of remembered content through the use of such processes as recognition, rote memory and selective recall.

Convergent Thinking: is the thought operation involving the analysis and integration of given or remembered data. It leads to one expected result because of the tightly structured framework which limits it.

Evaluative Thinking: deals with matter of value rather than matters of fact and the verbal performance is characterized by its judgemental character.

Divergent Thinking: involves a sequence in which individuals are free to generate their own data within a data-poor situation, often taking a new direction or perspective.

Inasmuch as five judges were employed to classify the thought processes it was necessary to train them and then review the extent to which they might differ in the classification process. A set of verbal interactions was classified and reviewed by one of the principal investigators. This same set was then presented to each of the judges and after his analysis had been conducted, the judge and one of the principal investigators discussed the ratings. Each judge was then given 132 thought processes in Arithmetic, Social Studies and Science to classify, while working independantly. The frequency of responses in each category, by judges, are recorded in Table 2. Each subject in the table was subjected to a Chi Square test of Independence and in no instance was there a significant difference noted. We concluded that there was sufficient consistency in the rating procedures of the trained judges to enable them to classify the remainder of the verbal interaction independently.

In addition to the data originally sought, Pearson r's between intellectual traits and productive thinking were derived. Correlations among the various productive thinking stimulus/response modes were computed.

TABLE 2

X^2 Test of Judges Ratings of Classroom Verbal Interaction

Part A: Social Studies

	Category	Judges 1	2	3	4	5
Frequency	Routine	34	35	36	45	40
	Cognitive-Memory	54	54	46	47	50
of	Convergent Thinking	35	35	39	36	42
	Evaluative Thinking	2	0	0	0	0
Ratings	Divergent Thinking	7	8	11	0	0

$X^2 = 23.93$* N. S.

Part B: Arithmetic

	Category	Judges 1	2	3	4	5
Frequency	Routine	62	67	63	61	63
	Cognitive-Memory	57	53	59	56	57
of	Convergent Thinking	13	12	10	15	12
	Evaluative Thinking	0	0	0	0	0
Ratings	Divergent Thinking	0	0	0	0	0

$X^2 = 1.72$* N. S.

Part C: Science

	Category	Judges 1	2	3	4	5
Frequency	Routine	44	46	46	43	42
	Cognitive-Memory	80	70	72	90	73
of	Convergent Thinking	8	15	14	6	17
	Evaluative Thinking	0	1	0	2	0
Ratings	Divergent Thinking	0	0	0	1	0

$X^2 = 25.45$* N. S.

* $X^2 = 26.30$ for significance at .05 level

RESULTS

Productive Thinking In Children:

The means, standard deviations and F ratios by stimulus/response modes are presented in Table 3. An examination of the data indicates that there are no overall significant differences among the groups in any of the three test modes. Mentally retarded children in special classes, mentally retarded children in regular classes and non-retarded children of equal mental ages do not appear to be significantly different in their productive thinking abilities under conditions of Verbal Stimuli-Verbal Response; Non-Verbal Stimuli-Non-Verbal Response; Non-Verbal Stimuli-Verbal Response.

TABLE 3

Means, Standard Deviations and F Ratios for Three Treatment Groups on Three Stimulus/Response Mode Combinations of a Test of Productive Thinking

Stimulus/Response Mode		Special Class Retarded	Regular Class Retarded	Average Class Non-Retarded
Non-Verbal S Non-Verbal R	$\bar{X}$	65.08	64.46	65.85
	S. D.	28.09	31.14	16.70
	N	26	26	26
	$F = \frac{12.52}{653.28} = .02$: NS			
Verbal S Verbal R	$\bar{X}$	29.42	31.38	35.69
	S. D.	17.35	22.26	24.40
	N	26	26	26
	$F = \frac{217.39}{446.13} = .49$: NS			
Non-Verbal S Verbal R	$\bar{X}$	22.73	26.92	30.50
	S. D.	11.04	18.47	17.26
	N	26	26	26
	$F = \frac{393.16}{243.86} = 1.61$: NS			

The correlations between productive thinking and intellectual traits are contained in Table 4. The lack of any pattern of significant correlations between MA, IQ and the various productive thinking stimulus/response modes investigated suggests that performance on tasks of productive thinking may be satisfactorily demonstrated in children, of comparable developmental levels who differ in measured intelligence.

TABLE 4

Product-Moment Correlations Among Intellectual Traits and Productive Thinking Stimulus/Response Modes

	NVS/NVR	VS/VR	NVS/VR	
Total M A	.23	.13	.18	
Language M A	.22	.08	.10	N = 78
Non-Language M A	.06	.04	.10	
Intelligence Quotient	.12	.20	.31	

Although the data in Table 5 is limited, there appear to be interrelationships among the various stimulus-response modes investigated. This relationship is particularly noticeable, (r .70) between those response modes requiring <u>verbal responses</u> and the notion is extended that auditory encoding may influence certain aspects of productive thinking to the extend that this relationship is worthy of further study, particularly among the mentally retarded.

TABLE 5

Product-Moment Correlations Among Productive Thinking Stimulus/Response Modes

	NVS/NVR	VS/VR	NVS/VR	
NVS/NVR	1.00			
VS/VR	.37	1.00		N = 78
NVS/VR	.29	.70	1.00	

Classroom Verbal Interaction

Descriptive data in the forms of means and standard deviations of the frequency of thought processes contained in the verbal interaction of the classroom is contained in Table 6. Although the use of descriptive data limits the extent to which generalizations can be drawn from the data, it should provide the impetus for further inquiry into the nature of the thought processes contained in classroom verbal interaction.

The pattern of verbal interaction appears quite similar in each of the three types of classrooms sampled. The data indicates that the Cognitive-Memory category accounts for approximately one-half of the thought processes contained in the verbal interaction, irrespective of the presence of the mentally retarded. When this is combined with Routine nearly eighty percent of the thought processes contained in classroom verbal interaction are accounted for. The occurrence of Evaluative-Thinking and Divergent-Thinking processes is infrequent in the observed data.

TABLE 6

Means and Standard Deviations of Frequencies of Thought Processes Contained in Classroom Verbal Interaction

Category		Special Class Retarded (N=10)	Regular Class Retarded (N=5)	Regular Class Non-Retarded(N=9)
Routine	$\bar{X}$	48.10	43.80	64.22
	S. D.	17.58	18.12	16.86
Cognitive-Memory	$\bar{X}$	75.50	75.60	79.88
	S. D.	13.34	20.36	14.69
Convergent Thinking	$\bar{X}$	15.50	21.40	15.17
	S. D.	11.03	9.23	9.07
Evaluative Thinking	$\bar{X}$	6.00	3.00	2.00
	S. D.	8.16	0.00	0.00
Divergent Thinking	$\bar{X}$	2.00	4.00	5.75
	S. D.	0.00	4.10	5.99

DISCUSSION

Productive Thinking in Children:

In contrast to other research relative to productive thinking abilities among the mentally retarded (Tisdall, 1962; Rouse, 1965) this project was undertaken with subjects who had not benefitted from an instructional program specifically aimed at improving these traits. There were no significant differences among the three treatment groups on any of the three stimulus/response modes. However, without adequate normative data it is impossible to establish a reference point from which the performance of the subjects in this project can be contrasted. Accordingly, the overall performance levels identified cannot be described on a qualitative basis. It is assumed, therefore, that the performance of the subjects in the present study is representative of the populations from which they were selected and the suggestion is tendered that curriculum plans for the mentally retarded should not exclude productive thinking activities.

Productive thinking abilities appear inconsistently related to intelligence and academic achievement. This broad area of research is an area which should be pursued. Is it possible that improvement in performance on tasks of productive thinking will lead to improvement in performance on school-related tasks? Is it possible that skillfully developed measures of productive thinking might be employed as predictors of pupil performance in social, academic or vocational tasks? Are specific types of productive thinking (i.e. divergent thinking rather than convergent thinking) more susceptible to improvement? Are certain types of productive thinking patterns more observable among retarded or average children of one age, ability or developmental level than another? These are but a few of the questions which arise when one considers the need for future research in this area.

Classroom Verbal Interaction

The data pertinent to the frequency of thought processes occurring in classroom verbal interaction indicates that nearly eighty percent of the language is

categorized as Cognitive-Memory or Routine. This appears consistent with the need for the classroom to serve as a source of information and knowledge upon which teachers and pupils can operate. A preponderance of Evaluative-Thinking and Divergent Thinking might not result in closure for the teachers and students and, in effect, this could yield something less than an optional learning situation. Furthermore, a selective presentation of Evaluative-Thinking or Divergent Thinking stimuli might have a greater impact upon the behavior of students than an indiscriminate utilization for the sake of equating the frequency with which the various categories occur. One solid stimulus might be sufficient to trigger a qualitative analysis of a particular problem.

Instructional planning should take into consideration the incorporation of the productive thinking processes into classroom activity. Teachers should have sufficient contact with these processes in order to plant an appropriate stimulus and to assess the response pattern of the pupils. If the teacher stimulates toward divergency, assuming the stimulus is appropriate, she must be able to assess the interaction in order to determine if the youngsters are responding to the stimuli. In effect, "teaching thinking" requires planning and evaluation.

Within the context of classroom interaction there is a need to know more about the verbal and non-verbal correlates of productive thinking. It seems reasonable to suggest that we examine further the role of the classroom as a source of development of productive thinking and other aspects of cognitive behavior.

The verbal interaction reviewed in the present study indicates that considerable information and knowledge can be exchanged through oral language and, in view of the fact that this seems to be a more efficient means of communication among the mentally retarded, it is suggested that instructional planning consider a proportionate representation of auditory (listening and speaking) and visual (reading and writing) activity.

Appendix A

Summary Tables for Analysis of Variance for Three Stimulus/Response Modes

TABLE 7

Analysis of Variance for Non-Verbal Stimuli/Non-Verbal Response

Source of Variation	df	SS	MS
Treatments	2	25.03	12.52
Within Group	75	48995.69	653.28
Total	77	49020.72	

$$F = \frac{12.52}{653.28} = .02: \text{ NS}$$

TABLE 8

Analysis of Variance for Verbal Stimuli/Verbal Response

Source of Variation	df	SS	MS
Treatments	2	434.78	217.39
Within Group	75	33452.05	446.03
Total	77	33886.83	

$$F = \frac{217.39}{446.03} = .49: \text{ NS}$$

TABLE 9

Analysis of Variance for Non-Verbal Stimuli/Verbal Response

Source of Variation	df	SS	MS
Treatments	2	786.32	393.16
Within Group	75	18289.47	243.86
Total	77	19075.79	

$$F = \frac{393.16}{243.86} = 1.61: \text{ NS}$$

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