R E P O R T R E S U M E S

ED 019 326 UD 004 543

INTERRELATIONS IN THE PERFORMANCE OF BRIGHT, NORMAL, AND DULL CHILDREN ON LEARNING AND PROBLEM SOLVING TASKS.

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EDRS PRICE MF-$0.25 HC-$0.48 10P.

DESCRIPTORS- *TASK PERFORMANCE, *PROBLEM SOLVING, *INTELLIGENCE DIFFERENCES, EDUCATIONAL RESEARCH, LEARNING, FILMS, LOW ABILITY STUDENTS, AVERAGE STUDENTS, GIFTED, DATA ANALYSIS, JUNIOR HIGH SCHOOL STUDENTS, GRADE 4, COMPARATIVE TESTING, TEST RESULTS, INTELLIGENCE QUOTIENT, TABLES (DATA),

A STUDY INVESTIGATED THE RELATION BETWEEN PERFORMANCE ON LEARNING AND PROBLEM-SOLVING TASKS AND LEVEL OF INTELLIGENCE. PERFORMANCE WAS MEASURED ACROSS A SERIES OF 10 LEARNING AND PROBLEM-SOLVING TASKS PRESENTED TO SUBJECTS IN A SERIES OF SIX FILMS SHOWN IN A CLASSROOM. THE SUBJECTS WERE 275 JUNIOR HIGH SCHOOL STUDENTS AND 109 FOURTH GRADERS CLASSIFIED AS BRIGHT, NORMAL, OR DULL. THE BRIGHT STUDENTS WERE UPPER-MIDDLE CLASS AND THE DULL STUDENTS LOWER-MIDDLE OR LOWER CLASS. NO HYPOTHESES WERE PUT FORWARD, BUT THE TASKS WERE CONSTRUCTED TO REQUIRE A NUMBER OF PSYCHOLOGICAL PROCESSES. THE RESULTS SHOWED THAT BRIGHTER STUDENTS OUTSCORED THEIR AGE PEERS IN ALL TASKS. COMPARISON BETWEEN DULL SEVENTH GRADERS AND BRIGHT FOURTH GRADERS SHOWED WIDE VARIATION IN ABILITIES. THE DULL SEVENTH GRADERS SHOWED EXTREMELY POOR PERFORMANCE ON THE ANAGRAMS AND VERBAL MEMORY TASKS. IT IS POSSIBLE THAT THE TESTING SITUATION INDUCED THE VERY LOW SCORES IN THIS GROUP. TASK INTERCORRELATIONS FOR EACH GROUP OF SUBJECTS WERE COMPUTED. (DK)

Intercelations in the Performance of Bright, Normal, and Dull Children on Learning and Problem Solving Tasks

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Recent reviews of research on the relation between performance on learning and problem solving tasks and level of intelligence (Denny, 1964; Lipman, 1963; Rosenberg, 1963; Stevenson, 1963; Zeaman & House, 1963, 67) indicate the fragmentary and inconclusive nature of our knowledge in these important areas. Some studies report poorer learning by retarded subjects than by normal subjects of the same MA while others report no significant differences in performance. Resolution of the conflicting results found, however, is hindered by the problem of sampling, method, or task differences across studies. Similarly, there is little information about the extent to which different tasks are interrelated, especially for groups of different intellectual level. Although dimensions such as task difficulty, complexity and abstractness have been proposed as important in discriminating the performance of bright, normal and dull groups, relatively little is known about the correlations of different tasks described by these dimensions.

The primary purposes of the present study were to provide additional information about the types of tasks which elicit differential performance by subjects of different intellectual level, and to investigate patterns of task intercorrelations as a function of intelligence. In pursuing these objectives, we adopted a method quite different from that usually used. First, measures of performance were obtained for all subjects across a series of ten learning and problem solving tasks. The general

tendency in the past has been to report single studies comparing the performance of different intellectual groups. Comparisons of the results are difficult because of differences in the characteristics of the subjects sampled across studies, as well as differences in the types of tasks or variables investigated. The repeated measures design employed in the present study hopefully offers a more reliable basis for comparing tasks and reveals some information about task correlations. Second, the complete procedure for each task was filmed, thereby insuring a highly standardized procedure for all subjects. Finally, retardation was not confounded with institutionalization, since all subjects were attending classes in school.

No specific hypotheses were advanced in this study, but the tasks were constructed so they would tap a variety of psychological processes. For example, the learning tasks differed in the extent to which they relied on verbal processes and employed verbal stimuli. Further, some of the learning tasks involved the acquisition of single stimulus-response associations, while in others, classes of response elements had to be learned. All of the problem solving tasks required verbal comprehension, but differed in the degree to which the responses depended upon verbal production and conceptualization.

The 10 learning and problem solving tasks we used in this study were presented on 6 films. These films were shown on 6 different days to a total of 275 junior high school students classified as bright, normal, or dull. Mean CA and IQ for these groups is presented in table 1 of the handout. Data were also available for 109 4th graders with an average MA equal to that of the retardates. The classrooms comprising each group were drawn from different junior high or grade schools in Minneapolis. The socio-economic background of the bright group was upper-middle class and

that of the dull subjects was lower-middle and lower class. The etiology of the retarded sample was primarily familial, and with 1 or 2 exceptions, no gross physical or sensory impairment was found. About 20% of the retarded subjects were Negro. Although the 3 groups of junior high school students represented overlapping samples to some extent, we felt that the large sample size made it unnecessary to eliminate subjects from any of the groups. The filmed tasks were presented to intact classrooms and subjects responded in booklets constructed to coincide with the material being shown in the film. For example, the 4 stimuli appearing on each trial of the discrimination tasks appeared in the same order on the screen and in the appropriate page of the booklet.

Adaptation of these tasks for filmed presentation led to some modifications which should be noted. The paired associate task required the retention of 6 associates, and response involved recognition of the correct word previously paired on the screen with a nonsense syllable. The 2 discrimination learning films required the correct choice of 1 of 4 stimuli appearing either as an associate to a cue at the top of the page (in the successive case) or as a member of a certain class of items, for example, clothing, in the simultaneous case. The probability learning task employed a 60:30:10 non-contingent schedule. Subjects were required to guess which of 3 stimuli would next appear on the screen. The incidental learning film contained an 8 minute skit and was always presented on the last day of testing as a reward for participating in the study. After the film was shown, booklets containing 31 questions about central and peripheral film content were given to the subjects. The probability and conservation of volume problems were both adaptations of tasks described by Piaget. In the first task, the announcer showed the subjects 2 plastic

boxes containing different proportions of red and white pegs and then asked several questions about the number and color of pegs that would be drawn in different random samplings. For example, one of the questions was, "If I reach into box A without looking and get 1 peg, what color do you think it will be?" In the conservation problem, the announcer first demonstrated that 2 balls of clay displaced equal quantities of water in 2 identical beakers. Subjects were then asked to estimate the amount of water displaced in the second beaker relative to the first when the shape of the second ball of clay was distorted. In the age estimation task, subjects were asked to guess the ages of 6 adults after viewing 30 second film clips of each adult. Verbal memory was taken from the Stanford Binet "memory for stories" subtest, and the "anagrams" consisted of making as many words as possible from the letters contained in the word "generation" in 8 minutes.

The instructions in these films were designed to be as straightforward as possible and subjects asked few questions about what was required in any task. Additional time for responding was given to the retardates in all tasks except anagrams, but presentation of film material remained constant for all groups.

For the following analysis, these tasks were roughly divided into 2 groups: learning tasks, which included paired associate, discrimination, probability and incidental learning, and problem solving tasks, which included the remainder.

Since every task was administered to every group, a preliminary analysis for order effects was desireable. Presentation of tasks across classrooms for each group was arranged so that any task given during the first 3 days of testing for one classroom was given during the last 3 days in at least one other classroom. Analysis of the differences in performance for first half vs. last half presentation of a task for each of the

groups revealed no striking order effects. At every intellectual level, a few tasks elicited better performance when they were presented later in the sequence, but there was no consistency across groups.

T tests on comparisons among the 4 groups were computed and the differences reliable at the .05 level are presented separately for boys and girls in table 2. Although the bright subjects performed at a consistently higher level than the normal grade 7 subjects on all tasks, relatively few of the differences were significant at the .05 level. Those differences that were significant seemed to follow no easily discernable pattern. For example, the paired associates and simultaneous discrimination tasks, whose simplicity would presumably weaken their discriminative power, elicited significantly better performance from the bright group for both sexes.

Perhaps the most interesting comparisons are those of the retardate sample with their CA and MA peers. Comparison of the performance of the retarded sample with the 7th grade normal subjects revealed significantly lower levels of performance for the retarded group on all tasks except probability learning. Although there is a combined low IQ-MA factor in the retarded group, we had not really expected such widespread differences, since this sample had a relatively high MA. Tasks which fall under the general rubric of problem solving, for example, concept of probability, conservation of volume or anagrams, seemed to elicit stronger differences between the two groups than the learning tasks.

When the retarded group is compared with their MA peers, the 4th graders, a somewhat different pattern of results emerges. T tests comparing these two groups reveal few significant differences in performance on conventional learning tasks, whereas the differences with respect to problem solving tasks remain. Although an effort was made to make the

learning tasks challenging for all groups, they are quite similar to most of the simple types of learning tasks often used in research with the retarded. The problem solving tasks, on the other hand, are relatively more complex than those usually used, and in some cases required rather extensive use of verbal instructions. Both the complexity of these tasks and their reliance upon verbal skills may have contributed to the impaired performance of the retardates. Further, the tasks upon which retardates did most poorly were those which involved verbal conceptualization and production. Anagrams and verbal memory, for example, showed very low levels of performance by the retarded. It appears, then, that subjects in the dull group experienced relatively more difficulty with verbal coding and manipulation of information. By contrast, the bright subjects seemed to be most successful in modifying their response on the basis of the information they received. The only task in which retardates performed at a higher level than the 4th graders was probability learning. The greater tendency toward maximizing in retardates found here replicates earlier results (Stevenson & Zigler, 1958), but it should be noted that none of the groups approached maximizing or even probability matching behavior in the 60 trials alloted for this task.

Next, task intercorrelations for each group of subjects were computed. The number of significant correlations found for each group is presented in table 3. Inspection of these correlations indicated that, even among those tasks whose solution presumably involved the same basic prossess, correlations were rather low. Only about 12% of all correlations among either problem solving or learning tasks were significant. This general tendency held for all groups, except 4th grade girls, for whom learning tasks were somewhat more consistently related. Most of the significant

correlations obtained were between learning and problem solving tasks. Even considering the greater number of possible correlations in this class, there was a disproportionate number of significant learning-problem solving intercorrelations for most groups. These results cast some doubt on the validity of considering learning and problem solving discrete or orthogonal areas of research. One possible alternative to such a view is that the content of a task is at least as important as the form it takes. The significant correlations often found among anagrams, verbal memory and paired associates, for example, could be due to the verbal content of these tasks.

We were also interested in the extent to which the correlational matrices revealed equally strong patterns of correlations for each of the groups tested. Again refering to table 3, there was a moderate number of correlations for the normal groups and very few correlations for either the bright or dull subjects. The absence of task intercorrelation for the bright or dull subjects is probably not due to ceiling or floor effects. For the bright subjects, there was a reasonable amount of variability on the last block of trials for each of the learning tasks and in the retarded sample, performance was above chance level on all tasks. Second, although the variability of the bright subjects was somewhat less than the other groups, the differences were usually small. For instance, the standard deviations for the 4 groups on successive discrimination were bright subjects, 6.5, normal 7th graders, 10.1, retarded subjects, 11.1, and 4th graders, 10.7. Standard deviations for the anagrams task were 7.8, 7.9, 6.8, and 6.5 respectively.

One implication of these results is that those tasks which seem to be sensitive discriminators of performance between different groups don't necessarily predict as effectively general differences among subjects within groups. Although there was a significant decrement in the performance

of the retarded subjects on all of the problem solving tasks, these tasks did not seem to involve some basic dimension which would reliably discriminate differences among subjects within the retarded sample. Also, while paired associates, discrimination learning and incidental learning were all quite effective in discriminating the bright subjects from the other groups of junior high students, these tasks were not correlated for the bright group. Although the present data offer few hints about the possible dimensions which might identify differences among task related skills in the bright or retarded groups, it does suggest that they might be quite different from those applicable to groups of normal subjects. One possibility is that the moderately high degrees of variability found for both the retarded and the bright subjects may be due to special motivational, interest, or attentional factors indirectly related to these tasks.

Finally, the method used in the present study may have unduly penalized the retarded subjects. Since all tasks were given in a classroom setting, there is the possibility that the retarded subjects were distracted from the task more often. There was also minimal social interaction with the experimentors, whose main functions were to monitor performance and run the projector. These factors may have contributed to the poorer performance of the retardates and prevented the emergence of stronger task correlations. Research is now underway to investigate the possibility that a more responsive social milieu might improve performance on these tasks.

Table 1

Mean CA and IQ of each group

	Bright	Normal(7)	Dull	Normal(4)
CA (months)				
Mean	152.1	156.2	171.5	117.5
S.D.	4.7	5.9	10.5	5.2
IQ				
Mean	120.0	103.4	72.2	108.0
S.D.	11.1	13.6	8.7	16.5

Table 2

Significant differences between groups

	Bright Vs. Normal(7)		Normal(7) Vs. Dull		Normal(4) Vs. Dull	
	Boys	Girls	Boys	Girls	Boys	Girls
Paired Associates	.001	.001	.01	.001		
Discrimination Learning (Succ.)	.05		.01	.001		.01
Discrimination Learning (Sim.)	.01	.05	.01			
Probability Learning					.05	.05
Incidental Learning	.01	.05		.05	.01	.05
Conservation of Volume			.001	.001	.05	.05
Concept of Probability	.01		.01	.05	.05	.01
Age Estimation			.01	.05	.01	
Anagrams	.001		.001	.001	.001	.001
Verbal Memory		.01	.001	.001	.001	.001

Table 3

Number of significant correlations for each group

	Bright		Normal(7)		Dull		Normal(4)	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Learning intercorrelations (total possible 10)	1	1	0	1	1	1	1	5
Problem solving intercorrelations (of 10)	1	0	4	2	1	1	3	1
Learning-Problem solving intercorrelations (of 25)	2	3	6	10	4	4	7	4
Total	8		23		12		21	

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