DOCUMENT RESUME

ED 089 879		PS 007 268

AUTHOR Meyer, William J.

TITLE Young Children's Acquisition of Cognitive Skills Under Various Conditions of Redundancy, Punishment, and Perceptual Input. Research Report.

INSTITUTION Syracuse Univ., N.Y. Syracuse Center for Research and Development in Early Childhood Education.

SPONS AGENCY National Center for Educational Research and Development (DHEW/OE), Washington, D.C. Div. of Educational Labs.

PUB DATE May 70

CONTRACT OEC-3-7-70706-3118

NOTE 18p.

EDRS PRICE MF-$0.75 HC-$1.50 PLUS POSTAGE

DESCRIPTORS Behavioral Science Research; *Concept Formation; *Correlation; Developmental Psychology; *Discrimination Learning; *Individual Differences; Intelligence Quotient; Motivation; *Preschool Children; Task Analysis

IDENTIFIERS *Cognitive Style; Draw A Line Slowly Test; Task Complexity; Walk A Line Slowly Test

ABSTRACT

Discussion centered on three sets of factors that may influence the variability observed in "concept identification" (concept formation and discrimination learning) studies: stimulus characteristics, incentives employed, and subject characteristics. Stimulus characteristics are described in terms of the number of dimensions simultaneously present in the conceptual task. A study which investigated developmental differences in concept identification when memory aids were introduced for tasks of varying levels of complexity was described. The aids were helpful to all children, but especially to older subjects, and there was a remarkable variability in performance noticed. The incentive conditions of such studies may account for some of this variability, as indicated by reward versus punishment studies in which the punished subjects performed reliably better on complex tasks than rewarded subjects do. Finally, the effect of subject variables, in terms of cognitive style was investigated through a study of relationships between impulsive style and Stanford Binet I.Q. Thirty-three disadvantaged preschool children were administered two tests of ability to inhibit motor ability. Results showed that the two measures did correlate with the Binet in this sample, and the ability to inhibit motor performance had little to do with understanding of test instructions. Thus, cognitive style may be an important determiner of conceptual identification. (DP)

Document Number 70706-WS(5)
Printed May, 1970

Young Children's Acquisition of Cognitive Skills Under Various Conditions of Redundancy, Punishment, and Perceptual Input

William J. Meyer
(Syracuse)

Research Report

The research or work reported herein was performed pursuant to a contract with the Office of Education, U. S. Department of Health, Education, and Welfare through the Syracuse Center for Research and Development in Early Childhood Education, a component of the National Laboratory on Early Childhood Education, contract OEC-3-7-70706-3118.

YOUNG CHILDREN'S ACQUISITION OF COGNITIVE SKILLS UNDER VARIOUS CONDITIONS OF REDUNDANCY, PUNISHMENT, AND PERCEPTUAL INPUT

William J. Meyer, Syracuse University

One obvious component of cognitive skills is the ability to adequately identify concepts in a variety of problem situations. Laboratory experiments typically provide the subjects with pairs of stimuli in which one dimension (color, form, etc.) is relevant and other dimensions are irrelevant. The child's task is to determine which dimension, and which value (red, square, etc.), is relevant and to associate that stimulus with a specific instrumental response. Another strategy provides the subjects with a variety of objects which can be sorted in a variety of ways. Typically, the subject is encouraged to continue sorting the stimuli until it is obvious no further categorizations are available to him.

Each procedure serves its purposes adequately but each relies on the subject's determining the salient aspects of the stimuli. This is particularly evident with the experimental strategy where the subject must figure out what the experimenter wants in order to receive an M&M. These studies are typically labeled "concept formation" or "discrimination learning," suggesting that the concept is acquired during the experiment. What is more likely to be the case is that the subject already has the concept and can, prior to the experiment, adequately discriminate among the various dimensions and values of the dimensions. A more accurate description of these studies is "concept identification" or "attribute identification" where it is assumed that the attribute already exists in the subject's response repertoir .

At least three attributes of the total task situation can be identified as contributing to the variability usually observed in such studies: (1) stimulus characteristics, (2) incentives employed, and (3) subject characteristics. I shall now examine each of these variables.

Stimulus Characteristics. The term "stimulus characteristics" means the number of dimensions simultaneously present in the stimulus. For example, a pair of geometric blocks might include the dimensions of color, form, size, and, if they are paired, position. Clearly, it is possible to vary the number of dimensions from two, where one is relevant and the other irrelevant, to n dimensions with one relevant and n-1 irrelevant. Osler and Kofsky (1965, 1966) have shown that preschool kindergarten age children perform less well on any level of task complexity, but especially so with the more complex level. These investigators further showed that the older children dimensionalized the stimuli to a greater degree; that is, they tended to respond in terms of the available dimensions rather than in terms of the specific values of each dimension.

The fact that the older children spontaneously categorized to a greater extent than the younger children suggests that less of a memory load is placed on the older Ss; that is, failure to categorize requires the

S to recall the association between each separate stimulus and the correct response while categorization of stimuli requires only that the child recall the association between a combination of stimuli and the correct response. Thus, it seemed plausible to expect that a memory aid would benefit both younger and older children, but benefit the younger children to a greater degree. The following experiment, conducted by myself and David Hultsch, examined this possibility.

The subjects were 108 kindergarten and second grade children. There were 54 kindergarten children, mean CA = 5.9 years, and 54 second graders, mean CA = 8.0 years. The children were from lower-middle class homes and possessed average intellectual ability.

Concept identification tasks at three levels of stimulus complexity were constructed. Each level required the identification of one relevant concept and complexity was varied by including either 0, 1, or 2 irrelevant concepts. The positions of the correct responses were sequenced so that within a block of trials each stimulus appeared equally often, right and left sides were correct equally often, and shifting sides resulted in reinforcement as often as staying on the same side. The dimensions were color, form, and size, each of which was relevant equally often.

For the memory load conditions in which one or two previous instances were available, a lighted display box was placed behind each of the response buttons. Following a correct response, a print identical in content and size to the projected stimulus was placed in the box behind the appropriate response button. In the condition where one instance was available, the print remained in the display box until the S made another correct response, at which time the new stimulus replaced it. The procedure was the same for the two-instance condition except that two prints were on display. Following a third correct response, the earliest print was removed.

The subject's task was to determine the relevant dimension and then associate each value of that dimension with the appropriate buttons. Relevant dimensions and values were randomized over subjects. Trials were terminated after ten successively correct responses or after 144 trials.

The design is a 3 x 3 x 2 model with three levels of stimulus complexity, three levels of memory load reduction and two age levels. There were six Ss per cell. The stimuli consisted of pictures of geometric figures mounted on slides suitable for use with a Kodak 100 projector. The subject was seated at a table in front of a milk glass screen. Stimuli were rear projected and terminated upon the subject's response. A successive presentations procedure was used. Two buttons, one on the right and one on the left, were on the table and in easy reach of the subject. Activation of the correct response button operated an M&M dispenser. The presentation of the stimuli and dispensement of reinforcers was controlled by means of Gerbrands Program Timer.

Total errors to criterion were determined for each of the 18 groups and served as the data for analysis. There were statistically significant effects, at the .05 level attributable to stimulus complexity ($F = 5.9$) and to memory load ($F = 6.7$). Thus, the mean number of errors increased as a function of stimulus complexity and decreased as a function of memory load reduction. Chronological age was not statistically significant.

Although the age x memory reduction interaction was not statistically significant, a plot of the curves suggests that our hypothesis is incorrect; that is, the older Ss improved more as a result of the memory aids rather than the young Ss. It should be noted, however, that the memory reduction variable did improve the performance of the young Ss.

Two aspects of this study have impressed us. First of all, the memory reduction variable was helpful in learning the task. It is also clear, however, that this variable is more beneficial when the Ss tend to dimensionalize the stimuli in the first place. We suspect the memory aid serves to remind the older Ss on what basis their previous decision was made, therefore providing a basis for the next response. Secondly, we were impressed by the remarkable variability in performance. Our suspicion is that many children identified the correct concept very early because, indeed, it was highest in their hierarchy to begin with. Other children failed to learn altogether because of a willingness to accept low levels of reinforcement or an inability to attend to other stimulus dimensions. These alternatives are now being examined.

Incentive Conditions. Let me comment briefly here. Specifically, I am referring to some earlier work of mine (Meyer, 1964) where we ran concept identification experiments contrasting the effects of reward versus punishment. Consistently, we found that under complex stimulus conditions, as previously defined, the punishment groups always performed reliably better. When the level of complexity was low (1 relevant, 1 irrelevant), there were no differences. Our interpretation of these data was that punishment, which obviously implies that the response was incorrect, was a more efficient means for helping the S identify the stimulus dimension and value *we* had in mind. In this connection, it should be noted that the variances for the blame groups were consistently smaller. However, these variances remained large enough to suggest that still other variables were operating.

Subject Characteristics. One of the behaviors you cannot help observing in running these experiments is the number of children who do not seem to attend very adequately to the stimulus display before them. In the first study reported here, for example, we made a crude attempt to measure the amount of looking behavior. Although our data are quite incomplete, we did see children who examined the stimulus carefully comparing it with the memory stimulus. Other children responded almost simultaneously with the presentation of the stimulus. I can't say from this study whether this variation related to performance, but it makes sense that this occurred.

Clearly, I am referring here to something like the notion of cognitive styles as described by Sigel and Kagan, among others. We believe, like many others, that nonanalytic or impulsive styles may serve, in fact, to limit the stimulus input from the environment and/or may operate in such a way that the child responds before adequately assessing the total situation. The study I shall now describe is concerned with the relationships between two measures of motor impulsivity and Stanford-Binet I.Q. and was conducted by David Massari, Lois Hayweiser and myself. Maccoby, Dawley, Kagan, and Degerman (1965) have reported recently a significant correlation ($r = .44$) between the ability to inhibit movement and performance on the Stanford-Binet. In that report, the investigators raised the question as to whether or not a similar relationship would exist among children from a lower socioeconomic group or with lower average I.Q. scores (their sample was upper-middle class with an average Binet I.Q. of 135). They further raised the question as to whether the greater impulse control of the high I.Q. children is attributable to their greater ability to follow instructions. In this brief report, the relationship between impulse control and Binet I.Q. is examined using a sample of deprived preschool children and a procedure for measuring impulse control, which, at least, partially answers the question about ability to follow instructions.

Method

Subjects

The sample is comprised of 33 children whose families met the poverty criterion with respect to income and who were further known to the school district officials either through social service agencies or through prior encounters with the family. The mean chronological age of the children is 64.8 months and the SD is 6.9. The average Stanford-Binet I.Q. is 90.0 with an SD of 16.8.

Procedure

As part of an overall evaluation of behavioral change resulting from the six-week intervention experience, the "Draw-A-Line Slowly" (DAL) and the "Walk-A-Line Slowly" (WAL) tests were administered during the first and last weeks of the program. These tests presumably measure a child's ability to inhibit motor activity.

The DAL requires the child to draw a line, beginning at the top of a plain 8-1/2" x 11" piece of paper and proceeding to the bottom of the page, as slowly as possible. The following instructions were used: "I am going to draw a line on this paper as fast as I can. I will start here at the top and go to the bottom. Now, you try it, take the pencil and go as fast as you can to the bottom. Very good. Now, this time I am going to draw a line from the top to the bottom of the page as slowly as I can. Watch. Now you try it. Draw the line as slowly as you can. That was very good." These were practice trials designed to show and explain to the children the meanings of the terms "slow" and "fast." The children were then given the test trials in the following sequence of conditions:

1. The children were instructed to draw the line slowly using an 8-1/2" x 11" piece of paper with no markings. The directions were simply to draw the line as slowly as possible starting at the top and going to the bottom of the page.
2. The children were instructed to draw the line slowly using an 8-1/2" x 11" piece of paper on which there was an "X" at the top and at the bottom. The child was instructed to draw the line "even more slowly" and to connect the X's.
3. This was a repeat of condition Number 2.
4. The children were instructed to draw the line as fast as they could using an 8-1/2" x 11" piece of paper with no markings.
5. The children were instructed to draw the line as fast as they could connecting the X's at the top and the bottom of the page.

The WAL task required the children to walk a path defined by two six-foot long parallel lines of adhesive tape, five inches apart, which were placed on the floor. The children were instructed to place one foot on each tape. This task was given under three conditions in the following order:

1. In this condition the children were told: "I want you to walk to the end of the tape making sure you do not step off the lines." No instructions concerning speed were given for condition Number 1.
2. In this condition the children were instructed: "Now, I want you to walk the line as slowly as you can."
3. In the last condition the children were instructed: "Now, I want you to walk the line as fast as you can."

The procedures for administering the DAL and the WAL have two features not included in the Maccoby et al procedures:

1. The instruction to perform the task "as fast as possible" which will provide a check on the childrens' ability to follow instructions.
2. The initial condition in each of the tasks whereby the children were simply instructed to draw the line or walk the line without directions relative to speed.

The Stanford-Binet was administered during the first and the last weeks of the intervention experience by trained, competent examiners. The examiners administering the Stanford-Binet, and the examiners administering the DAL and the WAL were different, and there was no communication between them with respect to the results on their particular tests.

Results

The data derived from the three administrations of the DAL slowly, were intercorrelated to determine consistency on the three measures. The median intercorrelation was .89, indicating a high level of consistency among the three measures. In treating the data it was decided, therefore, to pool performance on the three measures. Hence, elapsed time in drawing the lines could be a function of the length of lines. It was decided to use a rate measure; that is, length of line divided by time to draw the line. (Analyses involving the straight latency measure yields identical results.) It should be noted that a high score on the rate measure is indicative of high impulsivity. A rate measure was also determined for the Draw-A-Line Fast condition. Straight latency measures were used for the Walk-A-Line Test under each of the three conditions. Product moment correlations were run between each of the measures and performance on the Stanford-Binet.

With respect to the first question raised in this study, the correlation between the DAL slowly and Stanford-Binet is of the same order of magnitude as reported by Maccoby et al for the pretest measures (r = .45) and somewhat higher for the post-test measures (r = .56). A similar degree of relationship was found for the WAL slowly and the Stanford-Binet with again a much higher correlation among the post-test measures. Thus, the conclusion is warranted that these two measures of motor impulsivity correlate with the Stanford-Binet among a sample of children whose average I.Q. is somewhat below average.

The second question of concern in this study is the degree to which these measures correlate with Binet performance because of the inability of the poor performers on the Binet to understand the directions. We examined first the correlations between the Draw-A-Line Fast and Walk-A-Line Fast measures with the Stanford-Binet. All of these correlations are essentially zero. Since there is no apparent reason why children should better understand the meaning of "fast" as opposed to "slow," it would appear that the variation among children in the ability to control motor impulsivity has relatively little to do with understanding the instructions. Two additional empirical arguments can be made for this conclusion. In the first place, there is a statistically significant difference between performance under the slow condition as opposed to the fast condition for both the DAL and the WAL on both the pre- and post-tests (WAL: $t = 6.58$, 8.94; DAL: $t = 8.49$, 11.55; all ts $< .01$, df = 23). The second case can be made from inspection of the correlations between performance on the WAL under the "regular" condition with the Stanford-Binet and performance on the WAL slowly and fast. First, the correlation under the regular conditions and Binet are of the same order of magnitude as under the "slow" condition. Second, the correlations between the regular condition and the slow condition are substantial and positive. These two sets of results suggest that under this task condition children's performance without any specific instructions is substantially related to their ability to conform to the "slow" instructions and that this behavioral tendency is related to performance on the Binet. Interpretation of the correlations involving the "fast" condition is difficult because of the comparatively low test retest correlations for both the DAL and the WAL. With respect to the pretest correlations, however, the data indicate that the tendency to respond rapidly correlates to a moderate degree with performance under the slow condition and under the regular condition. All correlations involving the fast condition for both the DAL and the WAL are essentially zero on the post-tests. In general terms, however, the predominant trend of the correlations suggests that the inability to inhibit motor behavior pervades over all instructional conditions and that this inability is significantly related to performance on the Stanford-Binet.

Discussion

A comparison of the correlations between the measures of motor impulsivity and Stanford-Binet reported by Maccoby et al with those reported in this paper, suggest that their results were not simply a function of the properties of their sample. Thus, the results of the two studies suggest that measures of motor impulsivity may have meaning over another broad spectrum of children, at least with respect to intellectual ability.

The second objective of this study was to determine whether the significant correlations for the slow condition for the DAL and the WAL are, in fact, an artifact attributable to the inability of the less intelligent children's understanding of the instructions. With respect to the DAL, the children were required to not only draw the line slowly but also to draw the line as fast as they could. It was reasoned that if the resulting correlations with the Binet were simply a matter of cognitive ability, significant correlations should have occurred with both the slow and fast conditions. This did not occur. With respect to the WAL, the children were required to walk the line slowly, fast, and under a condition of no instructions other than to simply walk the line. It can be argued that the "no instruction" condition would approximate the child's general tendency to respond impulsively and, therefore, this measure would correlate with performance on the Binet. Again, there was no reason to assume that children would understand the "fast" instructions better than the "slow" instructions. Here again, the "fast" condition did not correlate significantly with Binet performance, but both the "slow" condition and the "no instruction" condition were significantly correlated with the Binet. Finally, it should be noted that there was a statistically significant difference between the time scores for the "slow" and "fast" condition. Although our procedures admittedly do not provide direct evidence concerning the question of cognitive competency, the trend of our correlations does not indicate that this is a highly important variable. To argue otherwise, incidentally, is tantamount to saying that a significant proportion of Binet Variance is related to the ability to understand the meaning of "slow" and "fast," which is a tenuous proposition at best.

One appropriate question that may be asked is the degree to which the DAL and the WAL are intercorrelated, especially under the "slow" condition. The appropriate product moment correlations are -.40 and -.72, for the pre- and post-test administrations, respectively. In addition, it will be recalled that the correlation between the "no instruction" and the "slow instruction" for the WAL was .81 and .60 for the pre- and post-tests administrations, respectively. These correlations lend support to the conclusion that lack of motor control may generalize across a broad spectrum of behaviors. There are additional data available from this study indicating that the DAL and WAL are significantly related to gain scores resulting from a six-week intervention, performance on such tasks as the Perceptual Speed Test (PST) from the primary mental abilities test, and teacher's perceptions of the adequacy of the social-emotional adjustment of the children. Thus, not only is lack of motor control related to performance on intellectual tasks, but this behavioral trait is apparently related to how children are perceived in terms of their social-emotional development.

I should like to comment briefly on one aspect of this study which, I believe, has implications for the study of cognitive behavior among poor children. The issue is the nature of the antecedent conditions. Certainly, the extensive work of Hess and Shipman points to the fact that the parents of poor children tend to generate nonanalytic low impulse control behaviors suggesting clearly that programs of parent education are crucial. And there is also reason to believe that the poor performance of these children on concept identification reflects in part, at least, their lack of awareness of what stimulus dimensions are likely to be salient to middle class experimenters (or teachers). There is, however, another source of variation which is at least as important; namely, the biological integrity of the orgnaism. A recent survey by Birch, for example, shows the remarkable degree of malnutrition and anemia occurring in children from poverty areas. And, of course, the work of Pasamanick showing the high incidence of cerebral dysfunction among these children. One cannot speak with certainty about cause and effect in this area, but evidence suggests that the syndrome of hyperactivity and low impulse control is related to these biological deficiencies. Coupled with the stylistic patterns of their parents, we may well be seeing here an interaction effect which is overwhelming.

The title of Dr. McDavid's presentation clearly points the direction that must be taken--fitting procedures to the child. That this is the direction of future research is obvious from every title on this symposium. In our own laboratory, we are continuing our work on methods to help the children identify our concepts and we are beginning this month to examine the eye scanning and fixation patterns of children.

References

Birch, H. Health and the education of socially disadvantaged children. Mimeo, 1969.

Maccoby, E., Dawley, E. M., Hagen, J. W., & Degerman, R. Activity level and intellectual functioning in normal pre-school children. Child Development, 1965, 36, 761-770.

Meyer, W. J. & Offenbach, S. Effectiveness of reward and punishment as a function of task complexity. Journal of Comparative and Physiological Psychology, 1964, 55(4), 532-534.

Osler, S. & Kofsky, E. Structure and strategy in concept learning. Journal of Experimental Child Psychology, 1966, 4, 198-209.

Osler, S. & Kofsky, E. Stimulus uncertainty as a variable in the development of conceptual ability. Journal of Experimental Child Psychology, 1965, 2, 264-279.