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ABSTRACT

This study sought (1) to discover ways to teach kindergarten children to listen to a rule that defines a concept and then to apply it, and (2) to learn if rule-learning is facilitated when the pupil is required to verbalize the rule while using it. The task used in the study (1) involves deductive reasoning, (2) requires rule utilization rather than rule verification, (3) requires the learning of four rules (negation, conjunction, disjunction, and joint denial) that were found to be appropriate for this population, (4) requires an understanding of certain function words, and (5) was presented at a level of complexity above that used in laboratory experiments. The subjects, 5-year-old Negro children, were divided into three groups: one group who received instruction in the rules that required them to verbalize the rules themselves (N=6), one which received no instruction (N=6), and one group which received instruction in the rules but who were not required to verbalize the rules themselves (N=8). The oral group scored significantly higher than the control group, but there was no significant difference between the Oral experimental group and the non-Oral experimental group. There was no reliable evidence that self-verbalization is superior to normal instruction. (MH)

TEACHING KINDERGARTEN CHILDREN TO APPLY CONCEPT-DEFINING RULES[1]

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Introduction

The major purpose of this exploratory study was to discover ways in which kindergarten children might be taught to listen to a rule presented by a teacher and then to apply this rule to a succession of events. The kind of rules involved in this study were those which define concepts. The application of the rule consisted of identifying positive and negative examples of the concepts. Since most concepts in school are learned in this deductive fashion, the ability to listen to and apply concept-defining rules is a valuable learning outcome for a child starting school. Actually saying the rule aloud to provide self-cues might be an important way in which this instruction could be assisted. Therefore, a primary question for this investigation was to determine whether rule-learning is facilitated by requiring the pupil to speak the rule aloud as he applies it in a succession of items.

The task used in this study possesses a number of features:

1. The task involves deductive rather than inductive learning.
2. It requires rule utilization and not rule verification.
3. The four rules selected are the conceptual types found earlier in this project to be appropriate for this population.
4. From the viewpoint of languge learning, the task requires an understanding and use of certain function words.
5. In an effort to approximate conditions within a classroom, both rule and instances were presented at a level of complexity or "noise" considerably above that used in laboratory experiments.

The study was carried out in two stages. The initial goal was to develop an effective instructional program for teaching children to apply new concept-defining rules. This oral program was evaluated by comparing the performance of an instructed group of children with that of an uninstructed group. Subsequently, a non-oral version of this program was prepared and tried out with another sample of children from the same population. The performance of these children was compared with that of the children in the oral group as well as the uninstructed control.

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Deductive versus Inductive Concept Learning

Most experimental studies in concept learning use an "inductive" approach. Bourne (1966) classified such studies into two groups: Those based on a reception paradigm and those involving a selection paradigm. In the former case, the subject is presented with a series of instances which he is required to identify as either positive or negative. As he makes his judgment he is given information as to whether he is right or wrong. When the subject finally reaches a criterion of a specified number of correct responses in a row he is said to have learned the concept. Under the selection paradigm, the subject is presented with a large array of examples simultaneously. Under these circumstances, the subject, not the experimenter, selects the instances for testing. The memory load is greatly reduced since information as to whether an instance is positive or negative remains available to the subject after he makes his test. The subject is free to develop and adopt a strategy of gathering information on his own.

These two approaches to the study of concept learning may well involve much of the same kind of subject behavior. Under either paradigm, it is possible for the subject to learn to make the appropriate responses without being able to verbalize the rule; he may never formulate and test hypotheses on his own. Certainly a large part of early learning is of such a non-verbal nature. However, even the kindergarten child frequently uses verbalization to assist himself in solving concept identification problems. Here the child may well be formulating hypotheses by using familiar rules or adaptations of such rules. In any event, although the learner may be given a varied amount of guidance in this task, he eventually formulates for himself the rules he finally uses. The process is inductive in the sense that the information the child receives relates to the instances; the rule must be derived from the information given.

However, inductive procedures are rarely adopted in the classroom. When learning a new concept the child is usually given the rule which defines the concept and then is asked to apply this rule by identifying positive and negative instances of the concept under a variety of practice conditions. Carroll (1967) says, "The most critical difference between school concept learning and concept learning in psychology experiments is that the former is, for the most part, deductive and the latter is generally inductive." Ausubel (1963) says that, "Most classroom instruction is organized along the lines of reception learning."

Englemann (1968) describes deductive processes as an important aspect of induction. He says:

> Current curricula often fail to demonstrate the character of logical reasoning and systematic investigation. This failure is closely related to an apparent misunderstanding of induction and that an inductive approach proceeds according to the strategy of "deduction." The difference between deduction and induction is merely a difference in which part of the argument is given. Both use the same argument form: Glasses break. This is a glass. This breaks. When the problem is

> inductive, one is given the last two parts; when the problem is deductive, the first two parts are given. The child who understands logical reasoning understands this argument form, whether the specific problem is one of filling in the first or the last part. Typical inductive training proceeds according to the seemingly tenuous assumption that the child will somehow learn this argument form from experiences that never bring the various parts together in any cohesive manner, or never tie in with deductions and inductions with which he is familiar. (P. 55)

Englemann goes on to indicate that learning to apply rules is highly important for the young child.

> The most important kind of induction the young child can learn is that rules that are given to him in the classroom apply to various instances. If the rule involves adding one to a number, he should learn that the rule holds for any situation he chooses to test. The inductive test of effective rules is where primary emphasis should be directed, because this emphasis familiarizes the child with the basic argument form of logical reasoning, and it demonstrates the value of rules. To learn a rule is to learn a shorthand solution to a range of problems. The child who learns to use the rules in this way also learns important skills connected with following instructions. (P. 55)

The deductive aspects of this task may be an important prerequisite to the handling of inductive type problems. In the current investigation this possibility was explored by including inductive concept identification problems as one of the final criteria.

Rule Verification and Rule Application

An important component of inductive concept learning is simply that of verifying the rule, that is, of testing a hypothesis. Two investigators have carried out studies in this field. Wason (1959), using concept-defining statements along with positive instances of the concept, asked the subjects whether or not the rule defined the concept as represented by a specific exemplar. In other words, subjects were asked to verify the rule. In some cases the instance presented was positive, in others it was not. Some of the statements were worded affirmatively, others negatively. Wason found that false negatives took much longer to verify than true affirmatives.

Trabasso (1967) read the concept definition to the subject and then presented an instance. The time taken to verify whether the rule was true or false was recorded. Trabasso found that the addition of negation greatly increased the time required for both conjunctive and disjunctive types of rules. Again it was much easier to confirm the positive than to disconfirm a false negative.

In the present investigation, the emphasis was placed not on verifying but upon applying rules. The differences are indicated in Table 1 , where it will be noted that these two approaches present the subject with quite different tasks. In the case of rule verification, the subject is asked to test the validity of the rule, assuming that the instance given is indeed a positive representation of the concept. In the case of rule application, however, the task is to determine whether the instance is positive or negative, on the assumption that the rule is truly valid. Referring to the table, it can be seen that the information as to whether the judgment of the subject is correct or not leads to quite different actions. Of particular importance is the source of the rule. If the individual proposes the rule to himself, verification can be equated with hypothesis testing. On the other hand, if the experimenter presents the rule to the subject for verification, it is similar to the studies of Wason and Trabasso on rule verification. Rule application occurs in inductive learning of concepts after the individual has received some assurance that the rule is indeed applicable. Where the experimenter or the teacher supplies the rule, evidence that the student truly understands the concept is provided when the rule is appropriately used.

Bourne has pointed out (1966) that there are two components in rule utilization: the rule itself and the attributes. In concept identification problems it is presumed that the attributes have already been experienced, that is, learned. The individual is able to make discriminations among the values of a dimension and may also be able to label them. When he is asked to identify the concept, he makes use of this prior learning of the attributes so as to classify or sort on this basis. The task of the typical concept identification problem is to determine which attributes are relevant and which are irrelevant. A more basic task in these problems is learning the type of conceptual rule involved in the particular concept. Haygood and Bourne (1965) showed that subjects who were told which attributes were relevant but not the rule did better than subjects who were told the rule but not the relevant attributes. Subjects who were given neither of these components made more errors than those who had either one or the other.

King (1966) working with adults as well as children, 6, 9, and 12 years of age, told his subjects which attributes were relevant. The inductive concept identification task was to identify whether the rule being used was conjunctive or disjunctive. He found that at every age level the disjunctive rule was more difficult than the conjunctive. King found that his subjects, especially the six-year-olds, frequently solved the problems but without being able to state the rule. Three stages in rule learning were suggested by his study. "In the first, children are not able to discover the rule nor to profit from verbal tutoring; in the second, they are not able to discover the rule by induction, but can learn to utilize it with the aid of verbal tutoring; in the third, they can discover the rule and utilize it without verbal tutoring." His study suggests that many children would profit from instruction during the rule utilization phase.

The task involved in this experiment was that of listening to a rule and then applying it to a variety of instances. While this task seems fairly straight-forward, a previous study (Thomas, Schutz & Keislar, 1968) indicates that it is one in which performance can be considerably improved with practice. This is true even though the attributes are familiar to the child and the definition of the concept is fairly simple.

Conceptual Rules

Haygood and Bourne (1965) have indicated that where two focal attributes partition a population, the 10 distinct rules constitute five pairs, one member of a pair being in one sense the complement of the other. The five pairs of conceptual rules are: affirmation and negation; conjunction and alternative denial; inclusive disjunction and joint denial; conditional and exclusion; biconditional and exclusive disjunction.

It has been noted (Thomas, Schutz and Keislar, 1968) that kindergarten children from lower class neighborhoods had no difficulty with affirmation, which was a very simple kind of rule for them to follow. The four conceptual rules adopted for this investigation, therefore, were negation, conjunction, inclusive disjunction, and join denial. In their experiment, Haygood and Bourne used the last three rules, but instead of negation, which was not a difficult rule for their subjects, they used the conditional.

The ability to use these rules involves language learning, particularly listening comprehension, where the child responds to the critical words in the rule. The different conceptual rules in this experiment require that the child pay attention to the following three words: not, and, or. These are the "little words," with which, according to Bernstein, culturally deprived children have difficulty (see Schutz, and Keislar, 1968). It would seem reasonable that the child who has been required to verbalize overtly the rules involving these function words will be more likely to pay attention to them and to use them appropriately.

Level of Complexity

Laboratory studies have usually used simple and highly controlled material for the experimental tasks. For example, Wason and Trabasso each used the dimensions of color, size, shape, and number. Having students identify concepts such as "the large red circle" offers considerable precision. The strategy involved is that of building a model which applies to highly simplified instances and to increase its complexity slowly during successive experimental sequences. In this way a final model of high complexity can be developed.

An alternate strategy is to start with the highly complex concepts and materials of the classroom and to attempt to deal with these in order to discover the relevant dimensions. In later stages one can then carry out studies on a more abstract, controlled basis, using the dimensions which have been isolated in the preliminary stage. This latter strategy has considerable merit in that experimental studies carried out in laboratory settings do not consider important classroom variables.

In the present project an intermediate position was taken. The complexity of the tasks varied in terms of the irrelevant factors present. The concepts adopted were similar to those the child might be exposed to in school. The attributes, e.g., earrings and glasses, were everyday objects of the child's environment. Since the child was required to identify pictures in which these objects were present, a major consideration was whether the child interpreted the pictures in the way the examiner intended. A variety of drawings were used so that a good deal of irrelevant material was always present.

TABLE 1

Comparison between Rule Verification and Rule Application

	Rule Verification	Rule Application
Assumption:	Validity of rule indeterminate	Rule is valid
Task:	To verify rule	To identify instances as positive or negative instances of the rule
Question Posed:	"This is a positive instance of the concept: could the rule define that concept?"	"Are these instances of the concept as defined by the rule?"
Concluding Action:		
If answer to the above question was		
"Yes" and was correct	Retain rule	Identify instance as positive
"Yes" and was incorrect	Reject rule	Identify instance as negative
"No" and was correct	Reject rule	Identify instance as negative
"No" and was incorrect	Retain rule	Identify instance as positive
Name of Process:		
If the rule given to subject by:		
1) Subject himself	Hypothesis testing	Rule application
2) Teacher or experimenter	Rule verification	Deductive concept learning and rule application

Another source of complexity in the present study was the mode of presentation of the rule. Here the subjects had to learn to extract the rule when it was embedded among irrelevant statements. That is, for every problem in the final task, the children were presented with a rule as well as with an irrelevant sentence. Given this "noisy" stimulus the child had to select the sentence containing the information which was appropriate for the question being posed.

Criterion Tests

Two types of criterion tests were used: rule application and concept identification. The first of these involved deductive learning of the rule while the second required identifying the correct rule through induction.

1. Rule Application Test. On the rule application subtest, there were eight problems, two for each of the four conceptual rules. The types of problems used are presented here arranged according to the type of conceptual rule. However, in the actual test the items were scrambled so that no two rules were ever given in succession.

Negation	Tony's mother does not wear a watch.
	The new teacher does not wear glasses.
Conjunction	Fatso Pig is wearing a bell and has spots.
	Richard's sweater has buttons and sleeves.
Disjunction	The lady bus driver wears earrings or a necklace.
	Betty's brother is dressed like a policeman or a spaceman.
Joint Denial	Jimmy's favorite present has no wheels and no ribbon.
	Lilly's purse has no handle and no zipper.

For each of the problems in the test, the children were told a story in which the characteristics of a missing object or person were described. This description constituted the concept-defining rule. The goal for each problem was always stated at the beginning of the story. E.g., "Jimmy has lost his sweater. Let's help him find it." For one-half of the problems, the critical concept-defining rule was given immediately, with an irrelevant statement second; for the other half of the problems the reverse order was followed. After the rule was given, the child was shown a card with two or three pictures and asked to identify which one might be the object or person. The correct picture represented the positive exemplar of the concept while the distractors represented negative instances.

The following is a typical problem:

> "Who could be Edward's new teacher? The new teacher does not wear glasses. He has a ring on his finger. Point to the one that could be Edward's new teacher." The child

was then shown five cards, each showing a picture of a face with glasses and one without glasses. The instruction to "point to the one who could be Edward's new teacher" was repeated with each card.

There were five cards for each problem, with two or three alternatives per card, making a total of 10 to 15 pictures per problem. In order to bring the story to a satisfying conclusion, the positive instance (the missing object) on the last item of each problem was identified by the experimenter.

Before the eight problems were presented, all the children were given special preliminary training in answering these kinds of questions. This training consisted of two parts. In Part I, the child was given a sample problem involving affirmation (a rule not used in the experiment because it was too simple) and then required to apply the rule to a set of three items, without error, twice in succession. If the child missed any of the items in this problem, the instruction was repeated with as much additional assistance as was necessary until the entire set of three items was passed without error, two times in a row. In Part II a new affirmation rule with five items was presented to make sure that the child truly understood what to do. It was found that in practically all cases those children who had demonstrated competency in following instructions in Part I passed all the items in Part II, providing some assurance that the instructions to the major part of the test were fully understood.

2. Inductive Concept Identification Test. The second part of the criterion test consisted of three concept identification problems, one problem being given to the children each day over a three-day period. For each of these concept identification problems, the child was shown a card on which were drawn rectangular boxes. Each box contained two pictured objects. The child was told to find the "correct" box on each card. After the child pointed to the correct picture he was given confirmation and the next card was shown. There were a total of eight cards per trial. A new set of cards was presented for the second trial and then the two sets were shown again for the third and fourth trials. If necessary, as many as eight trials could be given, continuing the procedure of the first four trials, or until the child could select the correct box on eight successive cards.

The rules for the inductive problems were as follows:

(1) Joint Denial "Not a comb and not a ring."

(2) Alternative Denial "Not a carrot or not pants."

(3) Disjunction Involving Conjunctive Attributes "Bone and hammer or leaf and tape."

It will be noted that the rule used for the first problem, Joint Denial, was also used in the rule application program. The second problem involved a fifth conceptual rule outlined by Haygood and Bourne, Alternative Denial, the complement of Conjunction. The third problem involved quite a difficult rule, Disjunction Involving Conjunctive Attributes.

In scoring the inductive problems, the total number of errors on all trials combined was taken as the measure of performance. So as not to bore children by repetition of a task once mastered, for the children who reached the criterion by passing on a single trial (a set of eight cards without error), it was assumed that they would have continued without error for the full eight trials.

Subjects

As indicated earlier, the program was administered in two stages. In the first stage, the original oral program was given to eight children in a day care center, with eight children from another day care center in the same neighborhood serving as a control. Unfortunately, it was not possible to provide instruction at both sites, hence random assignment to both treatments within each center was not undertaken. Because of attrition, the final number of subjects for this stage was 12, with six in the Oral group and six in the Control. In the second stage, eight additional children were given a Non-oral adaptation of the original oral program. Children in this Non-oral group selected responses for multiple choice items, and answered only "Yes" or "No" to questions. The subjects in all three groups were Negro children, approximately five years of age, ranging from 58 to 62 months.

Instructional Program

The instructional program for the Oral group consisted of four sections. The first unit dealt with negation, followed by conjunction, disjunction, and joint denial. Within each of these units a sequence of six major steps was followed: (1) Children were presented with problems in which only the rule was given. The child was asked to apply this rule to a single item, for example, "Which picture shows a dog with no collar?" (2) The child repeated the rule "A dog with no collar" and then selected an appropriate picture from among three alternatives. In this stage, children were presented with the same rule, repeated the rule, and then selected pictures from a series of items. (3) The children were presented with the rule describing an object. They were then asked to point to the object, for example, "Rover is a dog with no collar. Point to Rover." Here the children again repeated the rule and were expected to identify the picture on one item only. (4) The procedure was the same as in Step 3, but the rule was applied to a series of items. (5) Each conceptual rule was presented along with the irrelevant statement. Again the child repeated the rule and identified the correct picture. (6) The same sequence was followed as in Step 5, except now the child applied the rule to a series of items.

The oral response for each rule required the child to repeat the relevant part of the rule for purposes of self-cueing. In the example given above, the child would be instructed to repeat "no collar" for each card in this series.

Children were shown 20 examples of each of the four conceptual rules. The rules were presented so that a fairly random sample of attributes were used.

For the instructional program, the attributes consisted of separate pictures duplicated from a standard picture file. The use of a file containing a large number of pictures allowed the efficient production of the many frames required for training. The positive instances of the conceptual rules of negation and disjunction involved only one picture while the other two rules, conjunction and joint denial, required two pictures placed together.

The general format for instruction used stories as a setting for the task activities. For example, the following story was used to teach negation to the Oral group:

"It was late at night and everything was quiet at the toy store. All the people were asleep except the toy people. 'I'm hungry,' whispered the toy cowboy. 'I'm hungry too,' said the toy Santa Claus. So the toy people decided to look for something to eat.

(Problem 1) "Let's find all the things the cowboy picked to eat. He did <u>not</u> eat a pie. Say, 'not a pie'... Point to one of the things the cowboy picked to eat. (Show first card consisting of two picture choices, one of which is a pie.) Find something else the cowboy chose to eat. (Show second card, also with two choices, one of which is a pie. Repeat procedure for next five items.)

(Problem 2) "Now let's find all the things Santa picked to eat. He did <u>not</u> eat popcorn. Say, 'no popcorn'..."(Five pictures were then shown.)

Administration of Program

All children were given tests and instruction on an individual basis by the experimenter. An assistant was assigned the task of recording the child's responses and other anecdotal material. All tests and instruction involved showing the child pictures along with a commentary. Every effort was made to establish rapport with the child but without affecting the standard instructions. The lessons or tests took between 8 to 12 minutes each day. The testing and instruction were carried on in an area where, unfortunately, occasional disturbances were created by staff or pupils entering the room. For any given child, these probably occurred once or twice during the entire experiment.

Table 2 presents the testing and instruction schedule for the 13 day period. On the first day there was a short orientation in which the children were put at ease by the experimenter; they were asked simple questions involving picture identification. The second day all subjects were given the rule application pretest. The children in the two experimental groups then came in every day for a period of seven days. The first three of these daily lessons dealt with negation, which was judged to be of central importance. The three conceptual rules, conjunction, joint denial, and disjunction were then taught in one daily lesson apiece for the next three days. On the last day of instruction the experimental groups received practice using all four rules. Systematic reviews of all the previous learning were held at the beginning of each daily lesson. Four days were then devoted to the two posttests. On the first day, the rule application test was given, and on each of the remaining three days one of the inductive concept identification problems.

Results

First Stage

In this section, the Oral and Control groups will be compared. Although subjects were not randomly assigned to these two groups, the populations from which they were drawn appear to be so comparable that the usual tests of significance have been made. However, it should be kept in mind that interpretations of the results are subject to this reservation.

On the rule application test, the Oral group moved from a mean error score of 26.8 on the pretest to a posttest mean of 15.5, a gain of 11.3 points. The Control, however, showed on the average little improvement; they had a pretest mean error score of 22.5 and a posttest mean score of 21.3, a gain of 1.2 points. The difference between the two gain scores, using a nonparametric test, is significant at the .05 level. The analysis of covariance (see Table 3) also revealed significant differences, thus supporting the conclusion that the oral program did produce a reliable improvement in the ability to apply rules.

On the concept identification problems, the Oral group was considerably better than the Control. The overall mean error score for the instructed group was 15.3 while the mean for the Control group was 27.2. On the basis of a 2 x 3 analysis of variance (see Table 4), using a repeated measures design with two treatments and three problems, it may be stated that the difference between the two groups was significant on these inductive problems.

Final Stage

A few weeks after the completion of the oral program, the non-oral program was administered to eight children drawn from the same day care center as the Oral group. While the assumption of random selection is thus not technically tenable, the fact that these children were from the same population and received instruction in a standardized format seems to justify the use of statistical measures for random samples. Thus all three groups, the Oral and the Non-oral instructed groups and the uninstructed Control group have been included in the same analyses.

The mean error score on pre- and posttest administrations of the rule application test for the Non-oral as well as the Oral and Control groups are given in Table 5. It may be noted that the Non-oral group showed a gain of 4.6 which was intermediate between that of the Oral and the Control. An analysis of covariance, presented in Table 6, failed to show a significant difference among the three groups. In Figure 1 are presented the graphs for each of the three groups to show the change from pre- to posttest for each of the four types of rules. It should be noted that the Oral group improved a good deal on each of the rules, the Non-oral improved on Joint Denial and Negation, whereas the Control group showed little pre- post differences on any of the subtests.

Figure 2 shows the mean progress over each succession of trials for the three concept identification problems, by treatments. The results of a repeated

TABLE 2

Schedule for Testing and Instruction

DAY	ACTIVITY
1	Orientation
2	Rule Application Pretest
	Instruction:
3	Negation
4	Negation and Review Items
5	Negation and Review Items
6	Conjunction and Review Items
7	Joint Denial and Review Items
8	Disjunction and Review Items
9	Review Items on Total Instructional Program
	Posttests:
10	Rule Application Test
11	Inductive Concept Identification, Problem 1
12	Inductive Concept Identification, Problem 2
13	Inductive Concept Identification, Problem 3

TABLE 3

Analysis of Covariance on Rule Application Test
for Oral and Control Groups
With Deductive Pretest as Covariate

Source	df	MS	F
Total	10		
Error	9	32.28	
Treatment	1	227.13	7.04*

*p < .05

TABLE 4

Analysis of Variance on Inductive Concept Identification Problems
for Oral and Control Groups

Source	df	MS	F
Between Subjects	11		
A. Treatment (Oral vs. Control)	1	1284.03	7.28*
Subjects within Groups	10	176.41	
Within Subjects	24		
B. Problems	2	3545.59	60.65**
AB	2	1.69	
B x Subjects within Groups	20	58.46	

*p < .05
**p < .01

TABLE 5

Pretest and Posttest Errors on Rule Application Test
for Oral, Non-oral and Control Groups
with Deductive Pretest as Covariate

		Pretest		Posttest	
Group	N	Mean	SD	Mean	SD
Control	6	22.5	3.0	21.3	2.9
Oral	6	26.8	2.8	15.5	3.1
Non-Oral	8	24.5	2.9	19.9	3.2

TABLE 6

Analysis of Covariance on Results of Rule Application Test
for Oral, Non-oral and Control Groups
With Deductive Pretest as Covariate

Source	df	MS	F
Total	18		
Error	16	49.4	
Treatment	2	106.4	2.15

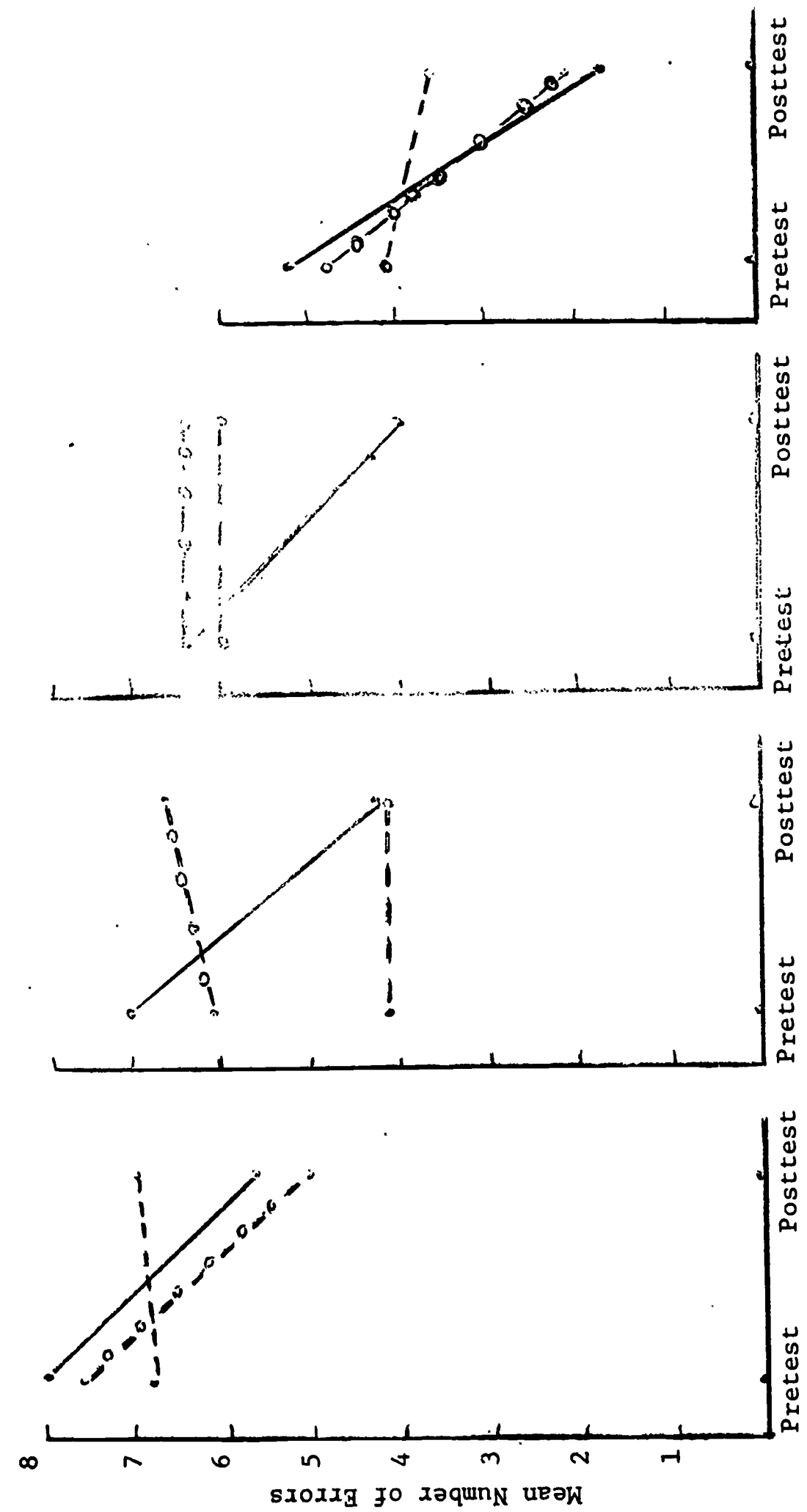

Figure 1. Pretest and Posttest Errors on Rule Application Test by Conceptual Rules for Each of Three Groups

measures analysis of variance for total scores (see Table 7) show that the differences among groups are highly significant. On the first problem, Joint Denial, the children in the two instructed groups showed rapid learning of the rule, whereas the Control group presented a pattern of very slow acquisition. A similar pattern can be seen for the second concept identification problem, Alternative Denial, even though this was somewhat different from the kind of rule encountered in the program. While the third concept identification problem, Disjunction Involving Conjunction, was much more difficult for all children, the difference between the progress of the instructed and uninstructed group is still apparent. It is of interest to note when, at the conclusion of the individual testing situation for each problem these children were asked how they knew which picture to select, not one was able to state the rule at all.

Discussion and Conclusions

The results from the first stage clearly indicate that the oral instruction program was effective in improving performance on the rule application task. This finding is of particular interest since the posttest included problems which were somewhat different from those given during training. The training consisted of instances in which each attribute was a total picture in itself, e.g., a box containing a toy car and a hat. The posttest, however, presented the child with instances in which the attributes were part and parcel of the total picture, e.g. a lady with earrings and a hat. The posttest was thus to some extent a transfer test.

On the inductive learning test the superiority of the experimental groups over the control can be understood in part through the fact that the test involved the same kind of problems as the training. Part of the superiority of the experimental groups may therefore be attributed to specific factors such as familiarity with the pictorial material. Even so, however, the inductive problems on the test were very different from those given during instruction; this finding suggests the importance of exploring further the possible transfer values of such instruction in rule application.

The improvement between pre- and posttest for the instructed group is fairly substantial. While there appears to be far more room for improvement on the part of these young subjects on this task, the posttest was designed to be fairly difficult so as to tease out any differences between the experimental groups which might differentiate the training effects. A number of other factors which were involved in the posttest performance need to be considered: 1) The program itself was fairly short with only a limited amount of time which these children actually spent in training. The lessons took approximately 10 to 12 minutes per day with a total instructional time of about one hour and a half. 2) While the drawings presenting the attributes had been checked for familiarity and clarity with a comparable population, these children may not have had as much experience with the attributes as was anticipated.

Comparing the posttest performance of the Oral and the Control, there is dramatic evidence to support the value of the kind of instruction provided in this experiment. The Oral group showed very clear improvement

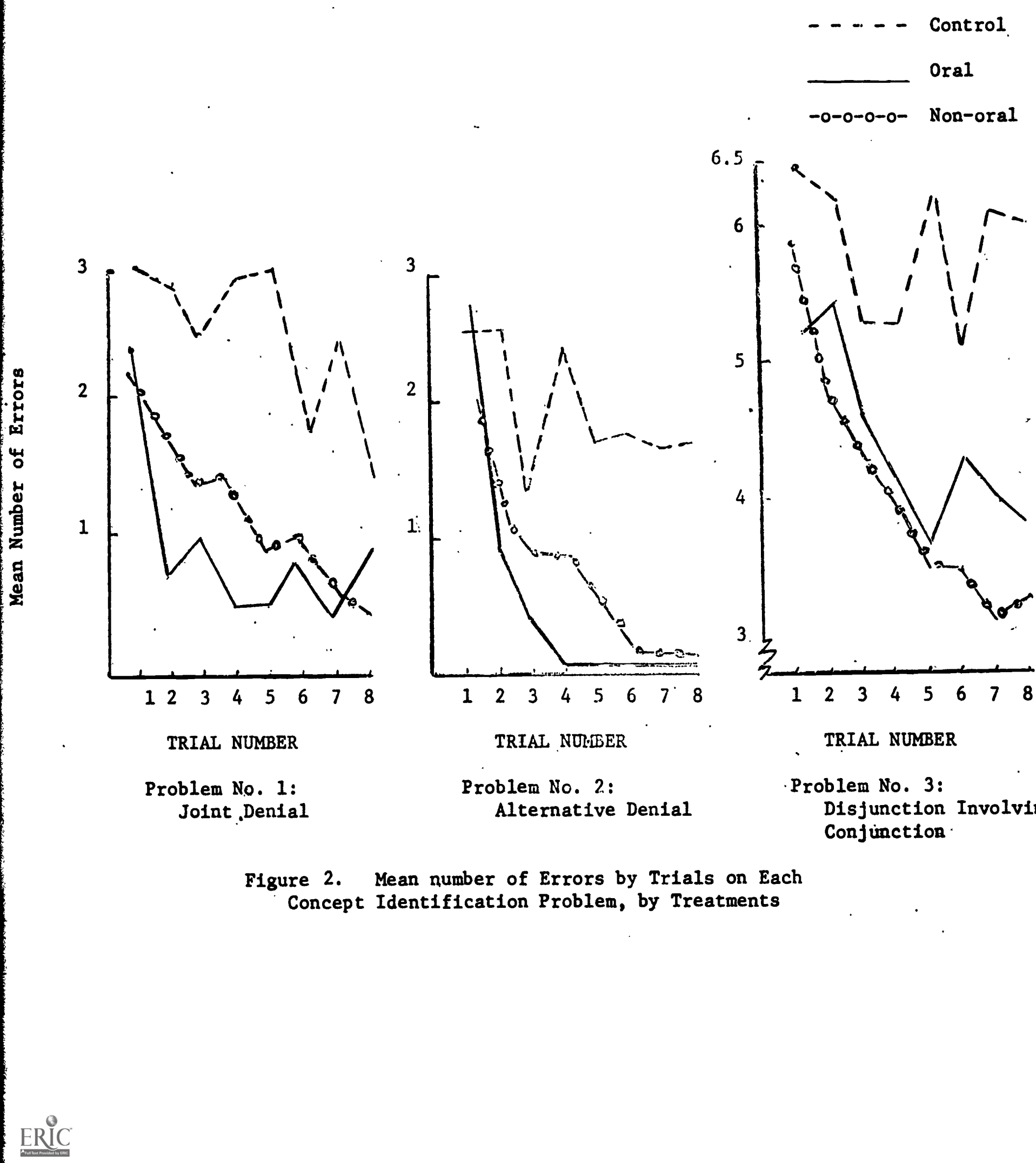

Figure 2. Mean number of Errors by Trials on Each Concept Identification Problem, by Treatments

TABLE 7

Analysis of Variance on Concept Identification Problems for all Treatments

Source	df	MS	F
Between Subjects	19		
A (Treatments)	2	915.82	4.94*
Subjects within groups	17	185.40	
Within Subjects	40		
B Problems	2	5336.71	11.08**
AB	4	13.87	
B x subjects within groups	34	481.70	

*$p < .05$

**$p < .01$

on the test even though the items were substantially different from the items in the instructional program. Clearly lower class children may profit by having their attention called to the importance of function words such as and, or, and not. By providing practice in listening to rules or descriptions, these children show improvement in following instructions and understanding what is said.

It is possible of course that part of this improvement was attributable to the ability of children to deal with the specific pictorial features involved in this type of task. It may be desirable in subsequent studies to have a control group encounter the same types of attributes and pictures but without practice in applying the conceptual rules. These control children might be asked simply to identify pictures that correspond to a particular description, in other words, the control group here would be given practice with only the simple conceptual rule of affirmation.

Of special interest is the finding that the experimental groups perform so much better on the concept identification problems. On the first problem the advantage could be expected, since these children had already experienced joint denial as a type of rule. On the other hand, they had also been given other rules which could have offered interference in the new learning. However, on these new problems, where the rules were somewhat different from those encountered during instruction, the superiority of the instructed groups is evident. The finding appears to support the notion that in inductive concept learning an important part of the process is that of hypothesis testing. For this study, however, this explanation cannot be supported. Even though these instructed youngsters were able to identify the appropriate positive instances, none of them were able to verbalize the rule.

It is possible that the experimental groups had an advantage simply by being familiar with the pictorial boxes used as stimuli in the task. For greater experimental rigor in future studies, it would be desirable to give the Control groups experience with these types of materials.

The data did not support the major hypothesis of the study, providing no evidence that verbalization of the rule increased the child's competency in applying rules on the one hand or discovering rules in concept identification problems on the other. While the differences in general favored the Oral group, they were not reliable. With the few cases used in this study, there is a danger of making a Type II error. In the investigation reported in the next chapter, the same hypothesis was included among those tested. Here, however, a much larger population of subjects was used and the results can be accepted with greater confidence.

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