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ABSTRACT

Two experiments using paraprofessional personnel were conducted to determine effectiveness of a schoolwide token system on academic performance of trainable mentally retarded (TMR) children. The first experiment consisted of 42 TMRs in a 6-week summer program, in which reading, writing, and arithmetic were the behaviors studied. Pretest and posttest measures on the Metropolitan Readiness Tests indicated that childrens' scores increased over 25% following only 18 hours of token reinforcement for academic performance (p greater than .001). The second experiment was designed to isolate the relative role of reinforcement on the childrens' academic improvement. The experiment involved 31 chidlren who were able to choose a class with or without reinforcement in writing and arithmetic. Results showed that TMRs chose to work on the subject area having reinforcement and also, that the childrens' correct academic performance increased significantly as a function of reinforcement. It was concluded that TMRs could profit from academic training when an extrinsic motivational system was involved. (CB)

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Atlanta Public Schools

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TOKEN REINFORCEMENT AND ACADEMIC OBJECTIVES WITH THE TRAINABLE RETARD

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PREFACE

In 1970, three studies were funded under the Elementary and Secondary Education Act of 1965 (ESEA), Title I (summer appropriation), and subcontracted to Dr. T. Ayllon, Professor of Psychology and Special Education, Georgia State University. The first report, "Token Reinforcement and Academic Objectives with the Trainable Retarded," (*Research and Development Report*, Volume IV, Number 2), was prepared by Dr. Ayllon with the assistance of F. Gerald McCullen, Kathleen Kelley, and Thomas Schneider, Jr. The second report, "A Comparison Between Standard Instruction and Reinforcement Program for the Trainable Retarded," (*Research and Development Report*, Volume IV, Number 3), was prepared by Dr. Ayllon with the assistance of Kathleen Kelley, and F. Gerald McCullen. A third article is a "Design for a Nine-Month School-Wide Program of Token Reinforcement for the Trainable Mentally Retarded," (*Research and Development Report*, Volume IV, No. 4). Since the data from the first study were a determining factor in planning the second study and the results from studies one and two were used in writing study number three, it is suggested that all three publications be read in the proper sequence.

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ABSTRACT

The program to which the trainable child is typically exposed consists of teaching self-help skills and recognition of necessary signs. Further, such programs utilize costly professionals such as teachers and psychologists. An attempt is reported here to establish academic objectives in a school for trainable retarded using incentives to develop and increase academic performance. Extensive use was made of untrained paraprofessional personnel. Two experiments were conducted to determine the effectiveness of a school-wide token (incentives) system on academic performance. One experiment included 42 children and consisted of pre-program and post-program measures on the *Metropolitan Readiness Tests* (MRT). The results of the first experiment show that the MRT scores of the children were increased over 25 per cent following only 18 hours of reinforcement (incentives) for academic performance, an increase which was significant beyond the .001 level. The second experiment, involving 31 children, utilized a multiple baseline technique. Here, children could select from two academic areas the one on which they wished to work. The results showed that the children chose to work on whatever subject area resulted in reinforcement, and did not choose the subject area which resulted in no reinforcement. Further, the children's correct academic performance increased significantly as a function of reinforcement. These results give empirical evidence of the effectiveness of a reinforcement system on achieving academic objectives in a school-wide program.

INTRODUCTION

The child defined as Trainable Mentally Retarded (TMR) typically falls in the I.Q. range of 30 to 55 (Robinson and Robinson, 1965). These children, who are often diagnosed as "brain damaged" or "mongoloid," are outnumbered by the Educable Mentally Retarded (EMR) whose I.Q.'s are between 50 and 75 (Kirk, 1954). In spite of the preponderance of retarded children in the educable range, public school systems have often emphasized special classes for trainable retarded children over those for the educable retarded (Robinson and Robinson, 1965).

The major objectives of special education for the trainable retarded child have typically revolved around self-care, personal etiquette, and responsibility (Goldburg and Rooke, 1967). Academic training is limited to the recognition of necessary signs ("stop," "danger," "men," "women") and elementary number concepts (Robinson and Robinson, 1965). One might have expected that such a curriculum would be justified in terms of the results produced. Unhappily, that does not seem to be the case. In fact, Hottel (1958) points out that trainable retarded children who have been exposed to special classes typically are no more advanced, either in self-help skills or academically, than children who have remained outside the educational system. These findings are confirmed by Kirk (1964) who summarizes a series of studies dealing with trainable retarded children. Kirk states, "Attempts at research with these groups (the trainable retarded) have netted relatively negative results." He goes on to state that in terms of the results of the research report it will be necessary to find new approaches to the problem of effective educational programs for the trainable retarded.

Consistent with Kirk's view there is now a growing body of literature providing just such a new approach. Recent research from the area of applied behavior analysis indicates that when an environment is designed to provide specific consequences contingent upon behavior, the individual learns highly complex tasks in relatively short periods of time. For example, responses have been successfully established even in the most retarded of all individuals, the so-called "vegetative idiot" who emits virtually no response (Fuller, 1949; Brownfield and Keehn, 1966; Rice and McDaniel, 1966). In addition, complex behaviors, such as self-care and self-control, have also been taught to retarded children when these behaviors were followed by reinforcement (Girardeau and Spradlin, 1964; Roos and Oliver, 1965). Indeed, toilet training, self-feeding,

and other self-care behaviors have been reported to be readily developed when the retarded child's environment reinforces the child for learning (Minge and Ball, 1965; Neal, 1963). These findings are in contradiction to those reported earlier by Hottel and Kirk who concluded that there was no difference in the children's skills with or without the special education classes. How does one reconcile these findings? One way is to note the absence in most training efforts of a motivational system to back up the training. The distinguishing characteristic of the research in applied behavior analysis is that it utilizes the individual's own motivation as the avenue for helping the person to help himself. This typically takes the form of tokens or points awarded by the trainer for improvement in self-care skills. These tokens or points are later exchanged for a variety of items including edibles, trinkets, and the like. Effectiveness of such procedures, therefore, suggests that failure to teach the child self-care and social skills is largely due to the method of teaching used. An intriguing possibility here is that if it is possible to develop these skills through reinforcemnt, could not the same reinforcement system be effectively used to generate academic skills? An encouraging start has already been reported with educable retarded children at the classroom level.

Birnbrauer, Wolf, Kidder, and Tague (1965) have presented three types of data for a class of 15 educable retarded pupils: (1) per cent of errors made, or accuracy; (2) number of academic items completed, or productivity; and (3) amount of time spent in a "time-out" area, or index of disruption. The children were reinforced for each academic item worked correctly, with a bonus of 10 points (tokens) for an entire page worked correctly, and a "few" points for being well behaved and "cooperative." All 15 pupils were in the program for at least one month or 20 academic days. The basic design of the study consisted of a period of token reinforcement, a period of no tokens, and reinstatement of token reinforcement. The back-up reinforcers consisted of a wide variety of edibles and trinkets. The following basic results were obtained during the no token period: (1) five subjects showed no adverse effects when the tokens were removed; (2) six subjects increased in per cent of errors, but continued to cooperate and to complete the same or a greater number of items; and (3) four subjects increased in per cent of errors, completed fewer items, and became serious discipline problems. When the tokens were reinstated, the work and cooperation of all subjects reached or exceeded previous levels. The above findings are consistent with research indicating that token reinforcement

programs are particularly effective with recalcitrant or deviant populations such as school dropouts (Clark, Lachowicz, and Wolf, 1968), emotionally disturbed children (O'Leary and Becker, 1967) and severely mentally ill individuals (Ayllon and Azrin, 1965, 1968).

In view of the success of the token economy concept in dealing with these widely divergent populations, it seemed probable that the application of reinforcement principles to academic objectives would increase the academic performance of trainable retarded children. Concentrating on "academic" performance allows the school to move away from its emphasis on self-help skills, and to begin to teach the trainable retarded child such basic subject matter as reading, writing, and arithmetic. If the trainable retarded child is to avoid becoming a ward of the state, and is to be self-sufficient to any degree, mastery of these basic skills is a necessity. A recent report (The Report of the President's Committee, 1969) indicates that in the very near future, many new jobs, especially in the so-called "service" area will be available to retarded persons. Success in these jobs, however, will demand knowledge of the rudimentary academic skills.

The major objective of this research was to extend the previously reported findings on the use of token systems to a school-wide program for the trainable retarded. This program had the following features: (1) emphasis on behaviorally defined academic objectives for the trainable retarded child, (2) determining the feasibility of an incentive system based on the children's own motivations, and (3) the utilization of paraprofessional personnel as an integral part of the school program.

EXPERIMENT I

School Facilities

The setting for this study was an urban public school for trainable mentally retarded children. The school had six standard classrooms, a gymnasium, a playground, an art room, and a cafeteria. Other than access to a public swimming pool, no special facilities or equipment were provided. This study was conducted in conjunction with the regular six-weeks summer program.

Personnel

The summer program staff consisted of six teachers and ten paraprofessional personnel (teenage volunteers) who functioned as aides. Of the six teachers, three had previous experience teaching retarded children, two had taught in regular public elementary schools, and one had no previous teaching experience. Each teacher's class was assigned one to two aides who acted as record keepers and tutors. The only special addition to this personnel was one graduate student who coordinated the implementation of the reinforcement procedures. An independent tester administered and scored the *Peabody Picture Vocabulary Test* (PPVT) given to each of the children at the start and conclusion of the six-weeks program.

Staff Orientation

Two days prior to the arrival of the pupils for the summer program, all teachers and aides were shown selected films and given lectures on behavior modification procedures in school settings, intermittently, throughout the program, meetings were held with each classroom teacher to assist in clarifying the objectives of the program, and the procedures necessary to implement the program. Midway through the six-weeks program, a progress report was given to all teachers and staff in an effort to assure familiarity with program procedures. Throughout the program, it was emphasized that a policy of no punishment would prevail. This policy was followed to the extent that even the use of punishment in verbal form was ruled out. The major emphasis was on developing in the children a feeling of success through the use of positive reinforcement for desired academic behaviors.

Subjects

There were 42 trainable mentally retarded children involved in this study. Approximately 90 per cent of the children were from low-income families. The ages ranged from 8 to 15 years (mean 11.2). The average I. Q. as measured by the *Peabody Picture Vocabulary Test* was 44, with a range from 14 to 79. Approximately 45 per cent of the children were white and 55 per cent of them were black. Table 1 gives the age and I.Q. score for the children included in Experiment I.

TABLE 1

AGE AND I.Q. FOR THE CHILDREN INCLUDED IN EXPERIMENT I

Subject	Age	I.Q.	Subject	Age	I.Q.
1	10.09	79	22	10.00	45
2	14.08	58	23	08.09	42
3	14.03	56	24	11.01	41
4	11.07	61	25	11.04	67
5	15.00	57	26	13.01	52
6	15.03	55	27	13.09	48
7	12.09	55	28	12.00	51
8	14.00	68	29	15.07	46
9	08.10	28	30	08.08	17
10	12.11	30	31	12.04	untestable *
11	11.03	26	32	10.09	14
12	10.08	26	33	08.02	21
13	14.09	19	34	08.07	untestable *
14	12.09	25	35	12.10	49
15	10.11	19	36	14.11	46
16	13.06	22	37	13.10	46
17	09.02	40	38	13.09	43
18	14.05	16	39	12.01	45
19	14.05	33	40	15.02	40
20	10.00	43	41	08.04	62
21	09.10	49	42	08.07	54

* Subjects whose behavior prohibited valid testing.

Defining the Response

The behaviors selected for observation and recording were those most relevant to academic performance namely, reading, writing, and arithmetic. The focus of measurement was on evaluating the children's academic progress through a medium that: (1) required reading and writing skills on the part of the children, and (2) produced standard, objective performance records for analysis and evaluation. Two advantages accrued to establishing written work as the major dimension of academic behavior. First, while the teacher retained the freedom to orally teach and quiz the children, evaluation of the children's academic achievement was based on written assignments. In so doing, the difficulties in recalling what a child said or answered when quizzed orally were avoided.

Second, such a permanent written record of performance made possible the cross-checking and re-analysis of the behavior since the behavior was both observable and enduring in its effect. Ayllon and Azrin (1968) have pointed out the advantage of such a procedure, which they term the "behavior effect."

Characteristics of Academic Stimuli

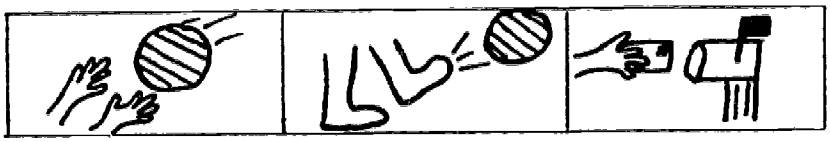
A mimeographed work sheet was developed which required that the children be exposed to five major academic areas: (1) words, (2) stories, (3) matching, (4) writing, and (5) arithmetic. These work sheets were based on modifications of standard educational material such as the *Metropolitan Readiness Tests* (MRT). These work sheets were also arranged in hierarchial levels of difficulty, thus facilitating their use as classroom teaching aids. Table 2 presents samples of the items in each of the five areas.

TABLE 2

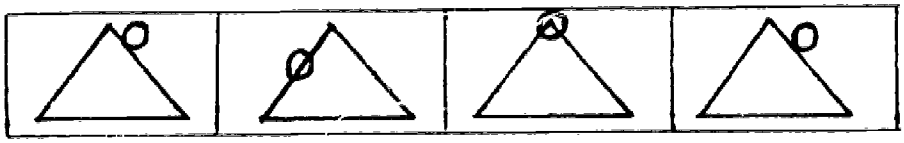
EXAMPLES OF WORK FROM EACH OF THE FIVE ACADEMIC AREAS

1 - WORDS (Teacher instructs the class to: "mark the bed")

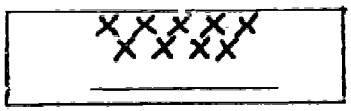
2 - STORIES (Teacher instructs the class to: "the ball is about to be caught - mark the picture that shows this")



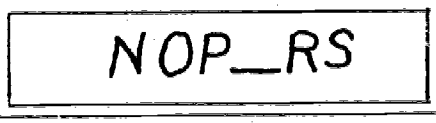
3 - MATCHING (Teacher instructs the class to: "mark the one of these," pointing to the three on the right, "like this one," pointing to sample on left.)



4 - ARITHMETIC (Teacher instructs the class: "on the line write the number that tells how many things there are above the line.")



5 - WRITING (Teacher instructs the class: "fill in the missing letter.")



Defining the Reinforcers

While it has been demonstrated that the teacher's attention and approval are extremely influential in shaping and maintaining the behavior of pupils (Hall, Lund, and Jackson, 1968), the findings of Birnbrauer, Wolf, Kidder, and Tague, (1965) and Ayllon and Azrin (1965) with token "economies" indicate that a motivational system that includes a large array of events and opportunities for behavior is particularly effective in generating and maintaining a wide range in behaviors (for a review of classroom studies utilizing token systems, see O'Leary and Drabman, in press). Therefore, an attempt was made in this program to offer opportunities for the child to select his own activity (or reinforcer) from a large variety of items and events. The tokens (conditioned reinforcer) used in the present investigation were soft drink bottle caps especially colored for this application. Each classroom had different colored tokens to facilitate record keeping. Token reinforcement was available only during the academic class period, and was contingent upon academic performance. Table 3 shows the academic performance for which children earned tokens.

TABLE 3

ACADEMIC PERFORMANCE THAT EARNED ONE TOKEN
ON COMPLETION OF EACH ITEM

1 - WORDS

a - picking out proper word from a group of three words

2 - STORIES

a - picking out picture that corresponded to a short-story, for example, 15 words, told by the teacher

3 - MATCHING

a - matching geometric designs
b - matching numbers
c - matching letters
d - matching words

4 - ARITHMETIC

a - copying numbers
b - counting
c - adding
d - subtracting

TABLE 3 (Cont.)

5 - WRITING

a - tracing letters
b - copying letters
c - filling in letters
d - writing the alphabet
e - writing words
f - reading printed questions and writing the answers

The reinforcers available in exchange for tokens were grouped in three main categories: (1) field trips, (2) special lunchroom, and (3) the entertainment area.

Field Trips

This category included trips to the park, zoo, swimming pool, bowling alley, and hamburger stands.

Special Lunchroom

A balanced meal was made available free of cost to all children daily. During the lunch hour, the children had a choice of two areas in which to eat: (1) the regular lunchroom at no charge or (2) a special dining room in exchange for tokens. The distinguishing features of the special dining area, which was adjacent to the regular lunchroom were a carpeted room, table cloth, padded chairs, flowers, recorded background music, and plastic bowls filled with cookies and potato chips.

Entertainment Area

A section of the gymnasium was converted into an entertainment area. Pictures, posters, balloons, and streamers adorned the walls and ceilings. Gaily colored booths were built with saw horses and heavy cardboard partitions. These individual booths offered a wide range of opportunities for entertainment as follows:

A. Store. In this booth, candies, and Kool-Aid were available, as well as trinkets, such as balloons, toy cars, marbles, hair ribbons, and hair pins.

B. Dance Hall. Music was provided through means of a record player. Children could select the music to which they wanted to dance.

C. Shooting Gallery. This area consisted of two booths: Booth A - plastic bottles could be knocked over by shooting at them with ping

pong ball guns; Booth B - one of the male aides put on his bathing suit and allowed himself to be soaked with shots from a water rifle.

D. Piano Palace. The music teacher played the piano, sang special requests, conducted sing-alongs, and told musical stories.

E. Miscellaneous Booth. Aides conducted painting lessons and took polaroid snapshots. They also provided grooming tips, as well as assistance in painting fingernails and grooming hair.

Table 4 describes the type of back-up reinforcers available and the number of tokens required for each.

TABLE 4

LIST OF BACK-UP REINFORCERS AND THEIR COST

1. Field trips (to swimming pool, bowling alley, park, zoo, and hamburger houses)	1 token per trip
2. Special lunchroom	1 token per admission
3. Booths in entertainment area	
Store	
Candy	1 token
Kool-Aid	1 token per cup
Trinkets	1 to 10 tokens, varying with trinket value
Dance Hall	1 token per 5 minutes
Shooting Gallery	
Booth A	1 token per 2 throws
Booth B	1 token per 2 shots
Piano Palace	1 token per 5 minutes
Grooming Salon	1 token per admission
Miscellaneous Booth	1 token per admission

Token Exchange

Three token exchange periods were scheduled at different times of the day. Such a procedure has been found to be effective in preventing behavioral deterioration due to competing sources of reinforcement (Ayllon and Azrin, 1968). The bus for field trips provided a distinctive place to which the children gained access by placing their tokens in a collection box held by an aide. At the gate of the special lunchroom an aide held a collection box in which the child placed a token before gaining access to it. To obtain admission to the desired booth in the entertainment area, the child deposited the required number of tokens in a collection box placed at the entrance to each booth.

Reinforcer Priming

In order to generate utilization of the back-up reinforcers the children were given, free of charge, some of the reinforcers -- for example, balloons and candy, during the first day of the program. The nature of other reinforcing events required that the children be exposed to them. For example, during the first five days of the program the children were exposed to the "special" lunchroom while on the way to lunch, and were allowed to remain in this special lunchroom in exchange for tokens. (See Ayllon and Azrin, 1968, for details on reinforcement priming procedures.)

Response Priming

To increase the probability of the pupils engaging in academically relevant activities, the teachers made Kool-Aid and candy available right in the classroom during the first five days of the program. Initially, the teachers reinforced staying in one's seat, being quiet, and appropriate classroom behaviors by giving the children a drink of Kool-Aid or a piece of candy. By the sixth day however, the teachers paired tokens with the candy and Kool-Aid, and established academic contingencies. This procedure served a double purpose: first, the children exchanged their tokens for back-up reinforcers; and second, it enabled the teacher to prompt academic components, such as following directions, writing, or using work sheets, that were necessary in order for the child to earn tokens.

An additional opportunity for children to earn tokens for academic work was provided in the first three days of token usage. A "work area," which consisted of a table and a few chairs, was arranged in the entertainment area of the

gymnasium. This area was manned by one of the classroom teachers and provided an invaluable opportunity to bridge the gap between academic work and reinforcement. The children received immediate token reinforcement for academic work, and exchanged the tokens which they had earned immediately following their being earned.

Recording of Response and Reinforcement

Aides implemented the recording of academic performance and the distribution of token reinforcement right in the classroom. They also implemented and recorded the token exchange held at the three designated areas of reinforcer availability. Each aide was given a clipboard and an especially prepared "Daily Token Record Form," which he filled out in duplicate with a record of each child's total daily earnings and expenditures of tokens. These sheets were collected and analyzed at the end of each day. In this way, all classroom teachers were relieved of the responsibility for any form of record keeping.

To help the children identify their classrooms, teachers, and aides, each of the six classrooms was assigned an individual color. These colors were displayed by badges which were worn at all times. The soft drink bottle caps which served as tokens were also color keyed to the classrooms. This token coloring scheme not only assisted teachers and aides in keeping up with the "earnings" of their particular pupils, but also afforded a unique counter-checking system for evaluating token utilization. At the end of each school day, all tokens spent for each activity (the total in a given collection box) were separated by color, and then the total spent by each individual classroom was computed. These sums were then compared with each aide's daily classroom tabulation sheets before tokens were returned to the classroom for use the next day. Correspondence was always within the plus or minus five per cent range.

Results

A comparison of the children's scores on the MRT before and after the six-weeks summer program affords an opportunity for a statistical comparison. The criteria for inclusion in the statistical analysis required that the child be present for both pretest and posttest, and that he attend at least 12 out of the 18 days of academic instruction for an 80 per cent attendance. This criteria was met by 42 pupils.

Average raw scores on the MRT, Form A, increased from 27.5 to 35.3, an improvement of 28.3 per cent (t = 5.38, significant beyond the .001 level). As a further check, the Form B of the MRT was administered to 32 of the pupils. This testing yielded an average raw score of 34.4, an improvement of 25.1 per cent over the pretest score on Form A (t = 4.48, significant beyond the .001 level). Table 5 shows the MRT scores before and after token reinforcement for the total of 42 children.

TABLE 5

METROPOLITAN READINESS TESTS (FORM A) SCORES BEFORE AND AFTER TOKEN REINFORCEMENT FOR THE 42 CHILDREN IN EXPERIMENT I

Subject	Pretest	Posttest	Subject	Pretest	Posttest
1	14	19	22	52	52
2	50	51	23	21	18
3	56	63	24	14	22
4	36	35	25	33	41
5	23	29	26	44	58
6	59	57	27	65	57
7	19	25	28	10	17
8	59	53	29	38	38
9	05	29	30	15	21
10	20	19	31	02	19
11	34	49	32	19	40
12	18	34	33	07	25
13	19	40	34	22	32
14	00	06	35	42	69
15	21	19	36	62	58
16	13	19	37	65	69
17	08	09	38	09	30
18	27	39	39	27	33
19	07	18	40	24	33 *
20	54	48	41	08	44
21	25	31	42	10	15

* Metropolitan Form B score. Subject 40 was not present when the post-program Form A was administered.

Collateral data indicating the relative level of effectiveness of back-up reinforcers for all 42 children are found in Table 6. Most of the tokens were exchanged for store items and edibles (44 per cent). Next most popular reinforcer was field trips (25 per cent) and the opportunity to eat in a somewhat fancy dining room (17 per cent). The remaining reinforcers totaled 24 per cent of the total amount of tokens spent during the period of six weeks.

The percentage spent represents the ratio of tokens spent divided by tokens earned. Thus, Table 6 offers an empirical index of the reinforcing characteristics of the back-up "reinforcers."

A comparison of I.Q. scores on the *Peabody Picture Vocabulary Test* before and after the program show no change. An average score of 44.7 at the beginning of the program versus 44.7 at the conclusion of the program.

Discussion

The results of Experiment I showed a significant difference in children's test scores before and after a six weeks reinforcement program. While this difference points to the importance of the over-all program, the question arises as to the relative role of reinforcement in the children's academic improvement. One interpretation of the results obtained in Experiment I is that they represent a "total-push effect" often seen in clinical work rather than the results being attributed to a given variable. According to this interpretation, the children's scores would improve significantly as a function of the general effects of the milieu and the social interaction and the high degree of enthusiasm of the personnel associated with the program. Indeed, such improvement might well be regarded as a natural outcome of investing time, interest, and attention in these children. In an attempt to isolate the relative role of reinforcement on the children's academic improvement, an additional study was conducted as part of the over-all program.

TABLE 6

PERCENTAGE OF TOKENS SPENT ON BACK-UP REINFORCERS

Tokens Spent / Tokens Earned = Per Cent for That Day

Day	Store	Field Trips	Lunchroom*	Shooting Gallery* Booth A	Shooting Gallery* Booth B	Total A & B	Dancing*	Piano Palace*	Miscellaneous
1	30/170 =71%	50/170 =29%							
2	144/212 =68%	54/212 =25%	.4/212 =06%						
3	105/169 =62%	52/169 =31%	12/169 =07%				00/169 =0%		
4	90/216 =42%	54/216 =25%	56/216 =25%				16/216 =7%		
5	92/192 =48%	50/192 =26%	37/192 =19%				13/192 =7%		
6	93/209 =44%	50/209 =24%	24/209 =11%	9/209 =4%	18/209 =9%	27/209 =13%	13/209 =6%	13/209 =6%	2/209 =1%
7	54/180 =30%	52/180 =29%	28/180 =16%	7/180 =4%	14/180 =8%	21/180 =12%	13/180 =7%	00/180 =0%	12/180 =7%
8	74/210 =35%	54/210 =26%	37/210 =18%	7/210 =3%	14/210 =7%	21/210 =10%	20/210 =10%	00/210 =0%	4/210 =2%
9	76/190 =40%	46/190 =24%	30/190 =16%	7/190 =4%	14/190 =7%	21/190 =11%	13/190 =7%	00/190 =0%	4/190 =2%
10	71/216 =33%	50/216 =23%	40/216 =19%	10/216 =5%	14/216 =6%	24/216 =11%	18/216 =8%	7/216 =3%	6/216 =3%
11	62/192 =32%	52/192 =27%	37/192 =19%	13/192 =7%	9/192 =5%	22/192 =12%	11/192 =6%	6/192 =3%	2/192 =1%
12	59/180 =33%	46/180 =26%	40/180 =22%	7/180 =4%	12/180 =7%	19/180 =7%	8/180 =4%	4/180 =2%	4/180 =2%
13	78/205 =38%	52/205 =25%	42/205 =20%	3/205 =1%	14/205 =7%	17/205 =8%	12/205 =6%	3/205 =1%	1/205 =0%
14	108/238 =45%	50/238 =21%	48/238 =21%	8/238 =3%	6/238 =3%	14/238 =6%	10/238 =4%	7/238 =3%	1/238 =0%
15	64/206 =31%	52/206 =25%	52/206 =25%	8/206 =4%	12/206 =6%	20/206 =10%	10/206 =5%	4/206 =2%	4/206 =2%
16	119/217 =55%	48/217 =22%	24/217 =11%	3/217 =1%	12/217 =6%	15/217 =7%	7/217 =3%	3/217 =1%	1/217 =0%
17	51/208 =25%	54/208 =26%	39/208 =19%	7/208 =3%	27/208 =13%	34/208 =16%	13/208 =6%	12/208 =6%	5/208 =2%
18	118/267 =44%	46/267 =17%	43/267 =16%	8/267 =3%	17/267 =6%	25/267 =9%	21/267 =8%	9/267 =3%	5/267 =2%
TOTAL	1,577/3,617 =44%	912/3,677 =25%	603/3,677 =17%	97/3,677 =3%	183/3,677 =5%	280/3,677 =8%	198/3,677 =5%	55/3,677 =2%	51/3,677 =1%

* All blocks not filled in - reinforcer not available.

EXPERIMENT II

A sample consisting of four of the six classrooms and involving 74 per cent of all subjects from Experiment I was the focus of an experimental analysis. For this purpose a multiple baseline technique (Baer, Wolf, and Risley, 1968) was used for recording and evaluating behavior. In addition, children in each of four classrooms served as their own control. The major objective was to reinforce one academic behavior while concurrently presenting the second one without reinforcement. Later a reversal of the procedure allowed a sensitive gauge of the motivation necessary for academic behavior. This experiment was conducted during the last three days of the six-weeks program. The definitions of the response dimensions, of reinforcement, and of the recording and implementation of the reinforcement program remained the same as in Experiment I.

Subjects

There were 31 children in four classrooms included in the experimental evaluation of the reinforcement procedures. Table 7 includes the age and I.Q. for the children involved in Experiment II.

TABLE 7

AGE AND I.Q. FOR THE CHILDREN INVOLVED IN EXPERIMENT II

Subject	Age	I.Q.	Subject	Age	I.Q.
1	10.09	79	15	10.11	19
2	14.08	58	16	13.06	22
3	14.03	56	17	09.02	40
4	11.07	61	18	14.05	33
5	15.00	57	19	10.00	43
6	15.03	55	20	09.10	49
7	12.09	55	21	10.00	45
8	14.00	68	22	08.09	42
A_1*	15.03	no score	23	11.01	41
A_2*	11.00	no score	A_3*	08.03	49
9	08.10	28	24	11.04	67
10	12.11	30	25	13.01	52
11	11.03	26	26	13.09	48
12	10.08	26	27	12.00	51
13	14.09	19	28	15.07	46
14	12.09	25			

* These subjects were added to the program during the final two weeks, and hence were not included in Experiment I.

Two academic responses, writing and arithmetic, were selected based on dimensions similar to those studied under Experiment I. Table 8 shows the specific academic performance that resulted in tokens. Back-up reinforcers consisted of the same wide range of activities, edibles, and trinkets as in Experiment I.

Procedure

For each of three consecutive days the performance of the children was recorded in two academic areas, arithmetic and writing, under three experimental conditions: (1) a two part baseline, one five minute part for arithmetic and one five minute part for writing; (2) token reinforcement of one academic area (writing) while the alternative academic area (arithmetic) was under extinction, which lasted for five minutes; and (3) reversal (extinction of writing while arithmetic work received token reinforcement) which also lasted for five minutes. Work sheets were prepared to test individual pupil performance in the two academic areas (arithmetic and writing). Each area contained 40 problems divided into sets of five problems each. Problem difficulty increased from set to set in each academic area. For example, writing progressed from tracing to copying, to actual writing of letters and words. Table 8 illustrates the progression in difficulty of both academic dimensions.

TABLE 8

ACADEMIC PERFORMANCE THAT EARNED TOKENS DURING EXPERIMENT II

1 - LETTER WRITING	
a - tracing letters b - copying letters c - reading printed question and writing the answer	1 token for a number of responses equal to that recorded during baseline for that session. 1 token for <u>each response above baseline</u> for that session.
2 - ARITHMETIC PROBLEMS	
a - copying numbers b - counting c - adding d - subtracting	1 token for a number of responses equal to that recorded during baseline for that session. 1 token for <u>each response above baseline</u> for that session.

Baseline

The baseline procedure consisted of two consecutive periods of five minutes each. In the first period the work sheets for one area (writing) were distributed to the children with no reinforcement for correct answers. In the second period, work sheets for the alternative area (arithmetic) were presented, also without reinforcement. At the end of the two five minute baseline periods, the teacher graded each child's work sheet. During the baseline period, the teachers gave instructions to the pupils as follows:

> I want you to work as many of these arithmetic problems as you can. You will get no tokens for working these problems, but do as many as you can. Any questions? O.K. Start work.

The teacher allowed five minutes for working on airthmetic problems. After collecting the arithmetic work sheets she distributed the writing work sheets and the above instructions were repeated, except that this time, the children were instructed to work on the writing problems. Again, they were given five minutes to work as many problems as they could. No reinforcement was given during baseline.

Reinforcement

The teacher first distributed work sheets for arithmetic and writing to the children. Next she advised each child of the score he had obtained in arithmetic and writing during the baseline procedure and instructed the class as follows:

> You will receive one token if you work as many writing problems correctly as you did before (baseline period). You will get one more token for each new correct answer. You may work on the arithmetic section if you want to, but you will get tokens only for correct writing problems.

This procedure also assured meaningful learning, going from the simple to the complex with an increasing response requirement, rather than mere repetition of the same response to the same stimulus presentation. Each child worked independently at his seat, and the teacher gave no help to the children during this period. At the end of five minutes, a kitchen timer rang and the teacher graded each child's work sheet. Each child received one token if he had matched his baseline score, and one token for each additional correct writing response.

Reversal

During this period, reinforcement contingencies were reversed; the subject matter that resulted in token reinforcement no longer did so and vice versa. The teacher gave the children their individual baseline scores and again gave them the chance to work on the academic area of their choice -- either writing or arithmetic -- but they were told that only correct arithmetic answers equal to or above their baseline scores would result in token reinforcement.

In summary, the above experimental conditions were carried out for each of three successive days in all four individual classrooms. Each day, a new baseline period was obtained, and the children were informed of their individual baseline scores which they had to equal or exceed in order to earn tokens; and each day the children were presented with a chance to do writing problems under both reinforcement and extinction, and arithmetic problems under both extinction and reinforcement.

Reliability Check on Grading of Academic Work

During the evaluation of reinforcement, two independent observers were present in each of the four classrooms in which the experiments were conducted. Tabulations of correct responses made by each child for writing and arithmetic were recorded for baseline and reinforcement conditions. Following each teacher's marking of the work sheets, they were also graded by one of the observers. While the tokens for correct responses were dispensed from the teacher's grading, correspondence between teacher and observer grading was in excess of 95 per cent. This reliability was obtained by dividing the number of academic responses where the teacher and the observer agreed as to the grading of the responses by the total number of academic responses.

Results

The children's academic performance in all four classrooms was consistently greater in the subject matter that resulted in token reinforcement, and consistently lower in the area that resulted in no tokens. This functional relationship between academic performance and reinforcement held irrespective of which of the two academic areas was being reinforced, and indicates that it was reinforcement and no other variable that maintained academic performance. Table 9 shows the mean number of academic responses per classroom for a five minute period.

TABLE 9

MEAN NUMBER OF ACADEMIC RESPONSES PER CLASSROOM
FOR A FIVE-MINUTE PERIOD

Classroom #1
N = 13

	Writing	Arithmetic
DAY 1	baseline	
	13.1	16.0
	Tokens 13.6	No Tokens 0.9
	No Tokens 5.3	Tokens 12.4
DAY 2	baseline	
	15.2	13.6
	Tokens 18.9	No Tokens 1.0
	No Tokens 4.9	Tokens 13.2
DAY 3	baseline	
	17.1	14.7
	Tokens 20.3	No Tokens 2.7
	No Tokens 0.0	Tokens 16.4

Classroom #2
N = 9

	Writing	Arithmetic
DAY 1	baseline	
	3.1	4.0
	Tokens 4.0	No Tokens 2.2
	No Tokens 1.4	Tokens 4.4
DAY 2	baseline	
	4.4	4.7
	Tokens 6.6	No Tokens 1.0
	No Tokens 0.3	Tokens 7.1
DAY 3	baseline	
	3.2	5.8
	Tokens 6.7	No Tokens 0.6
	No Tokens 0.0	Tokens 8.2

Classroom #3
N = 7

	Writing	Arithmetic
DAY 1	baseline	
	6.4	7.6
	Tokens 4.3	No Tokens 6.4
	No Tokens 2.0	Tokens 9.6
DAY 2	baseline	
	9.7	12.1
	Tokens 10.9	No Tokens 2.4
	No Tokens 1.7	Tokens 12.7
DAY 3	baseline	
	11.4	13.0
	Tokens 12.9	No Tokens 0.9
	No Tokens 0.0	Tokens 11.6

Classroom #4
N = 5

	Writing	Arithmetic
DAY 1	baseline	
	12.8	11.2
	Tokens 12.4	No Tokens 1.8
	No Tokens 1.0	Tokens 14.6
DAY 2	baseline	
	17.2	17.0
	Tokens 19.0	No Tokens 1.0
	No Tokens 3.2	Tokens 20.0
DAY 3	baseline	
	20.2	20.0
	Tokens 19.8	No Tokens 0.0
	No Tokens 6.2	Tokens 20.2

It can be seen that each day the academic performance is first assessed prior to the use of reinforcement procedures. This daily baseline of academic performance and subsequent experimental manipulations functionally affords a total of 3 replications of the reinforcement procedures in each classroom for a total of 12 replications across classrooms. An analysis of variance of the differences between academic performance under reinforcement and extinction for all three subjects yielded an F ratio of 22.83 which is significant beyond the .001 level of confidence.

Figure 1 (see Appendix) shows the results for the ten children in Classroom #1. It must be kept in mind that the children had the option to do either subject matter since material from both academic areas was made available to each child. To emphasize the correspondence between the child's academic behavior and its consequences, the upper segment shows the average correct response in writing while the lower segment shows it for arithmetic. Each of the three days has a baseline condition, reinforcement conditions for both academic areas and extinction conditions for both academic areas. It can be seen that during the first day, reinforcement served to maintain the number of correct responses obtained on writing (range, 13 to 14) during baseline. The extinction period for work on arithmetic led to a drastic reduction in the number of correct responses from 16 to 1. When the contingencies were reversed, the number of correct writing responses decreased from 14 (under reinforcement) to 6 (under extinction). Concurrently the number of correct arithmetic responses increased during reinforcement from 1 to 13. By the third day, the children's discrimination regarding the consequences led to a sharp decrease in writing responses from 17 to 0 during extinction. Concurrently, the children's arithmetic responses increased from 3 to 17 under reinforcement. Figure 2 (see Appendix) shows the results for Classroom #2 with nine children. It can be seen that on the first day the children's writing responses during baseline were 3. While this is increased slightly to 4 with reinforcement, it goes down to 1 under extinction. By the third day, the children doubled their output in writing under reinforcement versus their baseline or initial level. Under extinction the children stopped doing any writing. Similar results were obtained with arithmetic. On the first day there were only 4 arithmetic responses during baseline but there was a decrease during extinction and an increase during reinforcement. By the third day, the total number of arithmetic responses was 8 during reinforcement while it still remains at approximately the same

number (5) during baseline, and only 1 during extinction. Figures 3 and 4 (see Appendix) show the results for Classroom #3 and Classroom #4 with seven and five children respectively in each room. These findings parallel those for Classrooms #1 and #2. It is worth noting, however, that both classrooms also start with a relatively low number of academic responses but these are almost doubled by the third day of the procedure.

The relative degree of effectiveness of the stimuli used as back-up reinforcers can be assessed by examining Table 10.

TABLE 10

TOKENS EARNED AND SPENT BY THE 31 CHILDREN STUDIED IN EXPERIMENT II

	CLASSROOMS			
	1	2	3	4
Day 1	$\frac{31}{18}$ = 100%+	$\frac{25}{29}$ = 86%	$\frac{38}{14}$ = 100%+	$\frac{45}{50}$ = 90%
Day 2	$\frac{31}{55}$ = 56%	$\frac{28}{38}$ = 90%	$\frac{38}{65}$ = 58%	$\frac{45}{53}$ = 85%
Day 3	$\frac{44}{34}$ = 100%	$\frac{26}{29}$ = 87%	$\frac{76}{78}$ = 97%	$\frac{57}{71}$ = 80%
TOTALS	$\frac{106}{107}$ = 100%+	$\frac{79}{96}$ = 82%	$\frac{152}{157}$ = 96%	$\frac{147}{174}$ = 84%

Note: Percentages above 100 are possible because children could save tokens from day to day.

Discussion

When a token reinforcement system is integrated into the daily school activities, the trainable retarded child is afforded the opportunity to work for his own goals. By utilizing the child's individual likes and preferences as the generating force for learning, the teacher quickly makes contact with the child at an optimal level of motivation. The results of the experimental evaluation of reinforcement procedures indicate that when the children were provided with a situation in which they chose the subject matter on which to work, they consistently chose the subject matter that resulted in reinforcement. Irrespective of the intrinsically difficult features of the subject for a given child, children showed a significantly higher level of work on whatever subject matter resulted in token reinforcement. When both academic subjects were functionally under extinction, as was the case during each of the three baseline periods, children's academic performance was maintained. Daily, each child's baserate of academic performance was assessed, thus providing what amounts to a total of three replications of the same procedure per child. While methodologically it would have been desirable to keep the level of difficulty of the material at a constant level, this was not possible. The very nature of an educational effort requires a gradual increase in the complexity of academic work. In effect, each day, the baseline represents performance in response to increasing academic demands. Despite this natural increase in complexity of material, children maintained and in some instances even surpassed the baserate observed the previous day.

The findings obtained here indicate that the trainable retarded child can profit from academic training when an extrinsic motivational system is used as an integral part of the training program. Each of the three days of the experimental evaluation provided evidence of the overriding influence of reinforcement versus extinction in accelerating or maintaining academic performance. While it is likely that some children came to develop a personal relationship with their teacher, it is also clear from the results obtained in Experiment II that this and similarly uncontrolled variables were not powerful enough to override the effects of the independent variable, namely, the reinforcement procedures.

The children's organized reaction to the shifting of contingencies from one subject matter to the other revealed a great deal of self-control and adaptability. Indeed, children did not cry, whine, or otherwise display uncontrolled frustration. On the contrary, in the few instances when a child had continued working

on a subject that no longer resulted in tokens, his reaction typically included an increase in his verbal behavior. That is, rather than apathetically resigning himself to the consequences, he made efforts to ask how to get tokens. These results also reveal that the level of attention and concentration of the TMR child are not as deficient or as difficult to generate as has been maintained by previous investigators (Benoit, 1957; House and Zeaman, 1958a, 1958b; and Robinson and Robinson, 1965). The children's own academic performance under swiftly changing conditions indicate that they can develop attention and concentration when these are the components that are linked to a reinforcing system.

The reaction of the children to the reinforcement program is also of interest. According to reports from teachers and aides, children showed unfagging interest in listening and paying attention to the teachers. Children were particularly proud of having "earned" tokens and being able to use them at their own discretion. Much social and verbal interaction among children was observed to take place. Frequently this interaction took the form of one child coaching, explaining, or advising another child as to the number of tokens necessary for obtaining given reinforcers. Sometimes, children helped each other by lending each other tokens. Because tokens were colored-coded per classroom, a child could give tokens to another in his own classroom, but a child from a different class could not use them.

The opinions and impressions of the children's parents were also sought through the use of a short interview. Here, mothers were asked to give opinions regarding any changes that they may have noticed in their children. Results from this survey indicate that the parents had observed the child showing more interest in reading and counting at home than they had in the past. A preponderance of the parents indicated that the children seemed better behaved and generally interested in "school learning" in contrast to their previous school experiences.

CONCLUSIONS

Just how far can trainable retarded go in terms of academic training remains a question. The evidence here indicates that these children can learn, and do so within a short period of time (for example, 18 academic hours). It must be remembered that previous investigations found no difference in these children's learning even when they were being taught with the different methods typically utilized in special education.

The results of this study suggest strongly that so long as the child is regarded as a tabula rasa, contributing nothing to his own development, previous and similar efforts will continue to fail. The general approach of this study emphasizes the critical contribution to be made by each child when his peculiarly unique set of likes and preferences is utilized to further his development. Indeed, this point cannot be overstated.

The studies alluded to in this report, and similar ones, have largely ignored the child's own motivational system and have assumed that the child is as interested in education and training as his teacher is in imparting it. To be sure, many, if not most, of these trainable retarded children show severe deficiencies in attention, concentration, and following directions. These components can, however, be shaped by a school environment which is directed to developing the natural outcome of attention and concentration, and that outcome is academic performance.

One additional finding of some interest is that while the children's scores increased significantly on the academically oriented test, their scores on the *Peabody Picture Vocabulary Test* remained the same. While one might take the position that the I.Q. score is the "real" yardstick of improvement, previous research suggests that psychological tests are relatively primitive means to assess behavioral changes. For example, a study by Ayllon, Smith, and Rogers (1970) showed that through specific behavioral procedures a child diagnosed as suffering from school phobia could once again return to school in a matter of days. Further, they showed (1) that the child's school attendance was maintained a year after the behavioral procedures had been withdrawn, (2) that the child's grades increased from D's and F's to B's and A's, and (3) that her social interaction with her teacher and her peers improved dramatically. Notwithstanding those rather gross behavior changes, when the child was administered a battery of psychological tests the examiner concluded by saying, "It would seem that the school phobia may have been treated successfully, but it has not meant anything to this girl."

The question then is how is one to evaluate the effectiveness of a given procedure? The method of evaluation use by Ayllon, et al. (1970) was based on the child's observable and measurable behavior, namely, her school attendance, and not some other inner and unobservable mentalistic event. Similarly, the present study with the trainable retarded children was evaluated in terms of observable and measurable behavior directly related to academic performance.

Experiment I showed that the children's academic performance under a total reinforcement program led to a statistically significant increase in their scores on the *Metropolitan Readiness Test* (MRT), thus providing some evidence for the transfer of classroom learning to new test situations. Still, the pretest and posttest of the MRT remains an indirect means of assessing the effectiveness of the reinforcement program. A more direct one was the experimental evaluation of the reinforcement procedure using the actual academic materials being taught to the children.

Another factor which must be considered in evaluating any program implemented in a public school is its cost. The average cost of having one child in the Georgia public schools for one year is estimated to be about $561 (Georgia Department of Education, 1968). If it costs the state (or city) this much money simply to have a child in school, then it would seem reasonable for the state to expect some future return on its money, not an added drain upon the already overburdened tax resources of city, state, and county. Unfortunately, Kirk (1964) has found evidence that a large percentage of trainable retarded children become wards of the state following their completion of public school, thus further increasing their total cost to the state. If this process can be somehow reversed, and the trainable retarded individual can be made a taxpayer, rather than a burden upon the other taxpayers, then not only will the child himself have gained, but the society as a whole will benefit. Purely in terms of dollars and cents, it is incumbent upon the educational system to prepare the trainable retarded child to support himself to the greatest degree possible.

APPENDIX

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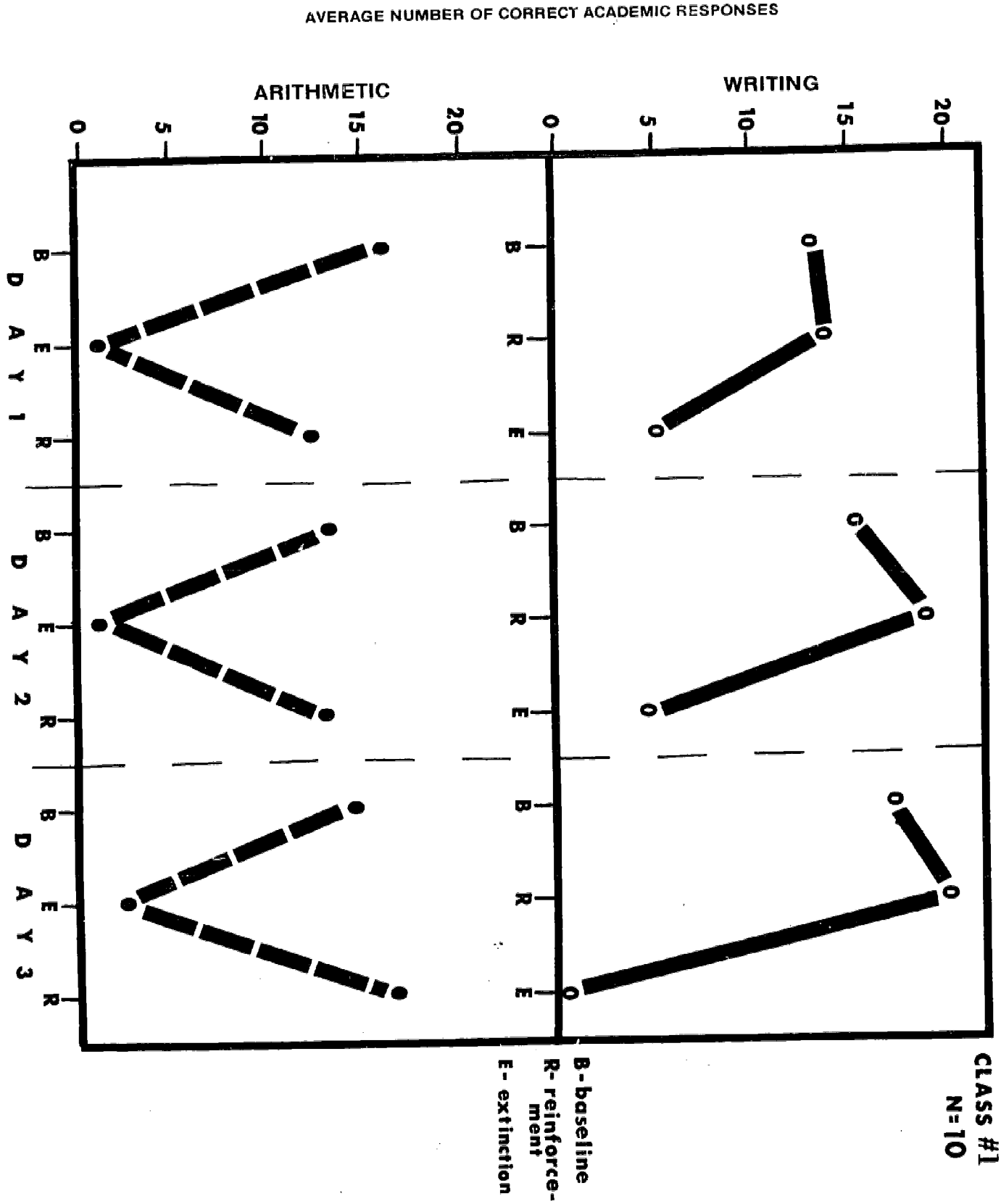
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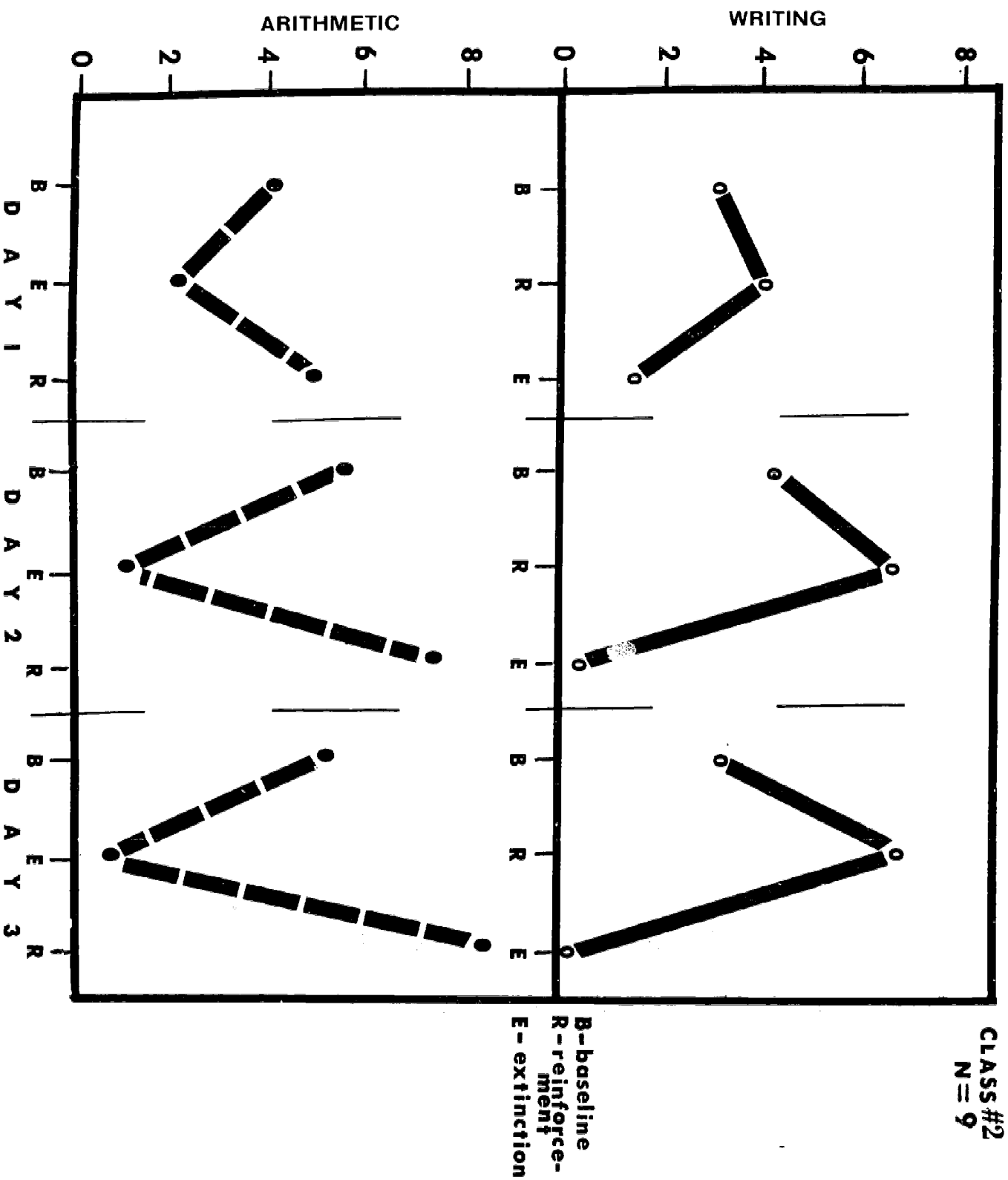
ARITHMETIC
WRITING
0
5
10
15
20
B
R
E
DAY 1
DAY 2
DAY 3
B - baseline
R - reinforce-
ment
E - extinction
CLASS #1
N=10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ARITHMETIC
WRITING
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4
6
8
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R-reinforce-
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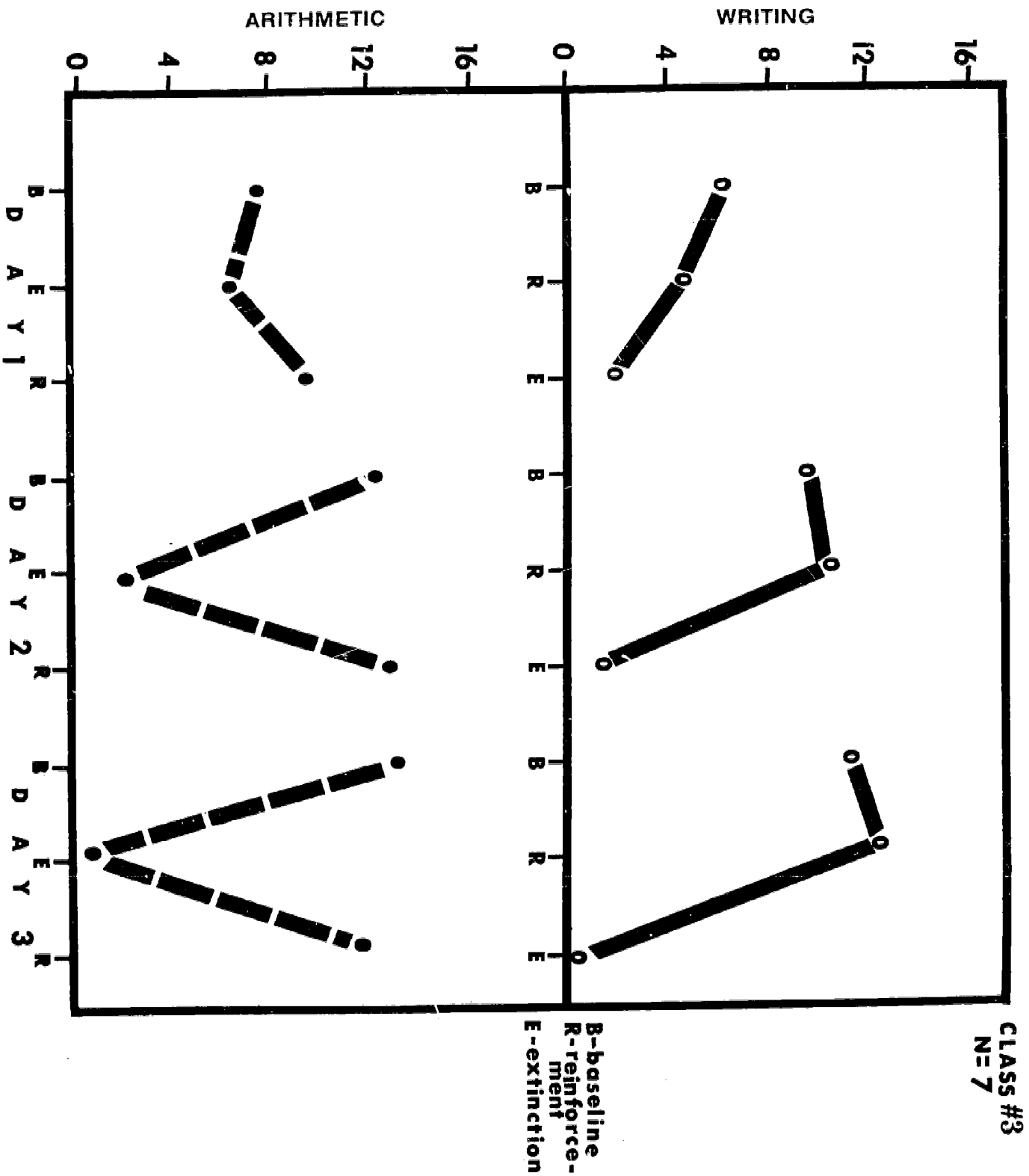
E-extinction
CLASS #2
N= 9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WRITING
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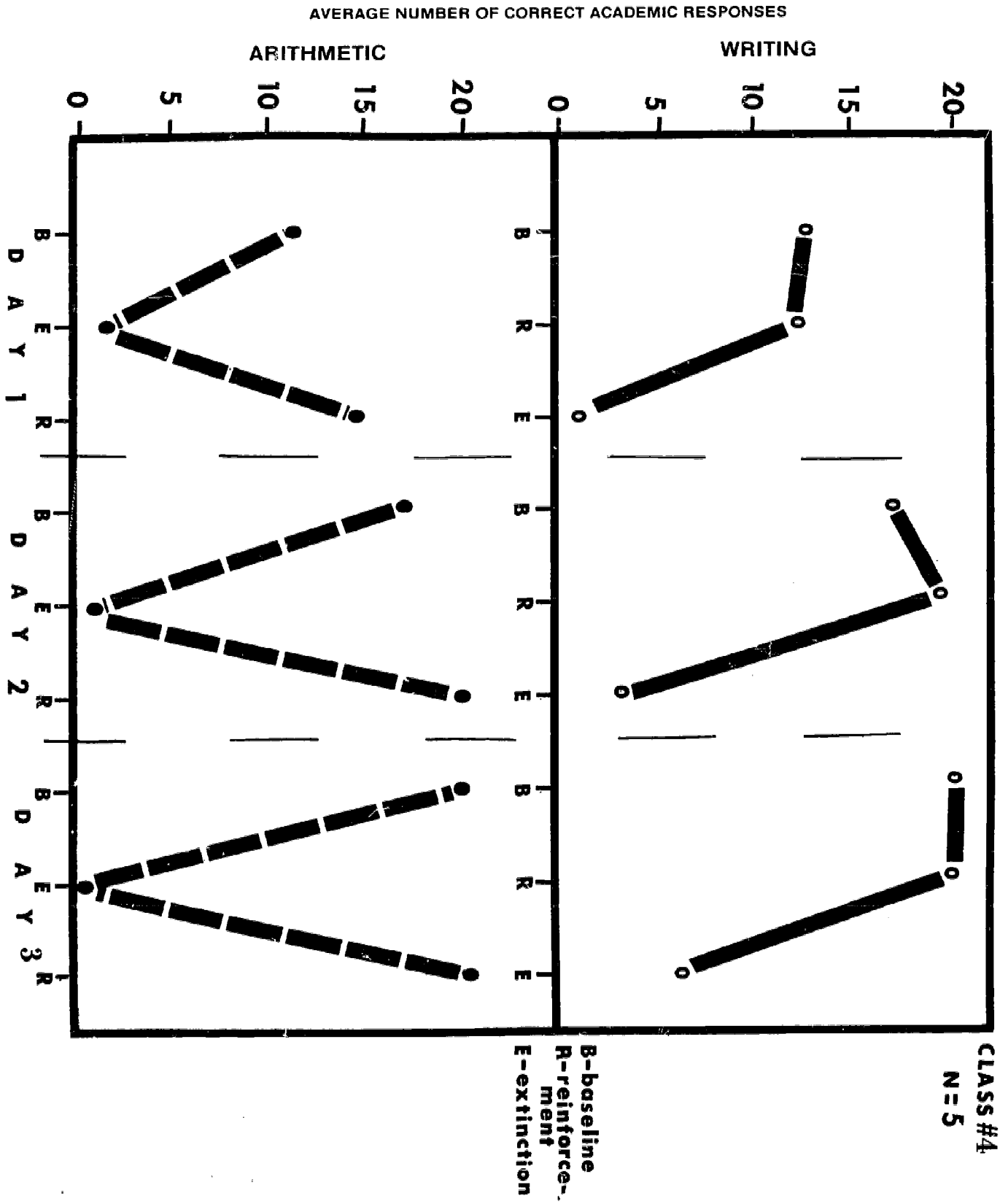
4
8
12
16
B
R
E
DAY 1
DAY 2
DAY 3
B-baseline
R-reinforce-
ment
E-extinction
CLASS #3
N= 7

37


AVERAGE NUMBER OF CORRECT ACADEMIC RESPONSES
ARITHMETIC
WRITING
0
5
10
15
20
B
R
E
DAY 1
DAY 2
DAY 3
B-baseline
R-reinforce-
ment
E-extinction
CLASS #4
N=5