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An investigation of differential reinforcement effectiveness as a function of type of task

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AN INVESTIGATION OF DIFFERENTIAL REINFORCEMENT EFFECTIVENESS AS A FUNCTION OF TYPE OF TASK

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PREFACE

The author takes pleasure in acknowledging the advice and supervision given to him by Dr. Edward H. Tiller during the course of this investigation. The author would also like to acknowledge the assistance given by Dr. Kenneth A. Blick, Mrs. Jean N. Dickinson, and the principal of Elmont Elementary School, Mr. George C. Hudgins.

ABSTRACT

Two tasks and four reinforcers were used to determine whether or not reinforcer effectiveness is in part dependent upon the type of task involved. An equal number (40) fifth and sixth grade children performed under each task condition for 20 trials (arithmetic and sequential processing) and received one of four possible reinforcers (candy, "good", grade A, no-reinforcer). The two dependent variables measured were time to complete either task and the number of errors made while performing upon one or the other task. A significant F was not obtained for either time or error scores at the .05 level of significance. Indications of a hierarchical arrangement of reinforcer effectiveness were obtained from looking at trend effects, but this should be viewed with caution. The unanticipated effectiveness with which the setting operation performed its function and the low difficulty level of the arithmetic task are discussed. Suggestions for further research are given.

Chapter I

INTRODUCTION

Operant conditioning paradigms employing response contingent reinforcement have been used to effectively modify student classroom behavior in elementary school settings. Response dependent or contingent reinforcement is based largely upon the principles of operant conditioning. In operant theory, the reinforcing event is made dependent upon the occurrance of the behavior. The reinforcer is available through no other means than as a consequence to the specified behavior. This type of contingency management requires the arrangement of environmental rewards and aversive stimuli to either strengthen or weaken specified behaviors. The underlying assumption of management programs of this type is that a desired behavior is strengthened by following the behavior with a reward or positive reinforcer while an undesired behavior is weakened by not following it with a reward. During a period of observation, the classroom manager must identify the behavior to be strengthened or weakened. Following this pre-reward period, begins a period of intervention. This period may involve introduction of reinforcers made contingent upon the occurrance of the desired behavior, when the specified behavior is to be strengthened, or upon the non-occurrance of the behavior, if it is desired that the behavior be reduced in its tendency to occur. The period of intervention may also be characterized by the introduction of aversive stimuli to follow undesired behavior coupled with positive reinforcers

when the desired behavior is demonstrated by an individual S or by an entire group of Ss. One additional possibility exists. A behavior may have as its consequence the diminution or revocation of previously attained positive reinforcing stimuli.

The scope and purpose of this study deals directly and singularly with positive reinforcers made contingent upon the correct responses of fifth and sixth grade children tested individually.

Currently, public education is primarily managed by utilizing aversive stimuli as a consequence of undesired behavior while inefficient use is made of environmental rewards. Suspension, expulsion, loss of privileges, ridicule and the like are primary stimuli used in the management of student behavior. There seems to be an institutional stubbornness against effectively utilizing potential positive reinforcers to buttress desired behavior coupled by an alarming steadfastness to preserve traditional aversive controls.

If management programs using response contingent positive reinforcers were to be implemented at all, it was and is of paramount necessity to identify possible sources from which to draw positive reinforcers. Praise and other social stimuli associated with the teacher's behavior have been established as effective controllers of children's behavior (Allen, Hart, Buell, Harris, and Wolf, 1964; Becker, Madsen, Arnold, and Thomas, 1967; Brown and Elliot, 1965; Hall, Lund, and Jackson, 1968; Harris, Johnston, Kelley, and Wolf, 1964; Harris, Wolf and Baer, 1964; Scott, Burton, and Yarrow, 1967; Zimmerman and

Zimmerman, 1962). Similarly, positive reinforcers in the form of candy or toys, or tokens redeemable for various objects or food, when made dependent upon specified child behaviors, have effectively altered their behavior (Hollander, 1968; Kulberg, 1967; Marshall, 1968; Safer, 1968; Weinberg, 1969; Witryol, 1968).

By using the types of positive reinforcers found to be effective in these and other studies, it is perhaps useful to classify these reinforcers into at least three discrete categories:

(1) social reinforcers - for example, giving attention or approval such as a verbalization, smile, or a pat on the back.

(2) material reinforcers having well-defined physical properties - for example, candy or toys.

(3) academically conditioned reinforcers - for example, stars or grades.

Hollander (1968) demonstrated that in the classroom situation fifth and sixth grade children performed a simple arithmetic task more rapidly when candy was administered, but they worked more accurately when given verbal approval. Both material and social reinforcers were found to be more effective than no reinforcer or verbal reproof. Perhaps, then, social reinforcers would be more effective than material reinforcers on a task stressing accuracy of response, while a material reinforcer would be more effective than a social reinforcer on a task requiring rapid completion.

Kulberg (1967) has shown that reinforcement effects vary as a function of both the age and the sex of the Ss when the task involves the learning of paired-associates. For first grade children, token reinforcers were more effective than candy or approval. For fifth and sixth grade children candy and approval proved to be more effective than token reinforcement. Both reinforcers (social and material) were equally effective on ninth graders.

The influence that social class has upon the differential reinforcing effectiveness of social and material stimuli has not as yet been clearly delineated. Initial investigation demonstrated that lower-class children learned a discrimination more rapidly when given a material reinforcer whereas middle-class children learned more rapidly when given a non-material reinforcer (Terrell, Kurkin, and Wiesley, 1959). Zigler and Kanzer (1962) obtained similar results using praise and knowledge of results as the two types of reinforcement. Praise was found to be more effective than knowledge of results with lower-class children while knowledge of results was more effective than praise with middle-class children. In an attempt to replicate these results, two similar studies were performed. In the first, results were in line with those found by Terrell et al. (1962). The second experiment yielded results showing no difference in reinforcer effectiveness for lower and middle class children (Safer, Martin, Kornreich, and Buell, 1968). Hence the specific relationship between social class and reinforcer effectiveness has not yet been clearly demonstrated.

There are three questions being asked through this research:

(1) Does a reinforcer have the property of differential effectiveness as a function of the nature of the task in which it is employed?

(2) Within a given task does the kind of reinforcer differentially influence task performance?

The third question asked deals with the possible differential contribution to total performance of material and social types of reinforcers.

(3) Is a social reinforcer more effective than a material reinforcer in improving accuracy of task completion while a material reinforcer is more effective than a social reinforcer in improving the speed of task completion?

Teachers and other classroom managers need to know if the effectiveness of response contingent positive reinforcement in modifying child classroom behavior is dependent upon the specific classroom activity in which the children are engaged. Without an answer to this question it is possible that reinforcer effectiveness might vary as a function of the specific task employed but the source or cause of this variability would remain unknown and hence uncontrolled.

Chapter II

METHOD

Subjects.

The Ss were made available through Elmont Elementary School in Hanover County, Virginia. The upper two-thirds academically of the fifth and sixth grades served as the Ss for this research. The upper two-thirds of each grade were selected in order to obtain groups of fairly uniform ranges of scholastic achievement. A total S population of 80 children was available allowing ten students to be assigned to each of the eight treatment conditions.

Design.

The four reinforcer and two task variables were combined to form four groups under each of two task conditions. Subject performance was scored both for time taken to complete the task and the number of errors made by the S on the task.

Forty Ss were randomly selected to perform on the sequential processing task. An equal number of Ss were similarly selected to participate on the arithmetic task. Four reinforcer groups of ten Ss each comprised each of the task groups. Thus there were eight groups in all. Each group of Ss was scored using the two dependent variables time and errors mentioned above.

Reinforcers. Four positive reinforcers were selected for this study. All reinforcers were administered after each S had supplied a correct response to a task problem whether it be a sequence correctly recalled or a sum correctly attained.

(1) A material reinforcer in the form of Hershey's chocolate kisses. One piece of this candy constituted one material reinforcer. Each reinforcer was administered by placing it upon the desk before the S.

(2) A social reinforcer in the form of verbal approval given by the Experimenter (E). The utterance of the word "good" constituted one social reinforcer.

(3) An academically conditioned reinforcer in the form of a letter grade (A) was given by the E to the S after an evaluation of the S's performance on each task problem. The reinforcer was administered by placing a red upper case A upon the S's completed response.

(4) A non-reinforcer condition which acted as a control for the above three conditions. Here the E gave no response after a task problem had been answered.

The E remained behind and to the left of each right-handed S and behind and to the right of left-handed Ss. From this vantage, evaluation of performances was made, timing was accomplished and recorded, and reinforcers were administered.

Tasks. Two task situations were selected to be used in conjunction with the aforementioned reinforcers:

(1) Sequential Processing Task. In this task the S was required to learn the sequential placement of six randomly selected digits presented visually upon the projection screen via a Kodak Carousel slide projector. Each of 20 slides was flashed on the screen for a three second interval. Subsequently, at the

end of this interval, the timer automatically advanced the projector and a blank slide appeared. Each S was instructed to record the sequence as he remembered it in the answer blocks provided when the stimulus slide was removed, and its companion blank slide appeared (see Appendix A). All sequence recall boxes were masked except those being utilized for the recall of a particular sequence. Timing by the E was initiated when the blank slide advanced into position and was terminated when the S said the word "stop" after having filled in all sequence recall blocks. At this point, the E evaluated the response as either correct or incorrect. If the response was correct, the appropriate reinforcer for that condition was administered. If the response was incorrect, no reinforcer was administered or comment made to the S. After the reinforcer was either administered or withheld, the E advanced the projector to the next stimulus slide thus recycling the procedure to be used with the remaining 19 sequences. All Ss participating in this task condition were presented with all 20 six digit sequences. It is important to note that this is a task which emphasizes new learning.

The specific dependent variables measured in task one were:

(a) number of sequences incorrectly recalled

(b) amount of time taken by the S to recall each sequence which was measured from the moment the sequence slide appeared on the screen (stop-watch start) to the moment

the S said the word "stop" (stop-watch stop).

(2) Arithmetic Task. Here the S was required to sum two, two digit random numbers for each of 20 problems (See Appendix B). The problems were presented on a single sheet of paper. All problems except the one being solved were masked by the E. After the S had recorded his solution, the E evaluated his performance as correct or incorrect and administered the reinforcer coincident with the condition employed. Timing was initiated when the problem was revealed to the S and was terminated when the S said "stop" after completing and recording the problem solution. This task is considered to be a relatively simple performance task with no new learning required for a fifth or sixth grade child.

The specific dependent variables which were measured in task two were:

(a) number of problems incorrectly summed.

(b) amount of time taken by the S to solve each of the problems.

All Ss were employed individually to ensure uniform, precise, and immediate application of the reinforcers. Each S was directed to a vacant office which served as the experimental environment. The Ss were seated at a desk facing the slide screen. For each task and reinforcement condition, a set of instructions was read listing the requirements of the task and the contingencies for reinforcement (see Appendices C and D). All Ss were seen between the hours of 9:00 and 12:00 each school

day for ten days.

Materials.

A Kodak Carousel slide projector was used in conjunction with a Hunter Interval Timer to regulate slide changes. In line with the timer was a telegraph key which allowed the initiation of a three second timing sequence with indefinite inter-projection intervals. The slides for the sequential processing task were constructed by typing the six digit sequences upon Radio-Mat transparencies and mounting them in Kodak Ready Mounts. A 24"X24" white projection screen was located directly across the room from the S at eye level. The S sat at an office desk facing the screen at all times. The Ss performing on the sequential processing task recorded their digit recall upon answer sheets containing twenty rows of six digit boxes each (see Appendix A). The Ss performing on the arithmetic task were supplied with a single sheet of paper on which was typed the 20 two digit arithmetic problems (see Appendix B). Two black paper masks were constructed so that only one set of recall blocks was visable on the sequential processing task and only a single arithmetic problem on the arithmetic task. A Maylan type stop watch was used to record to the nearest tenth of a second the amount of time needed by a S to recall a sequence or solve an arithmetic problem. Six packages of commercially produced Hershey's Kisses were purchased and used for the material reinforcer. A red Scripto Flair pen was used to indicate correct sequences or problems under the academic A reinforcer condition.

Chapter III

RESULTS

A single factor analysis of variance was computed for each of the two dependent variable scores (time and errors) under each of the two task conditions (sequencial processing and arithmetic). All four F ratios failed to reach significance at the .05 level (see Tables I - IV). Within the confines of the present experiment, the inability to reach significance indicates that the three reinforcers employed were no more effective in reducing either time or error scores than was no reinforcer at all.

Further analysis was carried out based upon time and error trends obtained by summing time scores or error scores over blocks of five trials. The information gained from an analysis of this graphical representation of the results indicates some rather interesting yet tentative relationships.

Sequential Processing Task.

Consider first the sequential processing task with its two dependent variables, time to recall 20 sequences and total number of errors made over 20 sequences. Looking at the time scores, there seems to be a reinforcer hierarchy which is maintained from trial one to trial 20 (see Figure I).

Insert Figure I about here

For all four groups there was an overall decrease in time needed to complete the 20 sequential processing digit rows. The individual trend lines seem to indicate that the rein-

Table I

ANALYSIS OF VARIANCE FOR TIME SCORES ON SEQUENTIAL PROCESSING TASK

Source of variation	df	MS	F
Between treatments	3	0.4424	1.5245
Within treatments	36	0.2902	
Total	39		

Table II

ANALYSIS OF VARIANCE FOR ERROR SCORES ON SEQUENTIAL PROCESSING TASK

Source of variation	df	MS	F
Between treatments	2	18.5667	1.4399
Within treatments	36	12.8944	
Total	38		

Table III

ANALYSIS OF VARIANCE FOR TIME SCORES ON ARITHMETIC TASK

Source of variation	df	MS	F
Between treatments	3	0.0244	0.2253
Within treatments	36	0.1083	
Total	39		

Table IV

ANALYSIS OF VARIANCE FOR ERROR SCORES ON ARITHMETIC TASK

Source of variation	df	MS	F
Between treatments	3	0.3	0.3829
Within treatments	36	0.7833	
Total	39		

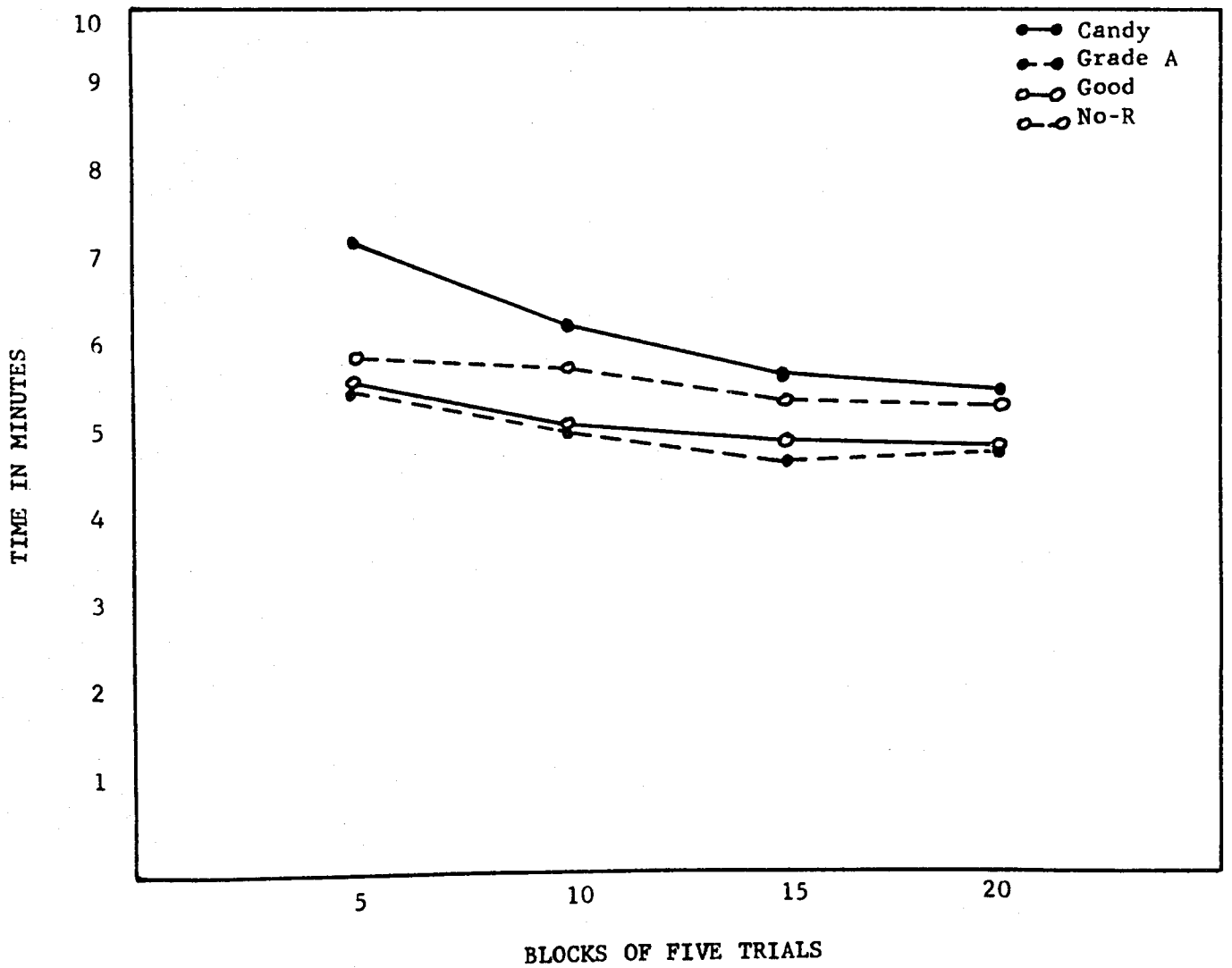

Figure 1. Trend effects for time scores - Sequential Processing Task

forcers academic grade A and "good" were the most effective in reducing time to completion scores. The control group which received no reinforcer was the next most effective, while candy as a reinforcer ranked as least effective in reducing the time score.

This same hierarchical ordering of reinforcers is indicated when the error scores on the sequential processing task are viewed. Here, the relationship is clearer after five trials than it was when time scores were being considered as the vertical separation of trend lines is more pronounced. As reinforcers, academic grade A was the most effective, with "good," no reinforcer, and candy following in order of decreasing reinforcer effectiveness (see Figure II). By the 20th

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Insert Figure II about here

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trial, the no reinforcer and "good" condition are equal in their reinforcer effectiveness. Again, as was found with time scores, there appears to be an overall drop in error scores across all 20 trials for all four reinforcer conditions.

Arithmetic Task.

Interpretation of time and error trend effects for the arithmetic task is even more hazardous than it was for the sequential processing task (see Figure III). Overall, it

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Insert Figure III about here

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required less time to complete the arithmetic than the sequential processing task. This can be seen by comparing the relative

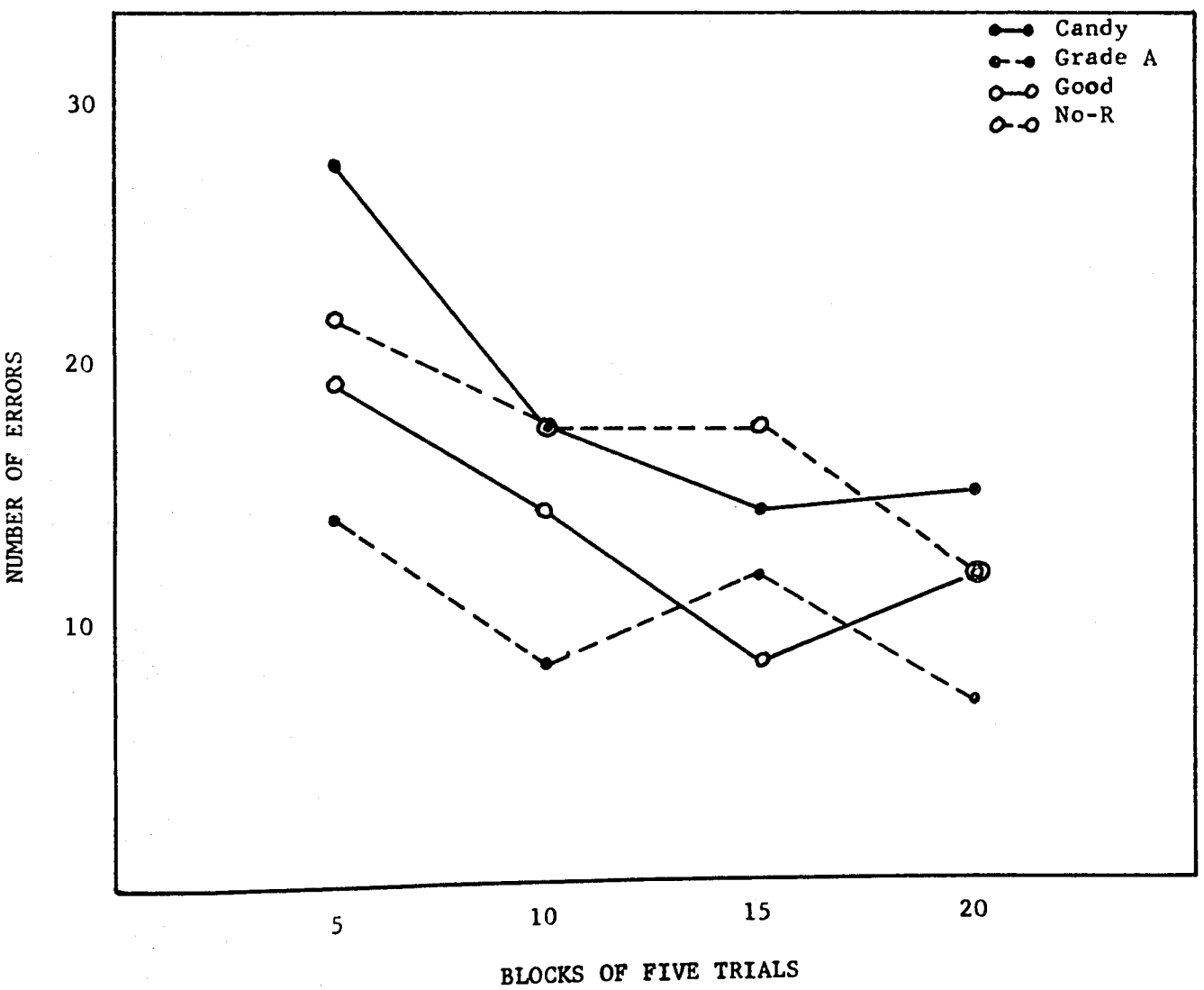

Figure 2. Trend effects for error scores - Sequential Processing Task

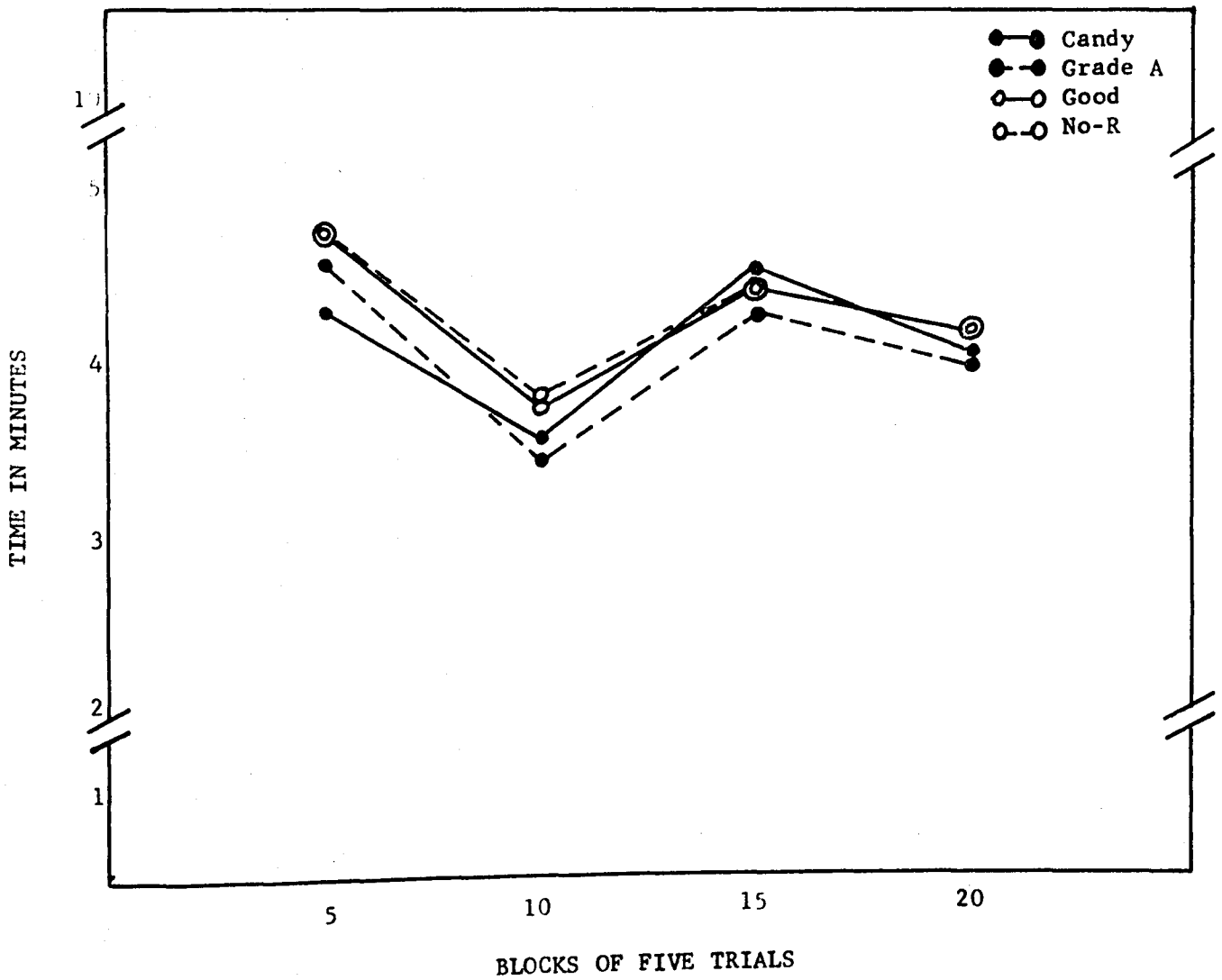

Figure 3. Trend effects for time scores - Arithmetic Task

position of trend lines on Figures I and III. Even though time scores were free to vary, there was little trend line separation for time scores on the arithmetic task.

The error scores on the arithmetic task cannot be interpreted due to the severely restricted range in scores (see Figure IV). In spite of teacher's appraisal of the task

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Insert Figure IV about here

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problems as appropriate for the S population, it appears that the difficulty level of the arithmetic problems did not permit sufficient score variation. Thus the problems were so easy for fifth and sixth graders to solve that very few of them made errors.

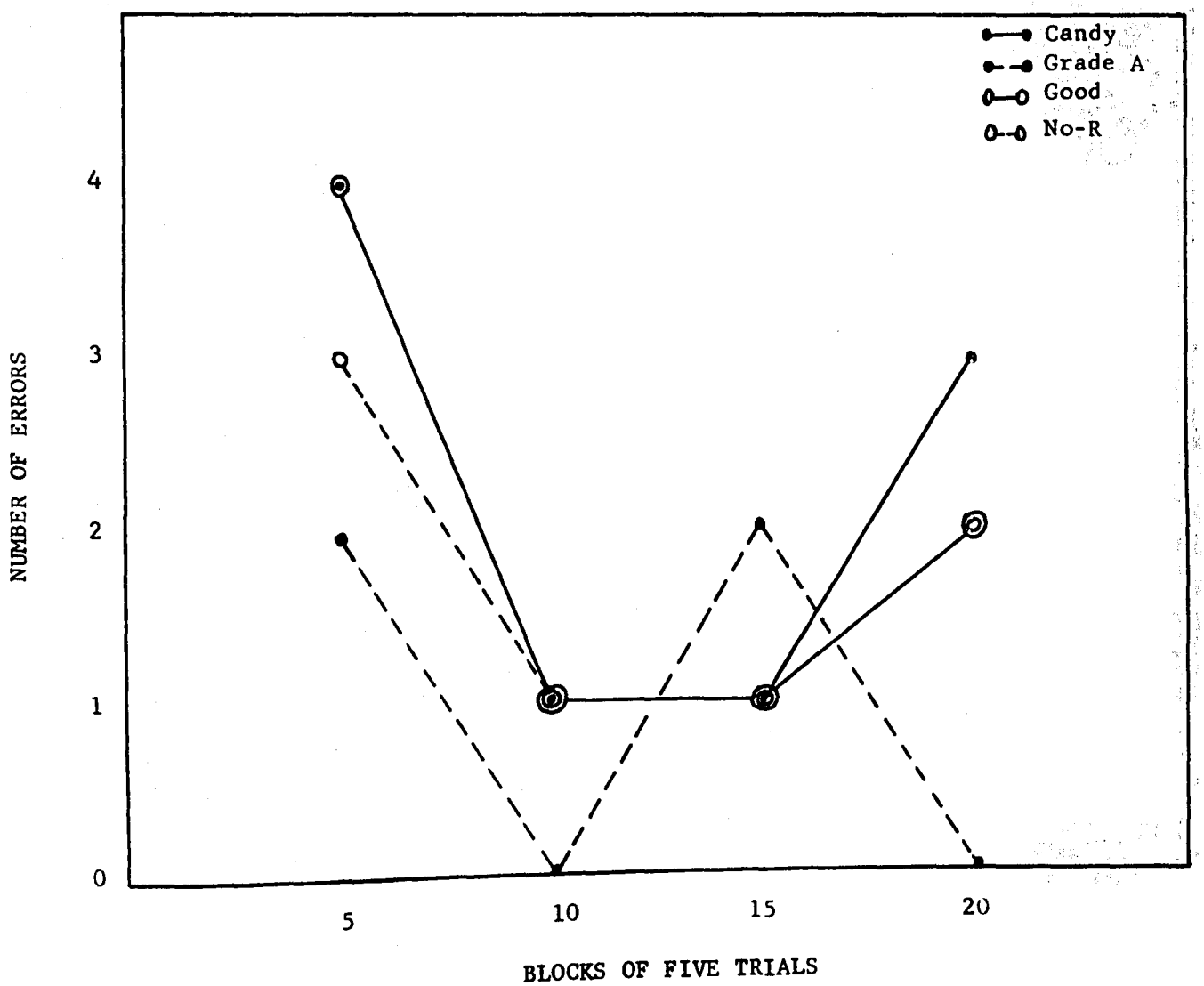

Figure 4. Trend effects for error scores - Arithmetic Task

Chapter IV

DISCUSSION

The conclusion which can be stated with little reservation is that a material reinforcer, a social reinforcer and a commonly used academic reinforcer failed to be any more effective than ignoring the S's response. This research outcome is very much at variance with current data bearing on this issue. Candy certainly has been found to be an effective reinforcer on previous occasions by many researchers. The same is true of social praise statements like "good." Indications are that teachers primarily use grades as academic reinforcers in the classroom situation although there is some question as to whether or not grades function as reinforcers for many students (Brackbill and Jack, 1958; Durio, 1966).

How does the present data aid in answering the questions posed for this research?

Does a reinforcer have the property of differential effectiveness as a result of the nature of the task? Based upon data from the present study, it is of course impossible to state a definite answer to this question. If any ranked hierarchy of reinforcers is present from task to task, it is the same and runs from grade A to "good" to no-reinforcer to candy in decreasing order of effectiveness. But based upon the failure to find significant differences between reinforcer groups, the type of task did not influence reinforcer effectiveness.

Within a given task, does the kind of reinforcer influence task performance? This question asks whether or not there is a

reinforcer hierarchy within a given task. There is no significant hierarchy present within either task, only indications of one. The indicated hierarchy is of course the same as is mentioned above. The questions arise as to why this particular hierarchy is hinted at and why does the candy condition fair so badly when evaluated along the dimension of reinforcer effectiveness. One possible explanation is that the indicated hierarchy is only an artifact of the non-significant results. Hence any order was possible. The one obtained was generated by random chance. It is also possible that candy played an inhibitory role. If this indeed was the occurrance, a certain uneasiness is prompted by the possible explanations.

Perhaps the placement of the candy during the reinforcement phase interfered with performance. This is especially probable when considering the S's performance on the sequential processing task. Recall of the sequence may have been adversely affected by allowing the accumulation of the reinforcers on the desk within the visual access of the Ss. This visual proximity may have acted to disrupt or otherwise interfere with the S's concentration and hence affect recall. Placement of the reinforcers in a hidden location is to be preferred until additional research delineates the role of exposed versus concealed reinforcer effects.

Alternative explanations must also be considered. Could the opportunity to acquire so desired a reward as candy actually inhibit rapid and accurate performance on the part of a capable child? Could the material reward situation have been so alien to the child that confusion, anxiety and misunderstanding disrupted

his performance? Children would be expected to find a reinforcer condition in which grades or praise were obtained for academic performance more compatible with previous experience than a material reward condition. Additional practice trials might serve to increase the S's acclimation to a material reward situation. Further research in this direction is required to provide a satisfactory answer.

Is a social reinforcer more effective than a material reinforcer in improving accuracy of task completion while a material reinforcer is more effective than a social reinforcer in improving the speed of task completion? Hollander's (1968) research in which 12 addition and subtraction problems were used in conjunction with four reinforcement conditions and fifth and sixth graders is representative of findings in the area. She found that children worked faster on an arithmetic task when motivated by candy reward. Further, these children worked with greater accuracy when motivated by praise. No such easily identifiable time and error effects were found in the present study. The Hollander (1968) data was gathered within the confines of the regular classroom. The present data was amassed in a specially constructed experimental environment by an E unfamiliar to the children. In spite of this and other differences such as the sex of the E a difference in reinforcer effectiveness along the lines of the Hollander data was expected but not found.

One explanation for the present results stems from the setting operation used in this research. To insure that the E would in fact be regarded by each S as an agent of the classroom teacher, each

child was informed by means of a special assembly that the E would be coming to the school to carry out a research project. Each child was told to regard the E as an extension of the classroom teacher and the research as an extension of classroom activity. It appears that the setting operation may have performed its function too well. Each child seems to have worked under unexpectedly high motivation, performing to his maximum ability irrespective of the reinforcer condition to which he was assigned. The possibility exists that the setting operation acted to skew the performance variance of the children toward the maximum end of the performance continuum. The supposed effects of such a setting operation cast doubts upon the use of the E as an administrator of reinforcers if conclusions relating back to actual classroom activities are to be made. At the very least the E must be described differently. Perhaps the classroom teacher must be relied upon in future research to apply reinforcers within the confines of the classroom. The methods used in the present study may have been too contrived and unnatural to enable the gathering of meaningful data and the drawing of useful conclusions relating to actual classroom situations and activities. The nature of the role that the setting operation played will remain within the area of speculation until such time as a research effort is mounted in which the setting operation is used as an independent variable accompanied by appropriate controls.

Although the setting operation was employed in part to prepare the children for the E's coming, no attempt was made to reduce or eliminate the E as a novel experience for the children. It is reasonable to assume that the novelty that the experimental

situation and the E held for the children acted to increase their willingness to perform. To reduce the novelty effect of the E, per-experimental exposure of the E to the children in day to day situations would be necessary. The reduction of the effect of the novel experimental situation would require the S population to perform over a number of trials beyond the 20 used in this research. Enough trials would be necessary so that the experimental tasks used would come to be considered by the children as merely routine tasks rather than new experiences. A second effect of this extended trials condition would be to increase the differences between groups thus allowing for the differential effectiveness of the reinforcers to influence performance on the tasks. The results should indicate which reinforcer(s) have the effect of maintaining rather than actually increasing performance.

Observation of the data does indicate the existence of an interesting functional dependency between time and error scores on the sequential processing task. A decrease in time scores was accompanied by a decrease in error scores. This can be seen by comparing Figures I and II. The possibility of predicting one score if the other is known is indicated, thus allowing the possibility to exist that time and effort need not be expended in gathering data on both time and error scores. One might suffice to predict the other.

The S population available to the E was 83 fifth and sixth grade children. This limited the condition membership to 10 Ss. If it had been possible to double the condition membership, there

would have been a greater probability of obtaining a significant F ratio for the time and error scores of the sequential processing task.

Future research utilizing these same two tasks should employ an arithmetic task with increased problem difficulty, thus partially assuring a greater range in the error scores obtained. Although the time scores for the arithmetic task were free to vary, they too suffered from whatever "motivating effects" were at work. Research is needed to find answers to the several questions raised by this investigation if classroom management programs are to be utilized to their full and promised potential.

REFERENCES

Allen, K. Eileen, Hart, Betty M., Buell, Joan S., Harris, Florence R., and Wolf, M. M. Effects of social reinforcement on isolate behavior of a nursery school child. Child Development, 1964, 35, 511-518.

Becker, W. C., Madsen, C. H., Arnold, Carole R., and Thomas, D. R. The contingent use of teacher attention and praise in reducing classroom behavior problems. Journal of Special Education, 1967, 1(3), 287-307.

Brackbill, Y., and Jack, D. Discrimination learning in children as a function of reinforcement value. Child Development, 1958, 29, 185-190.

Brown, P. and Elliot, R. Control of aggression in a nursery school class. Journal of Experimental Child Psychology, 1965, 2, 103-107.

Durio, Helen F. Reinforcement: candy, grades, or money? Texas Outlook, 1966-67, 50-51, 17, (in Runyon, 1969).

Harris, Florence R., Johnston, Margaret K., Kelley, C. Susan, and Wolf, M. M. Effects of positive social reinforcement on regressed crawling of a nursery school child. Journal of Educational Psychology, 1964, 55, 35-41.

Harris, Florence R., Wolf, M. M., and Baer, D. M. Effects of social reinforcement on child behavior. Young Children, 1964, 20, 8-17.

Hollander, Elaine K. The effects of various incentives on fifth and sixth grade inner-city children's performance on an arithmetic task. Dissertation Abstracts, 1968, 29(4-A), 1130.

Kulberg, Janet M. The effect of social class, age, and sex upon the value of certain positive reinforcers. Dissertation Abstracts, 1967, 28(5-B), 2127.

Marshall, Hermine H. Learning as a function of task interest, reinforcement, and social class variables. Dissertation Abstracts, 1968, 28(7-A), 2550-2560.

Runyon, Howard L. A paired comparison technique for determining reinforcement priorities of individual children. A Dissertation Presented to the Graduate Council of the University of Tennessee, 1969.

Safer, Martin A., and Kornreich, L. Buell. The interaction of social class and type of reinforcement in discrimination learning. Psychonomic Science, 1968, 11(6), 206-211.

Scott, Phyllis M., Burton, R. V., and Yarrow, Marian R. Social reinforcement under natural conditions. Child Development, 1967, 38, 53-63.

Terrell, G. Jr., Kurkin, K., and Wiesley, M. Social class and the nature of the incentive in discrimination learning. Journal of Abnormal and Social Psychology, 1959, 59, 270-272, (in Runyon, 1969).

Weinberg, Richard A. The effects of different types of reinforcement in training a reflective conceptual tempo. Dissertation Abstracts, 1969, 29(8-A), 2578-2579.

Witryol, Sam L., Lowden, Lynn M., Fagan, Joseph F., and Bergan, Tina C. Verbal versus material rewards as a function of schedule and set in children's discrimination preference choice behavior. Journal of Genetic Psychology, 1968, 113(1), 3-25, (in Runyon, 1969).

Zigler, E., and Kanzer, P. The effectiveness of two classes of verbal reinforcers on the performance of middle and lower class children. Journal of Personality, 1962, 30, 157-163, (in Runyon, 1969).

Zimmerman, Elaine H., and Zimmerman, J. The alteration of behavior in a special classroom situation. Journal of the Experimental Analysis of Behavior, 1962, 5, 59060.

Appendix A.

Digit Sequence Recall Data Sheet and Key

1	5	1	7	1	9	2
2	5	3	6	9	6	8
3	4	6	5	9	1	3
4	5	2	4	0	8	0
5	5	4	2	6	1	0
6	9	6	7	9	1	5
7	0	9	2	6	8	8
8	1	0	5	2	3	5
9	6	2	3	6	4	1
10	7	9	4	2	6	1
11	9	0	2	5	5	2
12	3	1	0	4	7	4
13	0	4	8	5	2	7
14	8	4	8	5	1	0
15	5	7	3	1	3	0
16	3	5	9	7	4	1
17	8	9	7	1	2	0
18	4	6	9	2	4	8
19	1	0	8	5	2	2
20	9	3	8	0	5	1

APPENDIX B. Arithmetic Task Problem Sheet and Key

83 + 52 = 135	23 + 25 = 48	83 + 49 = 132	29 + 43 = 72
38 + 39 = 77	65 + 24 = 89	97 + 80 = 177	83 + 86 = 169
42 + 97 = 139	18 + 60 = 78	98 + 16 = 114	59 + 32 = 91
79 + 40 = 119	60 + 33 = 93	23 + 75 = 98	14 + 98 = 112
49 + 80 = 129	97 + 24 = 121	33 + 81 = 114	39 + 21 = 60

APPENDIX C.

Instructions for the Sequential Processing Task

"I am going to ask you to learn several rows of numbers for me. I will show you each row on this screen one row of numbers at a time. Then the numbers will be taken off the screen and the screen will go blank. As soon as the screen goes blank try to remember the numbers in the same order that they appeared on the screen. As quickly and as accurately as you can, write the row of numbers as you remember it in the boxes that you see through the black cover. As soon as you have written down your answer say the word 'stop.' Let's do an example.

If you have written down the series correctly:" (Dependent upon which reinforcement condition the S participated in, one of the following was read)

1. "I will give you a piece of candy like this. Don't eat it now but save the candy until later."
2. "I will say the word 'good.'"
3. "I will write the letter grade A by your answer."

"Then the next slide will appear for a few seconds. As soon as it is removed, record the numbers for that row, one number to a box in the uncovered row of boxes. Be sure to say the word 'stop' as soon as you have finished filling the boxes.

Do you have any questions?

Alright, let's begin."

APPENDIX D.

Instructions for the Arithmetic Task

"I am going to ask you to solve some addition problems for me. All of the problems are on one sheet of paper but you will only be allowed to see one problem at a time. When I move this black cover and a problem appears solve it as quickly and as accurately as you can. As soon as you have written down your answer say the word 'stop.' Let's do an example. Ready begin.

If you have answered the problem correctly:" (Dependent upon which reinforcement condition the S participated in, one of the following was read)

1. "I will give you a piece of candy like this. Don't eat it now but save the candy until later."
2. "I will say the word 'good.'"
3. "I will write the letter grade A by your answer."

"As soon as I move the cover to show the next problem begin work on finding the answer and write it down on the sheet. Do not forget to say the word 'stop' as soon as you have written down your answer.

Do you have any questions?

Alright, let's begin."

VITA

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