THE EFFECT OF DELAY OF INFORMATION ON THE LEARNING OF A MOTOR TASK BY RETARDED AND NORMAL ADOLESCENTS

by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Definition and Formulation of Problem

The present study was concerned with the effect of delayed reinforcement on learning of normal and mentally retarded subjects. Reinforcement was defined as the knowledge of results of a motor task. Specifically, the present experiment was designed to study the effect of delayed knowledge of results on the speed with which human subjects learn a simple motor task; i.e., the drawing of a three-inch line while blindfolded. The criterion of learning was five consecutive correct responses.

Early studies with animals have demonstrated that the speed of learning is influenced by proximity of reinforcement to the response rather than the amount of reinforcement (Perin, 1942, Hull, 1951). Perin (1942) taught rats to run a maze under varying conditions of delayed reward and found that the rats learned the maze most quickly when they were rewarded immediately after the correct response. Perin used delay intervals of seconds and tenths of seconds. He conjectured that extending the delay interval longer than three minutes would negate any learning by the rats.

Saltzman (1951) investigated the effect of delaying reward on the rate of verbal learning in normal human subjects. The results of the Saltzman experiment are in agreement with the results of the animal studies. Learning, as evidenced by performance in some experiments, is slowed down when the reward is delayed.

Although there are apparently no studies dealing with delay of information and learning in retardates, two studies dealing with the delay of reinforcement gradient with retardates seem pertinent here.

E. M. Hetherington, L. E. Ross, and H. C. Pick (1964) investigated the effect of delay of reward on the learning of severely retarded, moderately retarded, and normal children. Their study involved a discrimination learning task with each child participating in each of four delay intervals (0, 1.5, 6, and 12 seconds). The total number of children participating in the study was 256. The moderately retarded and the normal children were matched for mental age. All groups made more errors under 12-second delay of reward than under immediate reward. The only other significant difference was in the number of errors between immediate reward and 6-second delay for the normal subjects. The severely retarded children learned more slowly than either of the other two groups at all delay intervals. Hetherington (*et al.*) concluded, in light of his findings, that delay of reward was detrimental to learning but there did not seem to be any interaction between I.Q. and delayed reward on performance.

L. E. Ross, Mavis Hetherington, and Nancy Wray (1965) compared the performance of normal and moderately retarded children on a size-discrimination problem under three delay-of-reward periods (0, 12, and 18 seconds). The chosen stimulus was either visible (V) or not visible (NV) during the delay period. Twenty-four normal children and twenty-four moderately retarded children, matched for mental age, were tested in each of five conditions of delay of reward: 0-second delay, 12V-second delay (visible stimulus), 12NV-second delay (nonvisible stimulus), 18V-second delay (visible stimulus), and 18NV (nonvisible stimulus). Retardates performed poorer than normals at the .05 level of significance at both the visible and the nonvisible conditions of delay. The moderately retarded-normal differences of the 1965 study are in contrast to the performance of retarded and normal children in the Hetherington study of 1964. While both normal and retarded subjects in the NV (nonvisible stimulus) delay group made slightly more errors at 0-second delay than the subjects of the 1964 study (all of whom were tested under NV conditions), the principle differences occurred at the 12-second delay where the retardates of the more recent study made more errors, and the normals fewer errors, than the subjects in the earlier study. Ross conjectured that the difficulty level of the more recent study was the influencing factor in the differences in performance.

Saltzman, Kanfer, and Greenspoon (1955) investigated the effect of delay of reward on human motor learning. They found no significant differences in the speed of learning to draw a three inch line blindfolded under conditions of 0-second delay, 10-second delay, and 20-second delay. The subjects in the Greenspoon study were ninety normal college undergraduates, thirty tested under each condition of delay. The reinforcement was defined as telling the subject how they performed on the line-drawing task.

The present study was based on the Greenspoon study with one primary modification: to investigate the speed with which normal and retarded adolescents learn a simple motor task under conditions of delay of information (delay of reinforcement).

It is hypothesized that there are no differences between normal subjects and retarded subjects in learning a motor task. It is further hypothesized that there is no relationship between delay of knowledge of results and speed of learning a motor task with retarded subjects and that there is no relationship between delay of knowledge of results and speed of learning a motor task with normal subjects. Finally, it is hypothesized that there is no differential effect between the way the normal subjects and the retarded subjects learn a motor task under conditions of delay of information.

The most obvious difference between normals and retardates seems to be memory, or lack of it. The experimental literature implies that retarded individuals are inferior in a short term memory learning situation but retain material, once learned, as long as normals (Pryer, 1960; Johnson and Blake, 1960; Ellis, Pryer, and Barnett, 1960). Norman Ellis (1961) has suggested that retarded persons have an incomplete or inefficient reverberatory system. Stimulus trace is invoked as an "explanatory" mechanism to account for immediate memory and an individual differences construct is postulated to explain behavioral inadequacy. Ellis goes on to point out the similarities between retardates and immature normals in regard to their immature or poorly developed central nervous system. Thus, the reverberatory circuits are considered to be inadequate for efficient learning as measured by short term memory. The trace theory will be discussed in greater detail later in light of the present findings.

Design and Method

Subjects

The subjects were thirty normal children and thirty retarded children. The normal children were randomly selected from a local consolidated secondary school in Watauga County, North Carolina. The retarded children were chosen from Western Carolina Center, Morganton, North Carolina. The files of all children at the Center were reviewed in the office of the psychologist and children retarded in the 60-75 I.Q. range as measured by an individual standardized test of intelligence were chosen. Individuals with recorded or observed indications of gross brain damage, or with any diagnostic indication of emotional disturbance, severe neurosis, or borderline psychosis were eliminated. Although the original plan was to limit the chronological age range in both groups to individuals having had their 14th birthday but not having had their 19th birthday, the lack of subjects in the retarded group fitting these particular age criteria necessitated using two children who were somewhat younger than 14 years. One child was 18 months younger and the other child was 16 months younger. The lower age limit was based on the assumption that the central nervous system in humans approaches maturity at this point.

In spite of efforts to maintain the chronological age range of the retarded group and the normal group within a five year span, it appeared, after testing, that the retarded group was younger than the normal group. A _t_ test was used to determine whether the ages were significantly different. The chronological ages between the retardates and the normals were found to vary significantly.

The mean age, SD, SEm, and SE_{diff} are presented in Table 1.

Table 1

Chronological Age Comparison Between

Retarded Group and Normal Group

	Mean (months)	SD	SEm	SE_{diff}	t
Normal	198.5	13.5	2.5	4.2	3.8*
Retarded	182.4	18.35	3.4		

*Beyond .01=2.750

Sex difference in the composition of the delay groups was not controlled. The incidence of each sex in each delay group was: Retarded; 0-second delay, seven males and three females. 10-second delay, six males and four females. 20-second delay, two males and eight females. Normals; 0-second delay, six males and four females. 10-second delay, seven males and three females. 20-second delay, seven males and three females.

The normal group and the retarded group were divided into three subgroups each. The three subgroups in each main group were designated: Retarded: I-R (0-second delay), II-R (10-second delay), III-R (20-second delay); Normal: I-N (0-second delay), II-N (10-second delay), and

III-N (20-second delay. The total number of subjects was sixty. There were ten children in each of the six subgroups.

Assignment of each subject to a treatment group (delay subgroup), was made as the subject entered the test situation. As each subgroup of ten subjects was completed, the following subject was placed in the next subgroup.

Apparatus

Each subject, examined individually, was seated on a chair at the end of a table. Taped to the end of the table was an 18-inch T-square. Two sharpened pencils were on the table in front of the subject. A Gra-Lab Electric Timer was used with a lighting device to indicate time lapse. Quadrille lined paper ($8\frac{1}{2}$ x 11) was used. The paper had been previously marked delineating three inch segments in order to facilitate immediate evaluation of the accuracy of the line drawn. One-fourth inch on either side of three inches was considered correct; that is, a line between two and three-fourths inches and three and one-fourth inches.

Procedure

Normals: Each subject was seated and the following directions were read:

I want to see how quickly you can learn to draw a three inch line when you are blindfolded. I am going to blindfold you and give you a pencil and place your hand with the pencil in it in position on this (blank) sheet of paper. When I say 'Go,' I want you to draw a three inch horizontal line. As soon as you have finished drawing what you believe to be a line three inches long, lift the pencil from the paper and then put it right down again. This will indicate to me that you have finished, and then I shall tell you something about the line that you have just drawn. If the line is three inches long, I shall say 'Right'; if it is between two inches and four inches long, but not three inches long, I shall say 'Wrong'; if the line is less than two inches long, I shall say 'Too short'; and if it is over four inches long, I shall say 'Too long'. So there will be four different kinds of comments that I can make: 'Right', if the line is three inches long; 'Wrong', if the line is between two and four inches long, but not three inches long; 'Too short', if the line is less than two inches long; and 'Too long' if it is more than four inches long. After I have given you this information about the line that you have just drawn, I shall replace your hand and pencil. Then, when I say 'Go', you will again try to draw a three inch line. We shall continue this procedure until you have drawn five consecutive three inch lines.

These instructions, or any parts of them, were repeated when necessary, and, as soon as it was clear that the child understood the procedure, he was blindfolded and the task was begun.

Retardates: Some reticence among some subjects was noted early in the data gathering process and the examiner made special efforts to establish rapport. If the child appeared reluctant to participate, the examiner showed him the timer and demonstrated how it worked. The examiner talked about the T-square and what it was to be used for.

The blindfold was shown to be another part of the "game" they were to play. Only after it seemed that the child was willing to try the task, the following directions were read:

> I want to see how quickly you can learn to draw a three inch line when you are blindfolded. I am going to blindfold you and give you a pencil and place your hand with the pencil in it on this (blank) sheet of paper. When I say 'Go', I want you to draw a three inch line straight across the paper. The T-square is to help you draw a straight line so you may rest your pencil on it and use it as a guide. As soon as you have finished drawing what you believe is a line three inches long, lift your pencil from the paper and then put it right down again. This is to let me know that you have finished, and then I shall tell you something about the line that you have just drawn. If the line is three inches long, I shall say 'Right'; if the line is almost right, but not quite, I shall say 'Wrong'; if the line is very short I shall say 'Too short'; and if the line is very long I shall say 'Too long'. So there will be four different kinds of things I can say to you after you've drawn your line: 'Right' if the line is just right and three inches long; 'Wrong' if the line is almost right but not quite; 'Too short' if the line is very short; and 'Too long' if the line is very long. After I have told you how close you came with the line you've just drawn, I shall take your hand and put the pencil in it and place it again on the paper. Then, when I say 'Go' I want you to again try to draw a three inch line. We will keep doing this until you have drawn five lines that are three inches long. Now, be sure and wait until I say 'Go' and don't worry when you don't draw it right in the beginning. This is just a game and it is hard for everyone to do it the first few times they try.

As soon as it was clear that the subject understood the directions the task was begun.

From time to time the examiner felt that a few of the children in both the normal group and the retarded group were overly tense and anxious, and reassuring comments to the effect that "You are doing fine," or "That was a fine try," were made.

With the subjects in subgroup I (0-second delay) of both groups, the information concerning the accuracy of the response was presented immediately after the line was drawn (after the subject raised his pencil and put it down again). As mentioned earlier, under apparatus, the rapid determination of the actual lengths of the lines drawn was accomplished by having the subjects draw the lines on coordinate paper which was substituted for the blank sheet of paper as soon as the subject was blindfolded. With the subjects in subgroup II (10-second delay) of both groups, the presentation of the information concerning the accuracy of the response was withheld for ten seconds (as measured by the electric timing device). With the subjects in subgroup III (20-second delay) of both groups, the information was withheld for twenty seconds. A ten-second intertrial period was maintained for all subgroups; that is, ten seconds always elapsed between the presentation of information and the word, 'Go', which started each trial. Each subject drew all of his lines on a single sheet of paper. The paper was moved slightly between trials and each line was started from approximately the same spot with reference to the subject's body. The subject was required to hold the pencil in such a way that during the actual drawing there was no contact of the drawing hand or arm with the paper.

The number of trials required to satisfy the criterion of five consecutive correct responses was determined for each child. The data for criterion trials are presented in Tables 6 A, 6 B, 7 A, 7 B, 8 A, and 8 B. If the subject did not meet the criterion in sixty trials, the experiment was terminated for that child, and "trials to criterion" was recorded as sixty.

Results and Discussion

The number of trials required for the thirty normal subjects to reach criterion ranged from six to sixty, with a mean of 26 and standard deviation of 15.5. The number of trials for the thirty mentally retarded subjects to reach criterion ranged from seven to sixty with a mean of 28.63 and a standard deviation of 13.2. The mean, the range, and the standard deviation associated with each main group of thirty and with each subgroup of ten, is presented in Table 2.

Table 2

Summary of Trials to Criterion for each Group

	N	Mean	Range	SD
Normal total	30	26	54	15.5
I-N	10	27.8	46	
II-N	10	23.7	35	
III-N	10	26.5	54	
Retarded total	30	28.63	53	13.2
I-R	10	24.7	25	
II-R	10	32	51	
III-R	10	28.2	53	

The scores were analyzed for homogeneity of variance using the simple analysis of variance technique (Underwood, Duncan, Spence, and Cotton, 1954, pp. 175-233). The mean difference between the normal group and the retarded group was analyzed by the t test. There were no significant differences in either the scores within the subgroups as tested by simple analysis of variance or between the retarded group and the normal group as tested by the T-ratio. The retarded group, however, performed much more consistently with most of their scores piling up in the middle range of the criterion trials. A very small range is noted especially in the I-R subgroup (0-second delay). The scores in this group ranged only from 16 to 41 or a total range of 25. The heterogeneity of the scores in the retarded group became more diffuse with each succeeding delay in information, with the widest range for the retarded group in the 20-second delay of information, with a range of 53. The scores in the normal subgroups appeared to cover more consistently a wider range of trials to criterion, although their highest range was also in the 20-second delay of information, with a range of 54. Although it is not obvious from the results of the statistical treatment, there appears to be a trend toward differences in performance between the normal group and the retarded group.

The differences in performance are presented in Figure 1. A summary of the t test between the normal group and the retarded group is presented in Table 3.

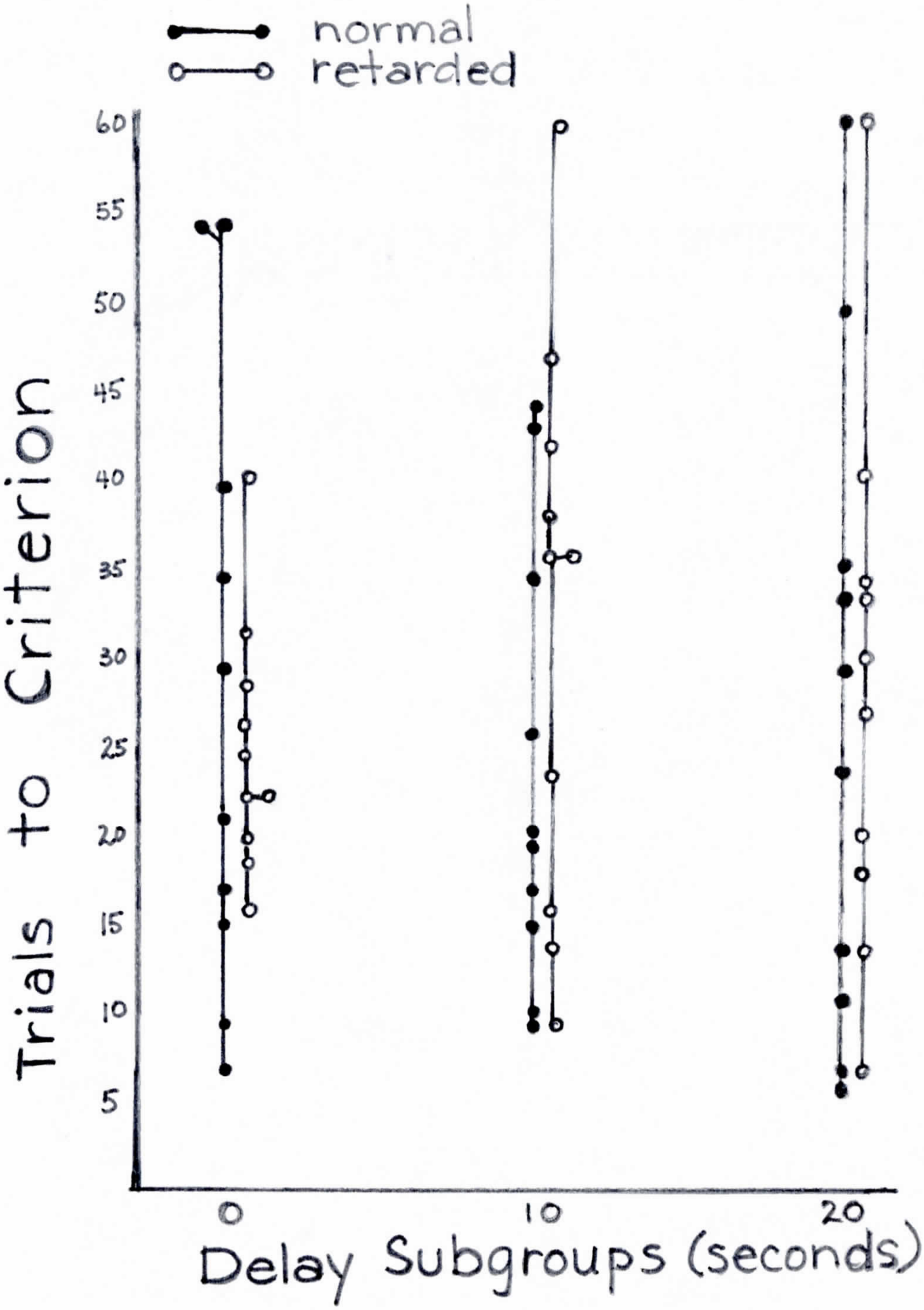
Table 3

Summary of t Test between Retarded Group and Normal Group

	Mean (trials)	SD	SEm	SE_{diff}	t
Normal	26	15.5	2.9	3.78	.08*
Retarded	28.63	13.2	2.4		

*.05=2.042

Figure 1. Trials to Criterion



A summary of the analysis of variance between the subgroups is presented in Tables 4 and 5.

Table 4

Analysis of Variance of Retarded Ss

Source of variation	Sum of squares	Degrees of freedom	Mean Square	F*
Total Group	5236.30	29		
I-R (0-second delay)	502.08	2		
II-R (10-second delay)	2404	2		
III-R (20-second delay)	2063.60	2		
Between group means	266.60	2	133.30	.72
Among retardates within groups	4969.68	27	184.06	

*F.05=3.35

Table 5

Analysis of Variance of Nornal Ss

Source of variation	Sum of squares	Degrees of freedom	Mean Square	F*
Total Group	6988	29		
I-N (0-second delay)	2571.60	2		
II-N (10-second delay)	1456.10	2		
III-N (20-second delay)	2972.50	2		
Between group means	87.80	2	43.90	.16
Among normals within groups	7000.20	27	259.26	

*F.05=3.35

The investigator observed some differences in the approach to the task between the normal children and the retarded children which seem to be pertinent. The normals represented a random selection of children from a medium-sized consolidated high school. These children were for the most part curious about the task and willing to attempt the task. They asked many questions about the purpose of the task and their part in performing the task. The normals were very much concerned about their performance and could not be convinced this was not some devious form of intelligence test that would affect their coming graduation or course schedule. They questioned the examiner about the performance of the other pupils and made conjectures about their own performance. The normals had little trouble getting started at the task; that is, the pure motor function of orienting one's arm to the paper and the straightedge in order to draw a straight line was quickly understood and easily performed.

The retardates, taken as a group, were wary of the task situation, and either were reluctant to participate or docilely did as they were told. Two children originally chosen for the task would not participate. The retarded children were more tense than the normal children and hurried to finish the task. Several children in the 20-second delay subgroup had to be reassured that they would finish soon; otherwise they threatened to quit the task and would not remain seated. One retarded girl in the 20-second delay subgroup did leave before she either achieved criterion or her sixty attempts were completed. She was very agitated, tense, and became hostile when asked to remain and finish the task. The 20-second delay of information appeared to be very agitating for both groups although the retarded group displayed more overt signs of tension and anxiety during the delay than did the normals.

The retarded group had some difficulties starting the task. They did not understand the purpose of the straight-edge and did not initially understand what was meant by a three inch line. When the examiner said 'Go,' the retarded child would often continue drawing a line until he could reach no further. Some difficulties were encountered by the retarded children in adjusting the pressure of the pencil to the paper; some lines were barely discernable, and others gouged holes in the paper. The children also perseverated their initial try and would take many trys before changing their response to suit the information given them. Once they learned what they were to do and had some successes, however, they learned to draw a three inch line while blindfolded.

Although the present study specifically investigated the quantitative aspects of learning a motor task, the foregoing qualitative differences bear further investigation.

Although statistical analysis did not clearly reveal any differential effect due to delay of information, there seemed to be a trend which indicated that delay did have a deleterious effect on the performance of retardates.

Future research may find more definite evidence that delay of information adversely affects the learning rate of retardates; if so, it would lend support to the stimulus trace theory as proposed by Norman Ellis (1961). Ellis has suggested that retarded persons have an incomplete or inefficient reverberatory system. Stimulus trace is used as an "explanatory" mechanism to account for immediate memory. Pryer (et al.) has implied, as a result of experimental findings, that retarded individuals are inferior in a short-term learning situation but retain material, once learned, as long as normals. The inference, then, is that retardates are handicapped in a short-term learning situation by an inefficient reverberatory circuit. In other words, retardates seem to have an inadequate memory trace. The expectation of depressed performance, as related to the delay factor in retarded subjects, as would be predicted from Ellis' stimulus trace theory, was not supported by the present study.

Secondary reinforcement was a factor discussed at some length in the Greenspoon (1955) study of human motor learning. Greenspoon conjectured that the delay of information factor was mediated by secondary reinforcement and further study of the task is necessary before any conclusive statements could be made concerning the Greenspoon data.

In the present study also, as it was based in a large part on the Greenspoon study, attention should be made to all possible sources of secondary reinforcement introduced unknowingly. Greenspoon conjectured that the effects of delayed reward, if any, were "probably equalized" by immediate secondary reward in the normal subjects. In the Greenspoon study, as in the present one, each of the subjects was required to keep his hand and pencil in place at the end of the drawn line until the information (reward) was presented. Greenspoon and his colleagues have suggested that the proprioceptive stimuli from the subject's hand and arm (proprioceptive after-image) provides an immediate differential secondary reward which counteracts the effects of the variable (the delay of information). As soon as those stimuli which were present when the examiner said "Right" had acquired secondary reward value, they then could provide immediate (secondary) reward for the correct line-drawing responses. Thus, the learning in the line-drawing situation might have been mediated directly by the acquired secondary reward of the proprioceptive stimuli, and only indirectly by the delayed reward provided when the examiner said, "Right." The role of secondary reinforcement in the present study may or may not be important, but it seems to be a further consideration in trying to see the results of the experiment more clearly.

The results of this study are applicable only to that range of retardates represented in this sample. Just as it was assumed that the normals represented a broad range of those school children we call "normal", so was it assumed that the retardates represented as wide a range of etiological factors including genetics, trauma, and disease.

A practical consideration must be taken at this point. The writer, in spending some time teaching retardates, has acquired a method of approach which utilizes repeated directions, demonstration, and encouragement. Although every effort was made on the examiner's part to maintain exact directions and procedure in reference to the control group of normal subjects, it was sometimes necessary to deviate from the projected pattern of procedure with the retardates in order to maintain the task situation. As a result of these deviations, perhaps learning aids were afforded the retarded subjects which were not afforded the normal subjects. Duplication of the experiment by an examiner less accustomed to a set approach in a learning situation with retardates might result in different data with different implications.

Summary

The present study investigated the effect of delayed knowledge of results on learning with normal and mentally retarded subjects. The experiment was designed to study the effect of delayed knowledge of results on the speed with which retarded and normal children learn a simple motor task. The task was the drawing of a three inch line while blindfolded and the criterion of learning was five consecutive correct responses.

The subjects were thirty normal high school students and thirty mentally retarded adolescent children in the educable range. Both groups ranged in chronological age from 12 years, 7 months, to 19 years. All normal subjects came from a local consolidated high school in Watauga County, North Carolina, and all retarded subjects came from Western Carolina Center at Morganton, North Carolina. The two groups, normals and retardates, were subdivided into three treatment groups of ten adolescents each, a total of six subgroups. The subgroups were designated I-N, II-N, III-N, (Normal); and I-R, II-R, III-R, (Retarded). The subgroup I (0-second delay) in each main group was given immediate information concerning their line-drawing attempt. Subgroup II (10-second delay) in each main group was made to wait ten seconds for information concerning each of their line-drawing attempts. Subgroup III (20-second delay) of

each main group was made to wait twenty seconds for information concerning each of their line-drawing attempts.

It was hypothesized that there would be no differences between the normal subjects and the retarded subjects in learning a simple motor task. It was further hypothesized that there would be no relationship between delay of knowledge of results and speed of learning a motor task with retarded adolescents, and that there would be no relationship between delay of knowledge of results and speed of learning a motor task with normal adolescents.

Statistical analysis of the data made the rejection of the null hypotheses impossible. A *t* test was done between the normal subjects and the retarded subjects and no significant difference was found. *F* analysis of variance was done between the subgroups with the result of no significant differences.

Although statistical treatment of the data indicated no significant difference in the learning ability of normal adolescents and retarded adolescents and no significant difference in effect of delay of knowledge of results of these two groups, certain differences in the approach to the learning situation were noted by the examiner. A trend toward a more deleterious effect on learning in the 20-second delay of information with retardates was noted.

A discussion of the possible mediating effects of secondary reinforcement was presented. The suggestion that secondary reinforcement plays a mediating role in the present learning situation is a tentative one, as are the other conclusions presented. The research in the area of delay of reinforcement, especially regarding retardates, is scarce and somewhat contradictory. In order to make more valid generalizations concerning the way retarded children learn, further experimentation and refinement of techniques in research must be made.

REFERENCES

References

Deese, J. The psychology of learning. 1958, New York: McGraw-Hill, Inc.

Ellis, N. R. Stimulus trace and mental subnormality. In N. R. Ellis (Ed.), A handbook of psychological theory and research in mental deficiency. New York: McGraw-Hill, 1963, pp. 134-156.

Ellis, N. R., Pryer, Margaret W., and Barnett, C. D. Motor learning and retention in normals and defectives. Percept. Mot. Skills, 1960, 10, 83-91.

Hetherington, E. M., Ross, L. E., & Pick, H. C. Delay of reward and learning in mentally retarded and normal children. Child Devlpm., 1964, 35, 653-657.

Hull, C. L. (1932) The goal gradient hypothesis and maze learning. Psychol. Rev., 39, 25-43.

Hull, C. L. (1951) Essentials of behavior. New Haven, Conn.: Yale Univer. Press, pp. 213-216.

Johnson, G. O., & Blake, Kathryn A. Learning performance of retarded & normal children. Syracuse: Syracuse Univ. Press, 1960.

Perin, C. T. (1943) The effect of delayed reinforcement upon the differentiation of bar responses in white rats. J. exp. Psychol., 32, 95-109.

Pryer, R. S. Retroactive inhibition in normals & defectives as a function of temporal position of the interpolated task. Amer. J. Ment. Defic. 1960, 64, 1004-1011.

Ross, L. E., Hetherington, E. M., & Wray, N. Delay of reward and learning in mentally retarded and normal subjects. Child Devlpm., 1964, 34, pp. 597-612.

Saltzman, I. J. Delay of reward and human verbal learning. J. exp. Psychol., 1951, 41, 437-439.

Saltzman, I. J., Kanfer, F. H., & Greenspoon, J. Delay of reward and human motor learning. Psychol. Rep., 1, 139-142.

APPENDIXES

APPENDIX A

RAW SCORES BY SUBGROUPS

RAW SCORES BY SUBGROUPS

Table 6 A

Normal--O-second delay I-N

Subject	CA(Mo.)	Sex	Trials to Criterion
1	188	M	7
2	181	F	53
3	184	M	15
4	207	M	17
5	214	M	21
6	186	M	34
7	218	F	40
8	207	M	29
9	186	F	9
10	190	F	53
	$\overline{X}$=196.1		$\overline{X}$=27.8

Table 6 B

Retarded--O-second delay I-R

Subject	CA(Mo.)	IQ	Sex	Trials to Criterion
1	204	70	M	19
2	150	64	M	23
3	172	67	M	22
4	152	67	M	26
5	174	62	M	41
6	169	67	F	22
7	183	70	M	28
8	181	70	F	16
9	199	65	F	32
10	176	65	M	18
	$\overline{X}$=176			$\overline{X}$=24.7

Table 7 A

Normal--10-second delay II-N

Subject	CA (Mo.)	Sex	Trials to Criterion
1	212	M	15
2	211	F	19
3	205	M	43
4	178	F	34
5	178	F	17
6	213	M	10
7	218	M	26
8	217	M	9
9	178	M	44
10	204	M	20
	$\overline{X}$=201.4		$\overline{X}$=23.7

Table 7 B

Retarded--10-second delay II-R

Subject	CA (Mo.)	IQ	Sex	Trials to Criterion
1	190	60	M	36
2	186	67	F	23
3	161	70	M	13
4	191	71	M	38
5	177	64	F	9
6	168	75	M	36
7	187	68	M	42
8	164	60	F	16
9	179	77	F	47
10	169	64	M	60
	$\overline{X}$=177.7			$\overline{X}$=32

Table 8 A

Normal--20-second delay III-N

Subject	CA (Mo.)	Sex	Trials to Criterion
1	204	M	60
2	179	M	6
3	189	M	11
4	207	M	13
5	210	M	7
6	188	F	23
7	189	F	35
8	202	M	29
9	211	M	49
10	203	F	32
	$\bar{X}$=196.2		$\bar{X}$=26.5

Table 8 B

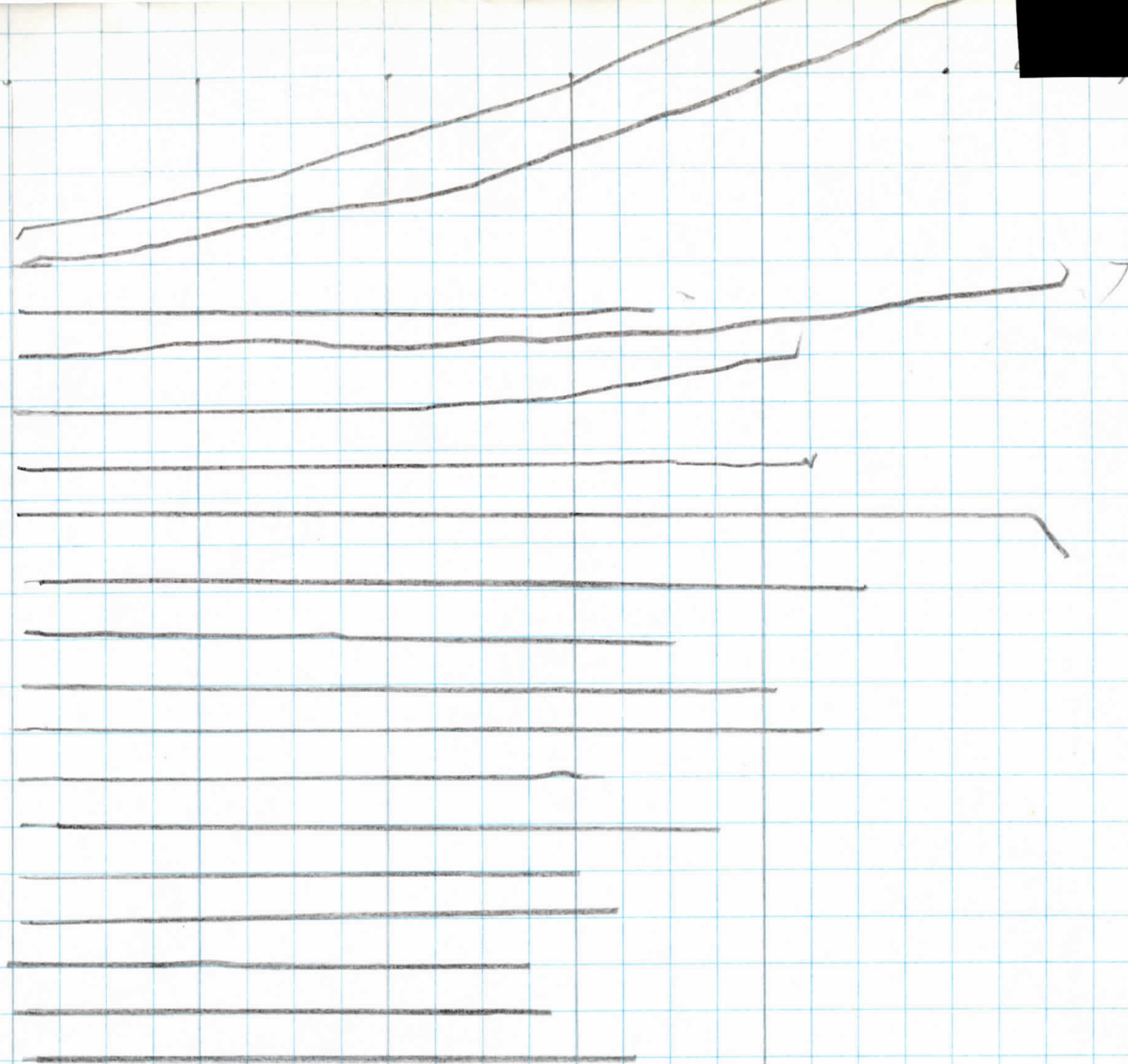
Retarded--20-second delay III-R

Subject	CA (Mo.)	IQ	Sex	Trials to Criterion
1	204	63	M	13
2	182	67	F	18
3	214	64	F	60
4	168	70	M	20
5	188	64	F	33
6	204	60	F	30
7	168	62	F	34
8	216	61	F	27
9	180	61	F	40
10	228	67	F	7
	$\bar{X}$=195.2			$\bar{X}$=28.2

APPENDIX B

LINE-DRAWING TASK ON COORDINATE PAPER

[redacted]



AN ABSTRACT OF

THE EFFECT OF DELAY OF INFORMATION ON THE LEARNING OF A MOTOR TASK BY RETARDED ADOLESCENTS

The performance of normal and moderately retarded (60-75 I.Q.) adolescents was compared on a simple motor task under three conditions of delay of information: 0-second delay, 10-second delay, and 20-second delay. The motor task was the drawing of five consecutive three inch lines while blindfolded. The delay of information was the delay of knowledge of results, or a delay in telling each subject how well they did on the line-drawing task. In the study thirty normal and thirty retarded children were subdivided into three delay groups each; six delay sub-groups with ten children in each group. Each of the three normal subgroups were treated under one condition of delay and each of the retarded subgroups were treated under one condition of delay. All children but two fell within a chronological age range of five years.

No significant differences were found by means of a *t* test in the performance of normal children and retarded children at the .05 level of confidence. *F* analysis of variance was performed on the subgroups within each main group with no significant differences being found in the performance within the subgroups as a result of the delay variable.

Although the statistical treatment of the data did not indicate significant differences in the performance of normal children and retarded children, certain differences in their approach to the testing situation were noted. The 20-second delay of information seemed to have a somewhat deleterious effect on the performance of the retarded adolescents.

The investigator briefly discussed the implications of the data in the present study in light of the memory trace theory proposed by Norman Ellis (1963) and urged continued research in the area of delay of information and the learning characteristics of retarded children.