POSITIVE REINFORCEMENT AND SUCCESS IN SPELLING: AN EXPERIMENTAL STUDY

by

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ABSTRACT

This study investigated the effectiveness of material (candy and trinkets) and social (verbal and written) reinforcement in increasing the Spelling performance of 144 elementary school pupils in grades 5, 6, and 7. Four treatment periods were used. As well as being grouped according to grade placement, the pupils were also divided into three groups according to their performance in the first (base-line) period, during which no reinforcement was given.

During the second period of the study, material and social reinforcement was given on a continuous schedule, contingent upon the pupils' having performed as well as or better than they had performed on the previous weeks' Spelling test. During the third period of the study, material reinforcement was given on an intermittent schedule but social reinforcement was maintained on a continuous schedule. The fourth period of the study used only social reinforcement on a continuous schedule. Each of the four periods of the study was six weeks in length.

Results indicated that such a program of reinforcement as used in this study can be effective in increasing performance in Spelling. Although there were differences in the way in which the increases occurred for each of the grades, the over-all effect for grades 5, 6, and 7 seemed not to be different. Pupils who were initially better spellers tended to gain less from this program of reinforcement than did initially lower performers.

Examiners: [redacted]

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CHAPTER I

INTRODUCTION

The title of "teacher" carries with it a responsibility to strive toward optimum performance from each student with whom one comes in contact. The great concern shown over those who achieve less than optimally is reflected in literature related to education. Some writers such as Chopra (1967), Miner (1963), Chabassol (1959), and Chabassol (1963) attempt a written defense of the concern shown about underachievement. Others such as Shaw and Grubb (1958) and Crescimbini (1964) imply its importance in their research. Skinner (1968) states the situation adequately when he says

> The truant and the dropout are conspicuous problems, but it is the underachiever...and the student who does just enough to get by who explain why our grade schools, high schools, colleges and graduate schools are running far below capacity. (p. 145).

An investigation of research related to underachievement reveals that many studies have attempted to find causes or correlates of underachievement rather than to decrease the level of underachievement of students with whom they deal. Examples include the work of Shaw and Grubb (1958), Crescimbini (1964), and Chabassol (1959). Although there are many reports of attempts to remedy underachievement through changes in methodology and curriculum, and through increased emphasis on counseling activities, there appears to have been little research undertaken involving the systematic application of learning principles to the task of increasing the performance of children in

academic subjects. This study will attempt such an undertaking.

THE PROBLEM AND DEFINITIONS OF TERMS USED

Statement of the Problem

This study attempts to investigate the effects of positive reinforcement on spelling performance. Subjects are pupils in regular classrooms. Material reinforcement is paired with social reinforcement, first, on a continuous schedule and then on an intermittent schedule. The study compares the performance of pupils before and after exposure to material reinforcement paired with social reinforcement made contingent on correct spelling responses.

Definition of Terms Used

Reinforcement. Reinforcement in this study is defined as the operation of presenting a reinforcing stimulus after and contingent upon the completion of a task.

Material Reinforcement. Material reinforcement in this study is defined as a candy bar or trinket(s) being given to Ss following and contingent upon the completion of each spelling task. This is consistent with the work of Peterson and London (1966), Pace (1967), Kulberg (1968), and Bruning (1964).

Social Reinforcement. Social reinforcement as used in this study is defined as the praising verbal or written comments of the teacher contingent upon Ss completion of each spelling task. Social reinforcement also includes displays of the work of children who received material reinforcement.

Criterion Performance (Task). The task, or criterion performance, is the achievement of a score equal to or better than the score obtained on the previous week's test. The spelling test is the usual dictation type test commonly used in elementary schools.

Continuous Reinforcement. In this study, continuous reinforcement is defined as the presentation of a reinforcing stimulus upon the achievement of criterion performance for each of the weekly tests within a given testing period.

Intermittent Reinforcement. Intermittent reinforcement is defined for this study as the presentation of a reinforcing stimulus on a variable-ratio schedule with a frequency of reinforcement equal to fifty percent of the appropriate responses being reinforced.

Conditioned Reinforcer. Conditioned reinforcer as used in this study is defined as a reinforcer which acquires its reinforcing properties as a function of experience rather than through biological characteristics. This is based on the definition of Michael and Meyerson. (1962).

CHAPTER II

REVIEW OF RELEVANT LITERATURE

Reports of success in using applied operant conditioning to effect behavior change are plentiful, and the rate at which they are appearing seems to be increasing. In the area of human behavior there seems to be wide application of operant principles. In a report published in 1958, Krasner notes that thirty-one studies of operant conditioning of verbal behavior had already been completed. Grossberg (1964, p. 73) discusses successful use of operant conditioning with "...maladaptive behaviors such as phobic reactions, anxiety reactions, enuresis, stuttering and tics..." and less successful attempts to use this model with "...alcoholism and some sexual disorders." More recent publications, such as Ullmann and Krasner (1966) and Gelfand (1969) make even more comprehensive reports of areas in which operant conditioning has been applied, including in part work with psychotics, schizophrenics, autistics, phobics, sexual disorders, tics, stuttering, toilet training, tantrum behavior, thumbsucking, mental deficiency and hyperactivity. The concern of this study, application of operant principles to normal classroom behaviors, however, has not been reported to any appreciable extent in the literature, and in fact Whelan and Haring (1966, p. 288) comment that information about use of operant principles in regular classrooms "...may or may not be forthcoming; it has yet to be demonstrated."

Much research using the operant model has come from school situations, but mainly from preschools, nursery schools, or special classes. Edwards (1968) notes in a review of the literature that there had been no related studies at the junior high school level and only a limited amount of work had been successfully undertaken with abnormal individuals and normal elementary school children. A review of literature indicates that relevant studies emphasize either academic performance of abnormal individuals or maladaptive social behavior of normal or abnormal subjects, but little research has been undertaken to study effects of operant conditioning upon academic performance of normal subjects.

The effectiveness of the operant model with maladaptive behaviors of normal and abnormal children in school situations has been investigated by several researchers. Harris, Johnston, Kelly and Wolf (1964) were able to successfully use adult attention as reinforcement in order to reduce inappropriate crawling behavior of a three year old nursery school child. Allen, Hart, Buell, Harris, and Wolf (1964), also using a nursery school child, used social reinforcement to reduce excessive isolate behavior. Nederhold (1969) was successful in developing a procedure for the reduction and control of inappropriate behavior displayed by two normal grade school students in a regular classroom setting. Johnson (1968) produced significant increases in the attending behaviors of grade one and two pupils through the use of reinforcement. The successful use of reinforcement in counseling a first grade boy is reported by Kennedy and Thompson (1967). In an

exploratory study, Barclay (1967) found behavior change occurred in a regular fifth grade classroom when reinforcement was used by the teacher. Using the teacher as a reinforcing stimulus enabled Zimmerman and Zimmerman (1962) to control tantrum behavior in a special class situation.

Token systems have been effective in assisting teachers and researchers modify inappropriate behaviors. For example, in an adjustment class of seventeen "emotionally disturbed" children, O'Leary and Becker (1967) paired social reinforcement with material reinforcement and withdrew tokens for inappropriate behavior. Through successively approximating desired behavior, they report change in the desired direction. Edwards (1968) reports a token system at the junior high school level as being successful in reducing inappropriate behavior. His conclusion is that further research in the area is warranted.

Reports of operant conditioning in areas of academic performance are sparsely distributed in educational research literature. As previously noted, studies reported are almost without exception related to abnormal subjects in other than regular classroom situations. Hewett (1964), for example, reports success in teaching reading to an autistic child using the operant model with gumdrops as reinforcers. Pace (1967) conducted a study which found that systematic reinforcement with pieces of candy accompanied significant increase in the efficiency with which educable mentally retarded pupils at the intermediate grade level memorized selected multiplication facts. Hallman (1959) used

monetary and verbal reinforcers to increase performance rates significantly for educable mental retardates.

Research relating to application of operant conditioning to academic pursuits of normal children in regular classrooms is limited. It would seem that efforts in this direction are overdue. In one or two isolated cases, reports do indicate success in this area. Hamner (1968) found tangible reinforcement resulted in more correct responses being given in a beginning program of individualized reading than did social reinforcement. In a pilot study undertaken by this writer, the performance in spelling of normal children in regular intermediate grade classrooms appeared to increase when material reinforcement paired with social reinforcement was introduced on continuous and then intermittent schedules.

CHAPTER III

THE THEORETICAL MODEL

The relationships between performance in school-type academic tasks, types of reinforcement, and schedules of reinforcement have been discussed by a number of educators. Staats and Staats (1964, p. 291), discussing the effects of reinforcements on learning and achievement, say "The behaviors of achievement..., and the amount of learning which occurs, may...be to some extent a function of the child's reinforcement system." This seems consistent with Bloom's (1968) observations regarding the model of learning for mastery proposed by Carroll (1963) in which he states students would likely spend more time on a learning task (and thus master the material to a greater extent) if they find the effort reinforcing. Continuing in this vein, Staats and Staats (1964) point out it is reasonable to assume behaviours associated with achieving a high standard of academic performance are not in themselves reinforcing. They comment, in fact, that "Effort behavior produces stimulation that is aversive" (p. 293). They state further that

> The same is true of accomplishment, attaining high standards, excelling oneself, rivalling and surpassing others, and so on. These consequences are not by themselves positive reinforcers. Prior to the appropriate training, there is no reason to suppose that surpassing others, matching standards, and so on, will be reinforcing. Such events only become reinforcing because they in the past have been paired with positive reinforcers (p. 294).

It seems reasonable to conclude, then, that in order for a child to strive toward optimum performance at an academic task, he must have at some time been positively reinforced for such behavior. As Cruickshank (1966, p. 108) states, "People do what they get rewards for."

Unfortunately, not all children have a history of positive reinforcement sufficient to cause them to expend effort in an educational context. In discussing the reinforcing values of educational achievement to children, Staats and Staats (1964, p. 294) note "There are no doubt great differences in the extent to which these kinds of reinforcers are taught to children", and for those with an inadequate history of reinforcement for academic endeavours

> ...the above sources of reinforcement will not be developed. The ramifications of this may be clearly seen in the educational situation. Briefly, it may be said that a child raised so that these objects and events have become reinforcers will have a more abundant supply of reinforcement in the school than will the child for whom these are not positive reinforcers. (p. 294).

Here, then would seem to be an important role of the teacher to attempt to make successful academic effort reinforcing for the child for whom it has not in the past been reinforcing. As Beatty (1950, p. 18) notes,"...the typical reward and punishment system... is ineffective because it remains extrinsic. The reward...fails because it is meaningless to the child."

Skinner (1968) deals at some length with the role of reinforcement in academic achievement. He comments that the presence of long-range

objectives are insufficient to get effort from students and suggests that they must be supplemented by short range, previously experienced reinforcers. Writing about effectiveness of grades and degrees as reinforcers, he says they function "...if at all, only as conditioned reinforcers" (p. 148). Therefore, the teacher must search for new reinforcers, primary reinforcers, which will effectively assist in conditioning some existing reinforcers to make them functional and useful. "To arrange good instructional contingencies, the teacher needs on-the-spot consequences", says Skinner (1968, p. 148).

Motivation and Reinforcement

Literature related to the operant conditioning model includes many references to the motivational effects of the reinforcing stimuli that are being used. Some writers (De Cecco, 1968; Murray, 1964) claim that reinforcement which has been introduced acts to motivate the subject. Others (Logan, 1960) disagree, commenting that unless a state of "motivation" exists prior to introduction of reinforcers, reinforcers will be ineffective. Yet others (Reynolds, 1968; Skinner, 1958) say the only relevant concern regarding the probability of an organism undertaking a certain behavior or group of behaviors is adequacy of reinforcement history related to such behavior or behaviors. No attention is paid to the motivational question.

For the purposes of this study, the motivational question is not a relevant one. The way in which reinforcement functions is not relevant. This is in keeping with the position taken by Skinner (1958, p. 84) who concludes that dealing with such questions as

operation of reinforcers is "...probably of little help...".

Nature of Material Reinforcement

The effectiveness of food as material reinforcement has been well documented in educational journals. Kulberg (1967), for example, found that candy was a more effective reinforcer than tokens, social reinforcement, or verbal reinforcement for children at grade five level. She did note, however, that at grade nine level the differential effect had been reduced to non-significance. Bruning (1964) also noted the value of using candy as reinforcers in his conditioning of a lever-movement response. Staats (1964) found that although candy is an effective reinforcer, indiscriminate use can cause satiation and a lessening of effectiveness. He advocates use of a variety of reinforcers in an attempt to minimize likelihood of this happening. Bijou and Sturges (1959), in a comprehensive review of research aimed at determining which reinforcers might be useful for work with children concluded both edibles and trinkets were useful. They comment "a large variety of edibles has been used effectively with children in...operant tasks" (p. 159). They also note the effectiveness of using trinkets as well as edibles "...to forestall satiation in experiments requiring many sessions" (p. 168). Terrell and Kennedy (1957) found that candy was superior to praise, tokens, and reproof in a discrimination learning task and in transposition to other similar tasks.

Schedules of Reinforcement

There are a number of ways in which schedules of reinforcement

can vary. Only the types of reinforcement schedules used in this study will be discussed here, however.

Continuous reinforcement is such that an organism is presented a reinforcing stimulus following each appropriate response. Variable ratio reinforcement is one of a number of possible schedules of intermittent reinforcement. Under such a schedule of reinforcement "...the organism is reinforced for a certain proportion of his responses, but the proportion is randomly varied about some value" (Staats and Staats, 1964, p. 64). For example, an individual may be reinforced for one out of three responses, but not necessarily for every third response.

It is an established fact that use of a particular schedule of reinforcement is an important consideration when use is being made of the operant model to effect behavior change. "The schedule of reinforced and non-reinforced trials in a learning situation is an important factor in maintaining a response in strength." (Staats and Staats, 1964, p. 59). Smith and Moore (1966, p. 149) note that "Certain schedules of reinforcement will sustain behavior normally if approached in gradual steps but will produce complete cessation if the individual is exposed to the final schedule at once." A reasonable conclusion drawn from these comments and from the findings of investigations into schedules of reinforcement (Ferster and Skinner, 1957; Bijou and Orlando, 1960) is that care must be taken in the selection of appropriate schedules of reinforcement. Reinforcement must come frequently enough in the initial stages to

establish desired behavior firmly, but must not continue to the point where its value is lost through satiation. It would seem, then, that perhaps continuous reinforcement in early stages of developing behavior, leading to intermittent schedules of reinforcement at a later time might be successful in development and maintenance of desired behavior.

CHAPTER IV

POSTULATES AND DEVELOPMENT OF THE HYPOTHESES

Literature cited to this point indicates systematic application of operant conditioning principles extended to school-type tasks such as spelling in school settings might be productive in increasing academic performance of pupils. Studies cited in which material reinforcement was effectively used on continuous schedules to effect desired behavior changes lead to the first hypothesis of this study, that performance of Ss in weekly spelling tests will show significant improvement when material reinforcement paired with social reinforcement is introduced on a continuous schedule.

Literature regarding learning principles suggests that in many instances continuous reinforcement is not necessary to maintain behaviors, and in fact in normal life situations intermittent schedules of reinforcement are adequate to maintain behaviours. Research on schedules seems to indicate a similar conclusion--that intermittent reinforcement is sufficient to maintain behavior. Consequently, the second hypothesis that this study will investigate is that a schedule of variable ratio material reinforcement, in conjunction with continuous social reinforcement, will be sufficient to maintain significant improvement in spelling over the performance shown in spelling in the absence of material reinforcement and with minimal social reinforcing stimuli.

Insofar as literature suggests that for many pupils teachers

are not reinforcing stimuli, and for many pupils competing for grades and marks is not reinforcing, it would appear that by systematically pairing material reinforcement on varying schedules with teacher's verbal or written reinforcements on a continuous schedule and with attainment of improved grades or marks, both teacher's verbal and written comments and attainment of marks or grades could in themselves become conditioned reinforcers. The hypothesis formulated to investigate this possibility is that following exposure to pairing of material reinforcement with social reinforcement from the teacher and with attainment of improved grades, pupils will maintain significant increases in performances in spelling when material reinforcement is withdrawn.

Formulation of the fourth hypothesis arises in part from a pilot study undertaken at an earlier time. The pilot work attempted in part to investigate the differential effects of reinforcement on initially high and low achievers in spelling. It was noted that those students who were initially "good" spellers showed less gain in their performance than did the "average" or "poor" spellers. It was suggested that perhaps this was because "good" spellers did not have as great a potential for improvement due to their scores being initially higher. It seems reasonable to expect similar results in this study. The fourth hypothesis, then, is that those Ss who were initially "good" spellers will show less gain than initially "average" or "poor" spellers.

"Good" spellers are defined as those achieving in the highest

third of the Ss in the first six-week period of the study prior to any treatment. "Average" spellers are defined as those who score in the middle third of the range of scores obtained by Ss during the initial six-week period of the study. "Poor" spellers are defined as those performing in the lowest third of the range of obtained scores from the first six-week period of the study.

Research dealing with the effectiveness of the operant model with individuals of different ages seems to indicate the model is effective for all age groups. However, effectiveness of the model in specific situations depends to a large extent upon appropriate selection of reinforcers. Skinner (1958, p. 72) comments that "A survey of the events which reinforce a given individual is often required in the practical application of operant conditioning." He advocates looking for effective reinforcing stimuli "...in the history of the individual" (p. 75). An assumption made in this study is that the individuals involved in the study have had a more or less common history of being reinforced with candy bars, trinkets, and verbal reinforcers, and as a result these reinforcers will be equally effective for the children of grades five, six, and seven. In order to investigate the adequacy of these reinforcers for the range of ages represented in the sample, a fifth hypothesis has been developed. It states that there will be no significant difference in the effectiveness of the material and social reinforcement for the pupils in grades five, six, and seven.

Statement of the Hypotheses

The following hypotheses are tested in this study:

1. Performance of Ss in weekly spelling tests will show significant improvement when material reinforcement is introduced on a continuous schedule, and paired with social reinforcement.
2. A schedule of variable ratio material reinforcement, in conjunction with continuous social reinforcement, will be sufficient to maintain significant improvement in spelling over the performance shown in spelling in the absence of material or social reinforcing stimuli.
3. Following exposure to pairing of material reinforcement with social reinforcement from the teacher and with attainment of improved grades, pupils will maintain significant increases in performance in spelling when material reinforcement is withdrawn.
4. Ss who were initially "good" spellers will show less gain than initially "average" or "poor" spellers.
5. There will be no significant difference in the effectiveness of the material and social reinforcement for the pupils in grades five, six, and seven.

CHAPTER V

METHOD OF THE STUDY

Subjects

The Ss consisted of 192 male and female pupils of three regular classes of each of two elementary schools located on the southern end of Vancouver Island, British Columbia. Both schools were in a rural setting but within ten miles of an urban centre. The suburban atmosphere of the area indicated these pupils should not be atypical of those from the periphery of a large urban area or of children from a smaller urban setting. Chronological ages of pupils ranged from approximately ten years through fourteen years and represented grades placements of from grade five through grade seven.

Procedure

The first six months of the ten month school year were divided by E into four six-week periods. These were (1) the pre-reinforcement period, (2) the period of material and social reinforcement on a continuous schedule, (3) the period during which material reinforcement on an intermittent schedule was given and social reinforcement on a continuous schedule administered, and (4) the period of no material reinforcement but social reinforcement on a continuous schedule.

Spelling words used for each of the grade levels were the words from the prescribed spellers texts designed for each of the grades. Texts used were "My Spelling" (Ginn, 1950) for the grade seven pupils, and "Spelling in the Language Arts" (Nelson's, 1964) for the grade

five and six pupils. Each class studied twenty words per week with a fifty word review unit on the sixth, twelfth, eighteenth and twenty-fourth weeks. This resulted in there being a total of 150 words for each pupil in each of the four periods of the study.

Teachers of the six classes were instructed to teach spelling in whatever manner they chose, but to use the method of their choice as consistently as possible for the duration of the study.

During the first six week period of the school year, teachers of the six classes involved taught spelling according to their own methodological preferences,keeping record of results achieved on weekly tests for each child. This group of scores was used as a pre-reinforcement base-line.

During second, third, and fourth periods, spelling was taught and tested in essentially the same manner as during the first period. No extra emphasis was given to spelling. However, using the previous week's spelling record as a comparative base-line, material reinforcement (candy, trinkets) and social reinforcement were given to each child who equalled or bettered his or her previous week's score according to the reinforcement schedules shown below.

TABLE 1

Schedules of Reinforcement

Period	Weeks	Type of Reinforcement	Schedule
1	1-6	None	None
2	7-12	Material	Continuous
		Social	Continuous
3	13-18	Material	Intermittent (Variable-Ratio)
		Social	Continuous
4	19-24	Social	Continuous

Teachers were instructed to mark the test papers as quickly as possible following the test and to return the papers to the pupils immediately. Reinforcement (material and social) was to be administered simultaneously with or directly following the returning of the test papers. The marking-returning reinforcement sequence should have taken place within one hour of the conclusion of the test.

Tests were given to all classes on the same day in an attempt to insure that there would be no previous knowledge of whether or not reinforcement was to be forthcoming. All classes used the same reinforcement schedules. Material reinforcement during the third period of the study was given following the first, third, and fourth tests.

Any child who did not meet the criterion performance did not receive material reinforcement but was verbally encouraged to improve his or her performance on the next week's test. The possibility of

reinforcement was not used by the teachers as a means of trying to motivate the Ss to study their spelling words. Records of each child's performance in weekly tests were kept in the same manner as during the first period.

Experimental Apparatus

The apparatus used for the delivery of material reinforcement took the form of pigeon-holes, three inches square and eight inches deep. Each cubicle was covered with a hinged door on which a Ss name was printed. If a S achieved the reinforcement criterion, (a spelling score equal to or better than the previous week's score) he or she was permitted to lift the door and remove the material reinforcement immediately upon receiving his or her test back. The material reinforcement was removed in the presence of the rest of the class. Identical apparatus was kept in each of the six rooms, in view of the children throughout the second, third, and fourth periods.

CHAPTER VI

RESULTS AND DISCUSSION

Raw scores for each S within each of the four periods of the study were added to give four total raw scores, one for each period. These total raw scores were converted to percentage scores. Ss who had been absent for any of the tests in the final three periods of the study were eliminated from the sample, since the number of possible social reinforcements was only eighteen, and missing one such reinforcement represented a loss of 5.5 percent of potential reinforcement. Further, to miss one of the nine possible material reinforcements would mean a loss of 11.11 percent of possible reinforcement.

Scores of the remaining 144 Ss were analyzed in order to investigate the following hypotheses:

1. Performance of Ss in weekly spelling tests will show significant improvement when material reinforcement is introduced on a continuous schedule, and paired with social reinforcement.
2. A schedule of variable ratio material reinforcement, in conjunction with continuous social reinforcement, will be sufficient to maintain significant improvement in spelling over the performance shown in spelling in the absence of material or social reinforcing stimuli.
3. Following exposure to pairing of material reinforcement with social reinforcement from the teacher and with attainment of

improved grades, pupils will maintain significant increases in performance in spelling when material reinforcement is withdrawn.

4. Ss who were initially "good" spellers will show less gain than initially "average" or "poor" spellers.
5. There will be no significant difference in the effectiveness of the material and social reinforcement for the pupils in grades five, six, and seven.

An analysis of variance for repeated measures was used in the initial investigation. Results are shown below.

TABLE II

Mean Scores for 144 Elementary School Pupils Classified by Grades for the Four Periods of the Study

Grade	Period One	Period Two	Period Three	Period Four
7	79.96	80.77	84.68	84.45
6	91.38	95.05	93.68	95.17
5	88.77	91.86	92.05	92.38
Grand Mean	88.04	90.89	91.19	91.92

TABLE III

Analysis of Variance of the Percentage Correct Scores Under Different Schedules of Reinforcement on 144 Pupils Classified by Grade Level

Source of Variation	SS	df	M.S.	F
Between Subjects	84113.00	143		
Grade Placement (G)	12451.27	2	6225.63	11.99*
Subjects Within Groups	73188.00	141	519.06	
Within Subjects	9100.00	432		
Treatment Periods (T)	1213.55	3	404.52	22.70*
'G * T' Interaction	351.44	6	58.57	3.29*
'T' x Subj. Within Groups	7538.00	423	17.82	

*$p < .01$

In order to test hypotheses numbers one, two, and three, Scheffé contrasts were carried out using the grand means for the treatment effects for the Analysis of Variance reported in Table III. A comparison of means of period one and period two (base line, and, continuous material and social reinforcement) indicated a difference significant at the .01 level. Differences significant at the .01 level were also found between the means of periods one and three (base line, and, intermittent material with continuous social reinforcement) and between the means of periods one and four (base line, and, continuous social reinforcement). Table III also reports a significant ($p < .01$) interaction effect. Mean scores reported in Table II reveal differential effects of continuous material reinforcement paired with social reinforcement between the grades. It is particularly noted that while the Grade Seven group gained very little from period one to period two,

the Grade Six group showed relatively large gain over the same periods. This may be at least tentatively explained by the fact that the teachers of the Grade Seven classes used in this study were also principals of the schools. It appears possible that a role conflict between disciplinarian and reinforcer could exist, perhaps to a greater degree than with the other teachers. Further, the fact that these principals only spend part of their time with the class (the remainder being taught by relief teachers) may well mean that a longer period of time is necessary for their reinforcement to become as effective as that of a teacher who spends more time with a particular class.

TABLE IV

Scheffé Contrasts for Means of Total Group over Four Periods Indicated by Analysis of Variance for Repeated Measures

Means	Difference
$\bar{X}_1 - \bar{X}_2$	-2.854 ± 1.609*
$\bar{X}_1 - \bar{X}_3$	-3.154 ± 1.609*
$\bar{X}_1 - \bar{X}_4$	-3.878 ± 1.609*

*$p < .01$

Thus, it would seem that hypotheses numbers one, two, and three are supported by the study. Performance in weekly spelling tests did show significant improvement when material reinforcement paired with social reinforcement was introduced on a continuous schedule (Hypothesis One). An intermittent schedule of material reinforcement paired with

continuous social reinforcement appeared to be sufficient to maintain significant improvement in spelling test results over the performance shown in spelling in the absence of material or social reinforcing stimuli (Hypothesis Two). Results of spelling tests following exposure to pairing of material reinforcement with social reinforcement from the teacher were significantly higher than results of spelling tests of the base-line period, even when material reinforcement was withdrawn (Hypothesis Three). Although there were increases in the means of the total group from each period to the successive period, only differences mentioned above were significant. A summary of the means for the total group and their differences is shown below.

TABLE V

A Summary of Means and Differences between Successive Means for the Total Group Over the Four Periods of the Study

Period	$\bar{X}$	$\bar{X}_{n+1} - \bar{X}_1$
1	88.038	2.854*
2	90.892	1.300
3	91.192	0.724
4	91.916	

*$p < .01$

In order to note the effects of the reinforcement program when pupils were grouped by base-line (period one) performance level, an analysis of variance for repeated measures was used. Although it is not an integral part of this study, results are summarized in Appendix D for the interested reader.

Hypothesis number four predicts that those pupils who achieved well during the base-line period would show less gain than those who initially achieved at lower levels. This hypothesis was tested by determining differences between the performances of each child from period one (base-line) to period four (continuous social reinforcement) in each of the three achievement groups (high, average, and low) and subjecting these difference scores to analysis of variance. Results are summarized in Table VI and VII.

TABLE VI

Means of Difference Scores Between Periods One and Four for Pupils Classified by Period One Performance

Performance Level	Mean
High	.417
Average	2.920
Low	8.298

TABLE VII

Summary of Analysis of Variance of Differences Between Scores for Periods One and Four for Pupil Achieving High, Average, or Low in Period One

Source of Variation	SS	df	MS	F
Between Groups	1662.38	2	781.19	25.72*
Within Groups	4281.90	141	30.37	
Total	5844.28	143		

*$p < .01$

Scheffé contrasts were used to investigate further the differences indicated in the analysis of variance. Table VIII summarizes the application of this test.

TABLE VIII

Scheffé Contrasts for Means of Difference Scores Between Scores in Periods One and Four

Means	Difference
$\bar{X}_L - \bar{X}_H$	7.781 ± 3.39*
$\bar{X}_A - \bar{X}_H$	2.503 ± 3.39
$\bar{X}_L - \bar{X}_A$	5.378 ± 3.39*

*$p < .01$

It appears that those pupils who are initially "high" spellers gain less from exposure to a program of material reinforcement paired with social reinforcement than do those pupils who are initially "poor" spellers. Those who initially perform in the "average" range of scores also appear to gain less from exposure to such a reinforcement program than the "poor" spellers. However, "average" and "high" spellers do not seem to differ from each other in terms of gains from exposure to social and material reinforcement on varying schedules. This lack of significant difference (at the .01 level of confidence) could possibly be explained by the clustering of scores in the upper portion of the "average" group. The three groups were formed by ranking the entire 144 Ss according to their percentage score of the first period and dividing them into three equal groups of 48 Ss. An examination of the data (see Appendix B) shows that 34 of the 48 scores in the "average" group fall above 90.00, where the range is from about 96.00 to 86.00. This would result in not only less ceiling for both "high" and "average"

groups than for the "low" group, but also causes the "high" and "average" groups to more nearly represent one group than two different ones. Consequently, one might not expect significant difference in terms of gains in achievement scores associated with exposure to a program of reinforcement such as the one used in this study. Insofar as these are relative, arbitrary groupings anyway, perhaps a future study should consider subjects as two groups ("high" initial achievers and "low" initial achievers) rather than as three groups.

In order to test hypothesis number five, which predicts no significant difference in the overall effectiveness of the material and social reinforcement for the pupils in grades five, six, and seven, the differences in scores between periods one and four for each pupil were calculated and subjected to analysis of variance. Tables IX and X summarize the results.

TABLE IX

Means of Difference Scores Between Periods One and Four for Pupils Classified by Period One Performance

Grade	Mean
7	4.457
6	4.802
5	3.613

TABLE X

Summary of Analysis of Variance of Differences Between Scores for Periods One and Four for Pupils in Grades Five, Six, and Seven

Source of Variation	SS	df	MS	F
Between Groups	15.70	2	7.85	.19
Within Groups	5827.67	141	41.33	
Total	5843.37	143		

These data indicate support for the fifth hypothesis. Although there appears to be a difference in the way a program of reinforcement such as the one used in this study operates for pupils in different grades (see Table II), there seems to be no reason to suspect that the overall effectiveness of such a program in improving the academic performance of pupils would not be the same for pupils in grades five, six, and seven.

Implications

It would appear from the results of this study that perhaps pupil performance in academic areas can be increased through consistent application of material and social reinforcement. This study paired short-term material reinforcement with continuing social reinforcement. If this is in fact the case, it seems that perhaps noteworthy implications follow. If material reinforcement paired with social reinforcement serves to increase the reinforcing value of the teachers' social reinforcements as suggested earlier in this paper (see Skinner, 1968) it may be of value to give consideration to exposing pupils at other grade levels to such a program of reinforcement as used in this

study. It would seem that this may have particular value at the primary grade levels, insofar as the establishment of the teacher as a reinforcing figure at an early point in a child's education could well be an important variable in the academic success of the child. Inservice training for teachers in logical and consistent use of these simple variables (with which they are already familiar) may also be useful. There is also the possibility that using only social reinforcement without pairing it with material reinforcement would be successful in increasing the academic performance of pupils if it was used consistently and appropriately by teachers. Further research in this area seems warranted.

Limitations

Use of a One Group Pretest-Posttest Design is discussed by Campbell and Stanley (1963). They suggest that uncontrolled factors such as history, maturation, and statistical regression may challenge the internal validity of this design and advocate the use of randomization and/or control groups to reduce the effects of such factors. Certainly one cannot dispute their claims, but as they state, there are situations where controls and randomization cannot realistically be achieved, and in such cases this design seems to be the most appropriate Selection of the schedule of intermittent material reinforcement for the third period of the study was arbitrary, and the results obtained may thus be particular to this schedule. Further investigation using alternate schedules of intermittent reinforcement may need to be undertaken in order to test generalizability.

Whereas it may be commonly expected that pupils would show improvement in Spelling over the course of a school year without any treatment occurring, it seems that experienced teachers do not find this to be the case. In fact, it seems that pupils tend to perform with about the same proficiency at the end of a school year as they do at the beginning.

Selection of the sample and especially the cooperating teachers would appear to be a major factor in a study of this sort. The fact of necessary volunteer cooperation on the part of the teachers may certainly lead to some Hawthorne Effect. The specific extent to which teachers carried out the directions given to them by E is another not completely ascertainable variable that may serve to confound results.

As suggested in the discussion of implications, the independent roles of material and social reinforcement were not clearly distinguished in this study, and further efforts to show such distinction in future studies would be in order.

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APPENDIX A

RAW DATA

*Raw Scores on Spelling Tests Totalled for Each Period and Converted to Percentages

S**	Period One	Period Two	Period Three	Period Four
701	8867	8800	8867	9267
703	9933	10000	9933	10000
704	10000	10000	10000	10000
705	9933	9800	9867	9867
706	9800	9933	986 7	9867
707	6067	8200	8067	7733
708	7267	6467	7933	8467
709	7800	7133	8067	8533
710	9933	9467	9600	9933
711	8933	9133	9667	9400
713	9933	9867	9867	10000
714	8200	8733	9000	8733
715	7933	8333	9467	9867
716	7133	7067	8667	8467
717	8467	8133	9467	9267
718	7800	8867	8333	8333
720	7800	8067	8933	8467
721	7077	5733	7467	7733
722	7400	7533	6133	6200
723	8067	9200	9308	8867
724	9667	9400	9600	9867
725	9267	9533	8933	9533
726	7800	8200	8267	8267
727	7667	6800	7533	7667
728	8538	8267	8467	7867
729	2600	4000	4467	3200
731	3545	4000	5333	5667
732	4091	3267	4067	3933
733	9400	9267	9600	9533
734	9800	9867	9533	9600
735	7267	7333	8200	7667
601	9667	9800	9933	10000
602	9933	10000	9867	9867
603	9200	9733	9267	10000
604	10000	10000	10000	10000
605	9867	10000	9800	10000
606	10000	10000	10000	10000
607	9800	10000	10000	10000
608	9867	10000	10000	10000
609	9200	10000	9400	9867

*to two places of decimals

**initial digit indicates grade level

APPENDIX A (cont'd).

S	Period One	Period Two	Period Three	Period Four
610	9533	9867	10000	10000
611	9800	10000	9867	10000
612	8467	9933	9800	9133
613	8067	9667	9200	9667
614	9867	9933	9867	9933
615	8933	9933	9600	9933
616	9333	9867	9733	9733
617	6600	7067	7400	8533
618	9133	9467	9133	10000
619	9733	9933	9933	9733
620	9733	10000	9467	9867
621	9800	9733	9467	9533
622	9800	9933	10000	9933
623	8667	9800	8800	8467
624	9867	9333	9733	9867
625	9133	9533	7933	7400
626	9733	9333	9267	9200
627	9533	8600	9000	9133
628	9600	9933	9733	9800
629	9867	9933	9333	9733
630	9867	10000	9800	9867
631	8600	9800	8800	9200
632	8267	9267	8667	9600
633	8400	8667	9133	9267
634	8933	9000	9000	9267
635	9133	9200	9733	9600
636	6067	7733	7267	6867
637	9467	9467	9600	9600
638	8533	9933	9200	9200
639	9667	9800	9800	9867
640	8667	9067	8667	9200
641	8867	9267	9200	9000
642	9333	9600	9400	9733
643	9933	9933	10000	10000
644	7867	8733	9200	9200
645	9200	9733	9333	9067
646	9667	9933	9733	9867
647	9933	9867	9733	10000
648	9400	9133	9800	9667
649	8533	8800	9800	9800
650	9733	9867	9400	9867
651	8600	9400	9000	9133
652	9400	10000	9867	10000
653	7333	9200	7800	9267
654	8800	9133	8867	9000

APPENDIX A (cont'd).

S	Period One	Period Two	Period Three	Period Four
655	9867	10000	9800	9933
656	7733	7467	8133	8067
657	9867	10000	9933	10000
658	9667	9800	9600	9933
659	6867	8667	9267	9200
660	9733	9933	9867	9933
661	8600	8933	9000	9533
662	9533	9533	9533	9800
663	9933	9933	9800	10000
664	8067	8200	8333	8267
501	8800	9733	9533	9867
502	8200	9533	9267	8800
503	9800	10000	10000	9867
504	9600	9867	9933	9867
505	7933	9133	8667	7600
506	4600	3333	2733	6400
507	4600	4800	6467	8133
508	10000	10000	9933	10000
509	9733	9867	10000	9867
510	7533	9867	8600	9267
511	9267	9933	9733	9867
512	9800	9733	9867	9933
513	8933	9267	9267	9467
514	6600	7200	6333	7333
515	9933	10000	10000	9800
516	9733	10000	10000	10000
517	9867	10000	10000	10000
518	9000	8867	8933	9267
519	7667	9133	9867	7867
520	4933	4533	4667	5800
521	9200	9733	9733	9667
522	9133	9333	9333	9267
523	8800	9733	9267	9667
524	9600	9933	10000	9667
525	9267	9733	9867	9800
526	10000	9933	9933	10000
527	8867	9533	9533	9400
528	9200	9933	9933	9467
529	9333	9267	9667	9733
530	9467	9600	9733	9333
531	9333	9800	9600	9600
532	8400	9067	9467	8667
533	8867	9267	9667	9400
534	8800	9267	9400	8600
535	9133	9067	9667	9400
536	7733	8133	7867	8000
537	8467	7667	8267	8400
538	8385	8467	8600	9067

APPENDIX A (cont'd).

S	Period One	Period Two	Period Three	Period Four
539	9533	9667	9933	9667
540	9533	9867	9533	9733
541	9385	9867	9600	9400
542	9600	9800	9600	9400
543	9933	10000	10000	10000
544	9600	9667	9733	9933
546	9400	9733	9600	9467
547	9800	9800	10000	9800
548	10000	9667	9867	9867
549	9667	9867	9933	9667
550	10000	9933	9933	9600

*to two places of decimals

APPENDIX B

Difference Scores Between Periods One and Four

S*	Difference	S	Difference
701	4.00	614	0.66
703	0.67	615	10.00
704	0.00	616	4.00
705	-0.66	617	19.33
706	0.67	618	8.67
707	16.66	619	0.00
708	12.00	620	1.34
709	7.33	621	-2.67
710	0.00	622	1.33
711	4.67	623	-2.00
713	0.67	624	0.00
714	5.33	625	-17.33
715	19.34	626	-5.33
716	13.34	627	-4.00
717	8.00	628	2.00
718	5.33	629	-1.34
720	6.67	630	0.00
721	6.56	631	6.00
722	-12.00	632	13.33
723	8.00	633	8.67
724	2.00	634	3.34
725	2.66	635	4.67
726	4.67	636	8.00
727	0.00	637	1.33
728	-6.71	638	6.67
729	6.00	639	2.00
731	21.22	640	5.33
732	-1.58	641	1.33
733	1.33	642	4.00
734	-2.00	643	0.67
735	4.00	644	13.33
601	3.33	645	-1.33
602	-0.61	646	2.00
603	8.00	647	0.67
604	0.00	648	2.67
605	1.33	649	12.67
606	0.00	650	1.34
607	2.00	651	5.33
608	1.33	652	6.00
609	6.67	653	19.34
610	4.67	654	2.00
611	2.00	655	.66
612	6.66	656	3.34
613	16.00	657	1.33

*initial digit indicates grade level

APPENDIX B (cont'd).

S	Difference	S	Difference
658	2.66	522	-1.34
659	23.33	523	8.67
660	2.00	524	0.67
661	9.33	525	5.33
662	2.67	526	0.00
663	0.67	527	5.33
664	2.00	528	2.67
501	10.67	529	4.00
502	6.00	530	1.34
503	0.67	531	2.67
504	2.67	532	2.67
505	-3.33	533	5.33
506	18.00	534	-2.00
507	35.33	535	2.67
508	0.00'	536	2.67
509	1.34	537	-0.67
510	17.34	538	6.82
511	6.00	539	1.34
512	1.33	540	2.00
513	5.34	541	0.15
514	7.33	542	-2.00
515	-1.33	543	0.67
516	2.67	544	3.33
517	1.33	546	0.67
518	2.67	547	0.00
519	2.00	548	-1.33
520	8.67	549	0.00
521	4.67	550	-4.00

APPENDIX C

*Constitution of Performance Groups

"High Performers"					
703	601	614	630	658	516
704	602	619	639	660	517
705	604	620	643	663	526
706	605	621	646	503	543
710	606	622	647	508	547
713	607	624	650	509	548
724	608	626	655	512	549
734	611	629	657	515	550
"Average Performers"					
701	616	640	501	524	534
711	618	641	504	525	535
725	625	642	511	527	539
733	627	645	513	528	540
603	628	648	518	529	541
609	634	652	521	530	542
610	635	654	522	531	544
615	637	662	523	533	546
"Low Performers"					
707	720	731	632	659	514
708	721	732	633	661	519
709	722	735	636	664	520
714	723	612	638	502	532
715	726	613	644	505	536
716	727	617	649	506	537
717	728	623	651	507	538
718	729	631	653	510	
			656		

*initial digit indicates grade level

APPENDIX D

Mean Scores for 144 Elementary School Pupils Classified by Base-Line Performance for the Four Periods of the Study

Base-Line Performance Level	Period One	Period Two	Period Three	Period Four
High	98.43	98.78	98.28	98.85
Average	92.18	95.26	94.72	95.10
Low	73.50	78.64	80.57	81.81

Analysis of Variance of the Percentage Correct Scores Under Different Schedules of Reinforcement on 144 Pupils Classified by Achievement on Base-Line Spelling Performance

Source of Variation	SS	df	M.S.	F
Between Subjects	84080.00	143		
Achievement Levels (A)	42378.02	2	21189.01	71.64*
Subject Within Groups	41704.00	141	295.77	
Within Subjects	9121.00	432		
Treatment Periods (T)	1251.00	3	417.00	25.62*
'A * T' Interaction	984.00	6	164.00	10.07*
'T' x Subj. Within Groups	6886.00	423	16.28	

*$p < .01$

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