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EFFECT OF SPATIAL TITRATION ON TASK PERFORMANCE

(TITLE)

BY

Lawrence M. Glowacki

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

Master of Arts

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY
CHARLESTON, ILLINOIS

1973
YEAR

I HEREBY RECOMMEND THIS THESIS BE ACCEPTED AS FULFILLING
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Abstract

A spatial titration method was used with a reinforcement schedule to determine task-reinforcement area separation most preferred and effective in producing high task performance. Two third-grade boys were given task contingent reinforcement where the task was solving arithmetic problems. Following shaping to stable response rates, the titration operation was introduced. Errors decreased the task-reinforcement area distance while correct responses increased the distance. With the introduction of Titration Phase 1, both subjects' incorrect responses produced a zero task-reinforcement area separation. In Titration Phase 2, both subjects were started at the opposite extreme of the reinforcement continuum. Repeated errors produced a zero task-reinforcement area spatial separation.

ACKNOWLEDGMENTS

Special acknowledgment for assistance in this research is given to Dr. Gary L. Holt, who directed this thesis. Additional comments and suggestions which proved to be invaluable, were provided by Dr. Randall H. Best and Dr. William P. McGown. I am deeply indepted to these people for making this research a truly educational experience.

I am grateful to Dr. Donald G. Gill, principal of Robert G. Buzzard Laboratory School, for providing the subjects and their background information for this experiment. A sincere thanks is directed to Dean Donald Kluge and Student Housing of Eastern Illinois University. It was through their efforts that the facilities to run this research data were willingly provided. Acknowledgment is also in order for Miss Luanne Hall, Miss Trina Cochrane, and Miss Rose Seiler for their assistance in the collection of this data.

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INTRODUCTION

Behavior modification has taken its place in the school system as one of the most innovative techniques in modifying behavior and increasing learning. Recent publications (Buckley and Walker, 1970; Homme, 1970) have been designed to aquaint the classroom teacher with the various techniques of modifying classroom behavior and using contingency contracting. Eleftherios, Shoudt, and Strang (1972), used an automated light display as a secondary reinforcer to decrease out-of-seat behaviors in 22 first-grade children. Meland and Stachnik (1972) used game rules and lights in controlling talking-out, disruptive, and out-of-seat behaviors in a classroom setting. Inappropriate verbalizations and other behaviors in a fifth-grade class decreased with the initiation of free time and token reinforcement.(Quesenbery, 1972). A delayed technique of a note signed by the teacher and addressed to the parents, modified the classroom behaviors of 3 ten to eleven year old children.(Sluyter and Hawkins, 1972). Thumb sucking behavior in a nine year old boy was decreased significantly by making the reinforcement of his peers contingent on the nonoccurance of the behavior (Ross and Levine, 1972). Academic performance has been effectively increased using rewards such as social approval, free time, token, verbal, and written reinforcement (Brooks and Snow, 1972; Klinger, 1972; Lipe and Jung, 1972; Smith, 1972; Wolf and Giles, 1968). Friedman and Bowers (1972) have shown that teacher reinforcement of spontaneous activities increased student verbalization both to the teacher and within the peer group. Increases in academic performances in concentrated subject areas have been cited. Ross and O'Driscoll (1971) used a free time contingency in improving spelling accuracy. Performance during art classes was controlled through the use of a token system (Colin, 1972). Holt (1971) used contingency contracting in increasing both reading and mathematics performances in 21 first-grade children. Verbal and written reinforcement were proven effective when used with arithmetic underachievers (Levin, 1972). Dil and Gotts (1972) increased arithmetic performance in 4 seven to nine year old underachievers, using peer group reinforcement. Many teachers can now use these techniques in contingency contracting, token systems, and reinforcement schedules for behavioral and academic purposes in the classroom.

Chaplin (1968), refers to the law of contiguity, as conceived by Aristotle, as a principle of learning and association which maintains that occurances which happen close together in time or space, have a tendency to be learned or associated. There exists broad professional agreement that contiguity of stimulus and response are necessary for learning. Still others argue that contiguity must be accompanied by reinforcement. Estes (1970) affirms that the contiguity of two behavioral events in time succession is necessary for entering the association in short-term memory. During the short-term memory retention interval, some associations may become consolidated and the information transferred to long-term memory storage. If the transfer does not occur, further associations are not possible, thus the information is lost from memory.

Learning association has been studied in primates, showing the effects of contiguity relationships on discrimination. Murphy and Miller (1958) conducted an experiment to find the importance of spatial relationships in discrimination learning of cue, reward, and the location of response. Learning occurred in the three instances where the cue was spatially contiguous with either the response or reward. Learning did not occur in the two instances where the cue was not spatially contiguous with the response or reward. Polidora and Fletcher (1964), and Wunderlich and Dorff (1965), also using monkeys, worked with contiguity relationships showing similar results. Discriminations were more difficult when the stimulus-response was spatially discontiguous, than when the stimulus-response was spatially contiguous.

Studying discriminations using spatial contiguity has been undertaken using human subjects. Seventy-two subjects were presented color discrimination problems where the contiguity of the stimulus and response were spatially varied (Wunderlich, 1971). Learning was most proficient when the stimulus and response were contiguous, but became progressively impaired when the stimulus and response became discontiguous. Other experiments in visual and tactual discrimination in children have shown similar findings (Wunderlich and Iorio, 1966; Wunderlich and Youniss, 1968). Research has demonstrated the effects of spatial contiguity by indicating that the closer the response is to the stimulus, the better the performance is; the farther the response is from the stimulus, the worse the performance is.

Personal space or distance is defined by Hiat (1971) as the physical distance that a person tends to maintain between himself and other stimuli. This area is assumed to reflect the space which the person regards as part of himself, comparable to his own "portable territory." Using 24 male and 24 female subjects, Hiat instructed them to approach a variety of targets, with a toe to toe distance measured after their approach. Personal distance for friend (person) targets were found to be smaller than personal distance for stranger (person) targets. Personal distance for an object target was smaller than that of a person target. Personal distance for a target that aroused negative feelings was larger than that of a more neutral target. Bass and Weinstein (1971), using children, attempted to determine what factors (sex, grade, setting, degree of aquaintance) affected the boundaries of personal space. Their findings show that personal space is aquired by the age of five and becomes relatively stable by third-grade. Smaller personal distances are maintained in a formal rather than an informal situation. This is also dependent upon the aquaintance to that situation. Males and females did not differ significantly in interpersonal distance, but older children have a tendency to show more spatial distinction than younger children.

A replication using personal distance was constructed by Nowicki and Duke (1971), using high school students. The conclusions drawn were that both male and female subjects preferred same sex-same race stimuli farther in distance than opposite sex-same race. Same race was preferred closer than different race, and females generally preferred stimuli at shorter distances than males. Using an entire social-cultural group, Grant (1972) observed the spatial behaviors of two caste memberships in India. The hypothesis was confirmed that peoples' use of space reflects their underlying social order. Brahmins (higher caste) maintained a greater spatial distance from the Harijans (lower caste) than from their own members. A similar tendency was shown by the spatial distance maintained by the Harijans. Study in personal distance has indicated that the individual desires to keep a greater spatial distance between himself and an aversive stimulus, and feels less of a need for spatial distance between himself and a neutral stimulus.

The method of titration has been primarily applied to the field of chemistry and defined as, the systematic process by which given amounts are added to a quantity until a desired terminus is attained (Webster's Third New International, 1966). Titration as applied to psychology is where a subject is able to control a stimuli as a result of his varying responses to that stimuli. Bekesy (1948) used a titration procedure with an audiometer to indicate tone thresholds. The intensity of the tone increased continuously as long as a button held by the subject was pressed, and decreased automatically when the subject released the button. The subject was then able to control the intensity of the tone, allowing it to fluctuate above and below threshold levels. Blough (1955, 1958) used a titration procedure where the luminance of a stimulus patch was controlled by a pigeon's response to it, during the interval between rewards. Responses (pecks) to key _A_ reduced luminance of the patch in small amounts, while responses to key _B_ increased the luminance of the patch. When the pigeons learned the procedure and performed consistantly under these conditions, data was obtained on their luminance thresholds. A titration method used by Lindsley (1957) measured the depth of sleep. A sleep-deprived subject was given a stimulus control switch by which responding would reduce the intensity of the audio-tone. Rapid response would reduce the stimulus to zero intensity, and continued responding would maintain that zero level. A medium rate of responding would keep the tone level at a medium intensity. No responding on the switch would cause the tone to increase to its full intensity. The subject's rate of response controlled the tone intensity, and the measure of sleep-depth was recorded. In an experiment using rats, a titration schedule measured fractional escape and avoidance of a shock stimulus (Weiss and Laties, 1958). Electrical shock was administered and increased in intensity every 20 seconds. Each time the rat responded by depressing a lever in the chamber, the intensity of the shock decreased by one step. Using this procedure, lever-pressing behavior was maintained by the rats, with both continuous and intermittent delivery of the shock stimulus. Information was also attained about threshold levels, and the amount of stimulus preferred. Evans (1963) used a titration schedule to measure performance decrement as a function of continuing heavy muscular exertion on a treadmill. He found that a titration schedule forced the subject to monitor his own behavior, which produced successive responses controlling the stimulus producing that behavior. Schrier, Stollnitz, and Green (1963), in color discrimination tasks using rhesus monkeys and a titration procedure, indicated that the titration method provided a reliable shaping of observed responses while increasing the spatial separation as quickly as the performance of each subject dictated. Separation of the discriminada from the manipulada was increased beginning from zero inches. Following two correct responses at a given interval, spatial separation was increased systematically; after each incorrect response, spatial separation was decreased. Four of the five monkeys exceeded 90% correct responses with a spatial separation of 12 inches or more. The titration method may then be a very effective means by which to establish a spatial increment best increasing performance. The subject may then control the spatial area where his task performance will be highest.

Skinner and Ferster (1957) discuss differential rate reinforcement as a schedule presenting a desired contingency, with a time limitation added to the response requirement. Differential reinforcement was effective in increasing sitting behavior in a four year old hyperactive retarded boy (Twardosz and Sajwaj, 1972). This procedure suggested that similar programs could be used to treat several behaviors simultaneously, increasing teaching effectiveness. Differential reinforcement of high rates (DRh), is an operation in operant conditioning where reinforcement is contingent upon a response frequency which meets or exceeds a response criterion with a specified time limit (Hendry, 1969). Hemmes and Ekerman (1972), used a DRh schedule to maintain increased key pecking behavior in White Charneaux pigeons. A DRh schedule of reinforcement has been used by Chadwick and Day (1971) in increasing the academic performance in underachieving grade school students. Verbal reinforcement and token points were used to reinforce attending to a task, efficiency (number of problems complete per unit of time), and accuracy (percent correct). Control of these three variables increased academic performance significantly. Percent of time at work showed a mean increase over baseline of 18%. Number of problems completed per minute showed a mean increase over baseline of 1.95. Percent of problems correct showed a mean increase over baseline of 20%. A schedule of differential reinforcement of high rates, may be an effective means by which both a correct response and its high frequency may be controlled. A DRh schedule can then be effectively applied in a classroom situation to increase rate and accuracy of academic performance.

Academic tasks using mathematics performance have been shown to have increased on almost every elementary grade level through behavior modification techniques. Arithmetic performance and attending to task were increased by praise and immediate correctness feedback, in a seventh-grade classroom (Kirby and Shields, 1972). Withdrawl of the reinforcement produced a return to lower baseline conditions. Rosenfeld (1972) had similar results, increasing performance in arithmetic skills in 60 sixth-grade students. Rosenfeld also showed a significant correlation between improved performance of many students, and improvements positively related to IQ. Accuracy and attending to task in mathematics were shown to have increased in first-grade children as a result of a program using contingency contracting (Holt, 1971). Ferritor and Buckholdt (1972), investigated performance contingencies on classroom academic performance of 14 third-graders. The task was designated as 100 arithmetic computation problems which were worked on for 20 minutes per day. A random sample of problems in addition, subtraction, division, and multiplication were used, testing arithmetic skills that had been previously taught. Performance contingencies increased the percent of problems correct. Randomly selected multiplication problems can then be an appropriate task for a third-grade student, provided that the child has had previous exposure to those particular mathematical operations.

Shaping, also referred to as successive approximation, is defined by Ferster and Perrott (1968) as an operation used to condition a new performance into the behavior repertoire of an organism. Performances which are emitted by the organism and are approximations of the desired behavior are reinforced. Reinforcement is administered after those performances which are in the direction of the desired behavior, and is withheld after those performances which are distant from the desired behavior. Skinner (1953), used successive approximation in systematically modifying the head raising behavior of a pigeon above a given height. This was done by opening the food tray very quickly whenever the head rose above the line. Skinner assimilates the process of shaping with the art of sculpturing, stating:

> Operant conditioning shapes behavior as a sculptor shapes a lump of clay. Although at some point the sculptor seems to have produced an entirely novel object, we can always follow the process back to the original undifferentiated lump, and we can make successive stages by which we return to this condition as small as we wish. At no point does anything emerge which is very different from what preceded it. The final product seems to have a special unity or integrity of design, but we cannot find a point at which this suddenly appears. In the same sense, an operant is not something which appears full grown in the behavior of an organism. It is the result of a continuous shaping process. (p.91-92)

Wolf, Risley, and Mees (1964) used the shaping technique to get a three year old autistic boy to wear glasses. Candy and fruit were used as reinforcement and administered when the boy exhibited approximations of the desired behavior. The criterion for reinforcement was systematically raised as approximations became more like the desired behavior.

Eventually the boy received reinforcement for wearing his glasses. Vogler and Masters (1970) successfully reinforced stable rates of cooperative behavior in 10 preschool children using the shaping technique coupled with M&M candies. Prentice (1971) showed that shaping could be equally successful, applied in both group and individual situations within the classroom. Attentive behavior was shaped in twelve classrooms ranging from kindergarten to sixth-grade. Shaping techniques can then be successful in changing a behavior through successive reinforcement of approximations of a more desirable behavior.

A reinforcement (RE) menu is defined by Addison and Homme (1965) as a list, either written or pictoral, of a variety of available events which are reinforcing to the subject. The subject may then select from the menu, either before or after the task, what reinforcement he would like to receive upon meeting the contingency. The provision of a variety of activities in which the subject can engage, has proven to maintain the strength of reinforcement over an extended period of time (Glowacki, 1973). Holt (1971) used the RE menu in his reinforcement of two mentally retarded females who performed reading and arithmetic tasks. The menus consisted of block stick figure characatures representing reinforcing activities, drawn on a transparent plastic sheet. In another experiment involving the performance of a first-grade class in reading and arithmetic tasks, Holt (1971) again used an RE menu, depicting stick figures participating in reinforcing activities. Menus were presented to the subjects before the initiation of the task. An RE menu may then be an effective method of presenting a preview of the available reinforcement. The RE menu increased the subject's interest in the reinforcer over an extended period of task time.

The reinforcement (RE) area is referred to as the place where reinforcement is administered (Homme, 1970). The task area (TA) then becomes the place where the task is performed. Homme (1970) contends that one method of emphasizing a difference between the task and the reinforcement is through spatial separation; designating a place for the task events and another place for the reinforcing events.

Sidman (1960) defines a steady state as that where the target behavior does not fluctuate in its consistancy over an extended period of time. Sidman poses the question of how one selects a steady state criterion. There is no rule to follow, for the criterion depends on the behavior being investigated and the experimental conditions which it is under. Long-term discriptive studies are helpful in that they provide an opportunity to observe the target behavior and estimate the degree of stability it can maintain. Based on these observations, a criterion can then be selected for determining a steady state.

The hypothesis, based on the survey of the literature, was that reinforcement occurring at extended spatial distances from the task area would not be as effective because of a disassociation between the task and the reinforcement. Reinforcement occurring spatially contiguous to the task area would not be as effective because of the negative or aversive connotation of the task stimuli. This would leave a spatial increment somewhere in between both extremes where reinforcement would be most effective. The purpose of this experiment was to answer that question; is there an optimal RE area-task area separation where reinforcement can be administered to facilitate high task performance? If so, this experiment would attempt to determine the effective distance interval from the task area where reinforcement could be presented, to attain a high steady state in task performance.

Method

A. Subjects

The subjects (Ss) were two third-grade boys from Robert G. Buzzard Laboratory School at Eastern Illinois University in Charleston, Illinois. Their selection for this experiment was based upon the applicability of the task to their academic performance as determined by observations of their teachers, academic achievement related to the task during the present school year, and a pretest task unit similar to those used in the experiment. The Ss were in a classroom arithmetic group designed to teach memorization and application of simple multiplication skills. Their academic achievement in this arithmetic group was satisfactory, indicating that work was still needed in multiplication to attain the level of a more advanced arithmetic group. There was enough classroom exposure of the child to multiplication operations for a multiplication task to be used. When given the pretest task unit, the Ss completed them showing that improvement was possible in both rate and accuracy. These points indicated that the task of solving multiplication problems by the child, required refinement of those skills which learning them demanded.

B. Apparatus

Sessions took place on the vacated seventh-floor of Andrews Hall dormitory at Eastern Illinois University.

The arrangement of the dormitory floor was, 14 rooms on each side of the hall. All 14 rooms on each side were equal distance to the one next to it, with approximately 1.07 decameters (35 feet) from the center of one room to the center of the next one. The arrangement of every room was identical, consisting of two desks, two beds, two closet areas, and a large window.

One task unit was designated as 20 single-digit multiplication problems, with numbers taken from the Rand Corporation book, A Million Random Digits with 100,000 Normal Deviates. The digits were typed into 20 multiplication problems on a 2.16 decimeter by 2.71 decimeter (8½ inch by 11 inch) sheet of paper, using an IBM Executive primary print typewriter (Appendix A).

Reinforcement was presented in a RE menu. The RE menu was represented by stick figures drawn with a wax pencil on a 2.16 decimeter by 2.71 decimeter (8½ inch by 11 inch) transparent plastic sheet. The stick figures depicted a person engaged in each of the four reinforcement activities (Appendix B). Reinforcement activities were selected through observations of the child, confiding in school records, interviewing the child's teachers and parents, and talking with the child himself. Consulting these various sources enabled selection of those activities which the child enjoyed doing most. These activities were effective reinforcers.

C. Procedure

Shaping Phase. A shaping process proceded the introduction of the titration to bring the rate and accuracy of the Ss' performance to a sensitive state. Sensitive state, which was an arbitrary rate, was defined as the level where the S met his highest criterion approximately 50% of the time.

One session was designated as the administration of one task unit and its consequences. Task units were done in a room at the end of the hall designated as the task area (TA). The S was seated in the TA at a desk and shown the RE menu. The task unit was then presented and the S timed with a stopwatch to determine his rate in seconds. The problems were checked for their accuracy in the presence of the S. Only the problems which were correct were counted. The criterion during the Shaping Phase was first set at a level where the S could meet the response requirement without much difficulty, to introduce him to the reinforcer. The criterion was raised systematically, one problem and five seconds per task unit, to produce the shaping. When the S failed to meet the criterion, it was lowered to the previous criterion and then shaping again continued. Performance was adjusted until ultimately the sensitive state was attained. At this sensitive state, the S consecutively met the criterion approximately 50% of the time.

After meeting the response requirement, the S was taken by the experimenter(E)to the RE area. Reinforcement consisted of five minutes in the RE area doing any one or a combination of the four selected activities represented on the RE menu. During the Shaping Phase, the RE area was located in a neutral area, a room separate from the hallway section. This prevented the S from associating the RE area of the Shaping Phase with RE areas to be used with the titration phases.

Titration Phase 1. With the sensitive state attained during the Shaping Phase, titration was introduced. The S was seated at the desk in the TA and exposed to the RE menu. The S was presented with the task unit, with the contingency set at the performance dictated by the sensitive state. The E recorded the time in which the S completed the task unit, and the number of problems were totaled in the presence of the S. If the S met the criterion (referred to as a correct response) during the first task unit, he was reinforced (as in the Shaping Phase, five minutes in the RE area) at ground zero. The TA was then used as the RE area.

To maintain a constant time lapse between the TA and the RE area, the E recorded the time in which the S could walk from the TA to the farthest RE area. This time interval was then maintained between every TA and RE area during Titration Phase 1. Upon completion of the task unit, the S was walked by the E out of the TA and into the hall. The E and the S remained still until enough time remained in the interval to walk at a normal pace from the TA to the RE area. The S was then walked down the hall, and at the end of the time interval, was escorted by the E into the RE area, wherever it was located.

Each successive time that the S met the criterion, he was moved up one room (approximately 1.07 decameters) where he was reinforced in that RE area. RE areas outside of the TA were designated as TA+1, TA+2, TA+3, ... TA+13. When the S failed to meet the contingency (referred to as an incorrect response), the error was recorded by the E and the S failed to receive reinforcement. The following time that the contingency was met after an incorrect response, the RE area was correspondingly moved back toward the TA. Incorrect responses by the S in the TA necessitated an equal number of correct responses to cancel them out before the S could proceed to TA+1 for reinforcement. Correct responses by the S in TA+13 necessitated an equal number of incorrect responses to cancel them out before the S could move back to TA+12 for reinforcement. The S was then controlling his RE area through the accuracy of his task performance.

Titration Phase 2. Still maintaining the sensitive state criterion, an arbitrary point of TA+10 was selected from which to begin Titration Phase 2. TA+10 was selected so that the responses of both Ss could be observed at the opposite extreme of the reinforcement continuum. TA+10 also allowed a fluctuation upward to be observed before reaching the physical limits of the design at TA+13.

The S was seated at the desk in the TA and exposed to the RE menu. The S was presented with the task unit, with the contingency set at the performance dictated by the sensitive state. The E recorded the time in which the S completed the task unit, and the number of problems correct were totaled in the presence of the S. If the S met the criterion (referred to as a correct response) during the first task unit, he was reinforced (as in Titration Phase 1, five minutes in the RE area) at TA+10.

To keep a consistant time lapse between the TA and the RE area, the E recorded the time at which the S could walk from the TA to the farthest RE area. This time interval was maintained between every TA and RE area during Titration Phase 2. Upon completion of the task unit, the S was walked by the E out of the TA and into the hall. The E and the S remained still until enough time remained in the interval to walk at a normal pace from the TA to the RE area. The S was then walked down the hall and at the end of the time interval, was escorted by the E into the RE area, wherever it was located.

Each successive time that the S met the criterion, he was moved up one room (approximately 1.07 decameters) where he was reinforced in that RE area. When the S failed to meet the contingency (referred to as an incorrect response), the error was recorded by the E and the S failed to receive reinforcement. The following time that the contingency was met after an incorrect response, the RE area was correspondingly moved back toward the TA. Incorrect responses by the S in the TA necessitated an equal number of correct responses to cancel them out before the S could procede to TA+1 for reinforcement. Correct responses by the S in TA+13 necessitated an equal number of incorrect responses to cancel them out before the S could move back to TA+12 for reinforcement. Thus, the S again controlled his RE area through the accuracy of his task performance.

Results

The hypothesis was not supported in that reinforcement would be most effective in some spatial increment between both extremes of the RE continuum. The criterion for steady state in RE-task area distance was based upon the observation of the target behaviors during a pilot study (Glowacki, 1973). This allowed for a three area fluctuation interval of the RE area during seven consecutive RE sessions. During Titration Phase 1, Subject 1 (S1) exhibited a steady state in the reinforcement area, of 22 consecutive RE sessions in the TA. In Titration Phase 2, a steady state was observed in that reinforcement was experienced in 15 consecutive RE sessions in the TA. At no time during both titration phases did S1 fluctuate out of the TA for reinforcement. The modal value of where reinforcement most frequently occurred was the TA. Subject 2 (S2) during Titration Phase 1, exhibited a steady state in the reinforcement area, of 14 consecutive RE sessions from TA to TA+2, and 12 consecutive RE sessions from TA to TA+1. At one time during Titration Phase 1, S2 fluctuated to TA+3 for reinforcement, but this did not indicate a transition state. This fluctuation to TA+3 was not observed again during either titration phase. In Titration Phase 2 a steady state was observed in that reinforcement was experienced in 17 consecutive RE sessions from the TA to TA+1. The modal value of where reinforcement was most frequently occurred for S2 was the TA. Reinforcement not previously stated for both Ss occurred out of the steady states during Titration Phase 2. The RE sessions were observed as a transition state, during the rapid fluctuation which brought the Ss back to the TA. Figures 1 and 2 show the fluctuation of the reinforcement areas for both Ss in Titration Phase 1 and in Titration Phase 2, respectively.

Criterion for steady state in task performance was based upon the observation of the target behaviors during a pilot study (Glowacki, 1973). This allowed for zero problem and twenty-nine second fluctuation interval of task performance, during seven consecutive RE sessions. During the steady state in RE area fluctuation, steady states in task performance were also observed. In Titration Phase 1, Ss 1 and 2 exhibited a zero problem and nine second and zero problem and eight second fluctuation respectively. Steady states in performance during Titration Phase 2 for Ss 1 and 2 were both a zero problem and eight second fluctuation.

Variability if the correct-incorrect response percentages during the Shaping Phase was 50% to 50% as defined by "sensitive state." In Titration Phase 1, S1 exhibited a 46% to 54% correct-incorrect response percentage. During the transition state between TA+10 and the TA in Titration Phase 2, the correct-incorrect response percentage dropped to 9% to 91%. When S1 was back in the same area denoted by the the steady state shown in Titration Phase 1 (TA), the correct-incorrect response percentage recovered to 41% to 59%. Observations for S1 and S2 were similar. In Titration Phase 1, S2 exhibited a 56% to

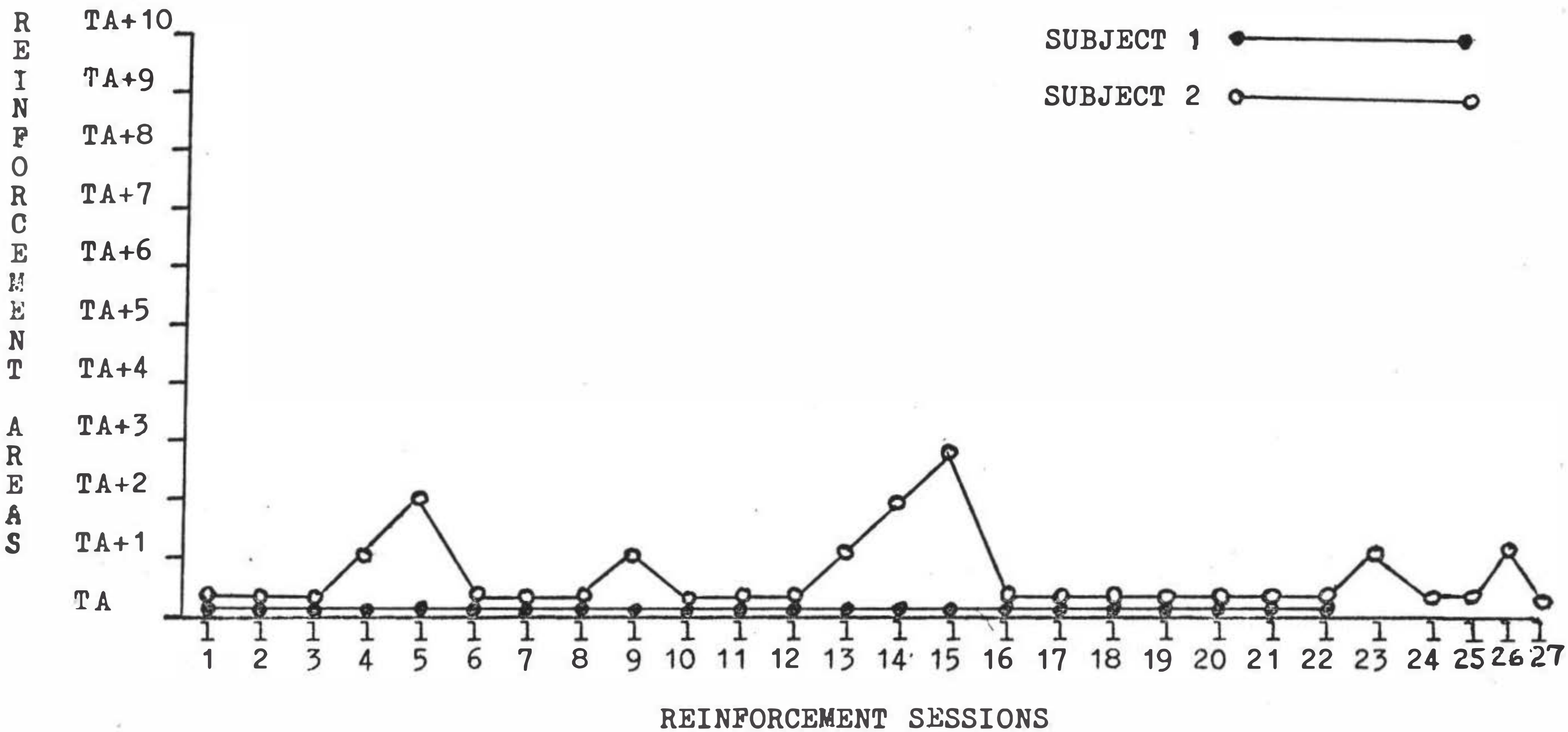

Fig. 1 Titration Phase 1. Reinforcement areas as a function of reinforcement sessions for Subjects 1 and 2.

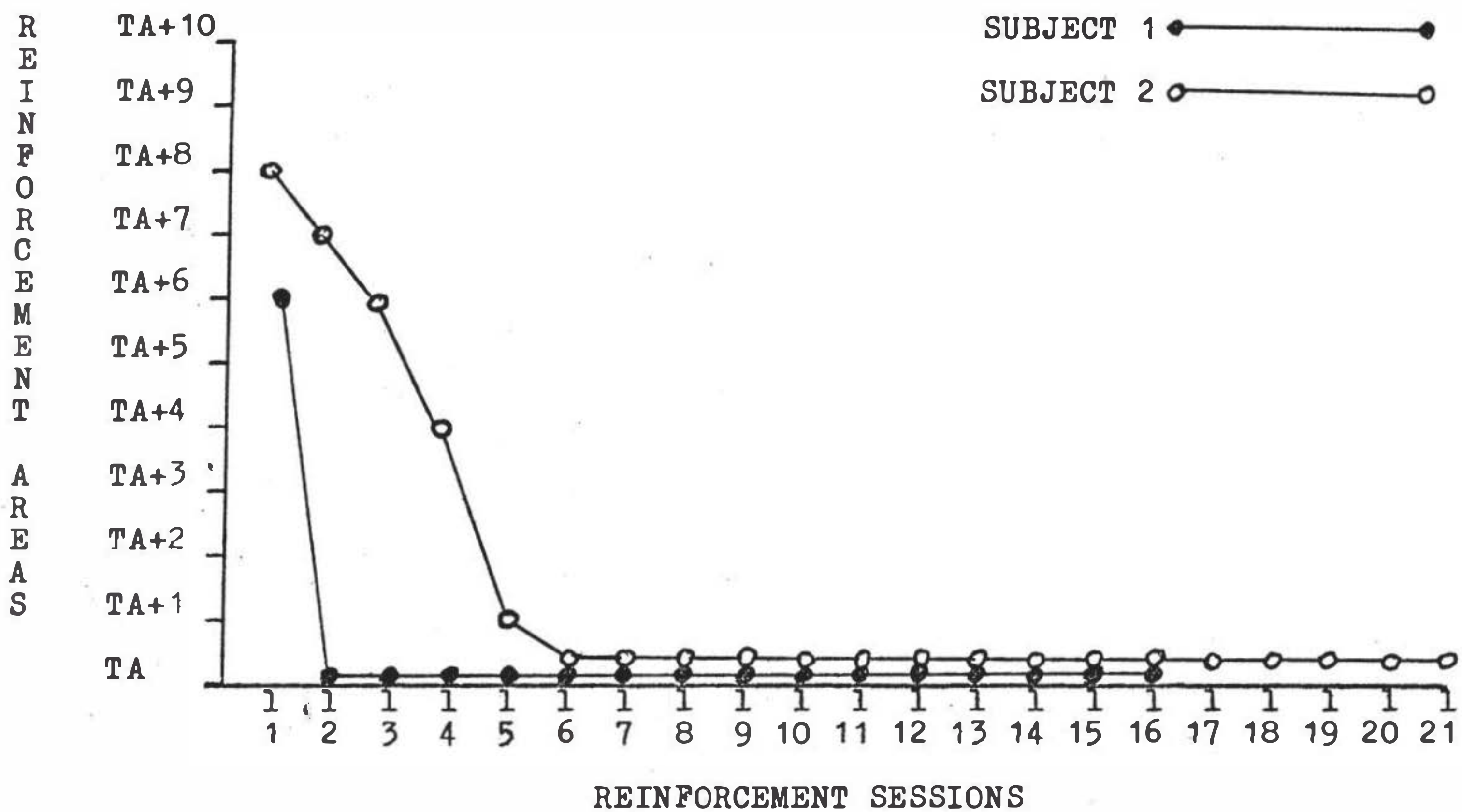

Fig. 2 Titration Phase 2. Reinforcement areas as a function of reinforcement sessions for Subjects 1 and 2.

44% correct-incorrect response percentage. During the transition state between TA+10 and TA+2 in Titration Phase 2, the correct-incorrect response percentage dropped to 33% to 67%. When S2 was back in the RE areas denoted by the steady states shown in Titration Phase 1 (TA to TA+2), the correct-incorrect response percentage recovered to 47% to 53%. The fluctuation of both S1 and S2 back to the areas of steady state shown in Titration Phase 1, resulted in an improvement in the correct-incorrect response percentages of 32% and 14% respectively during Titration Phase 2. Table 1 shows the variability in the correct-incorrect response percentages for both Ss during the Shaping Phase, Titration Phase 1, Titration Phase 2 (out of the steady state areas shown in Titration Phase 1), and Titration Phase 2 (within the steady state areas shown in Titration Phase 1).

TABLE 1

Correct-Incorrect Response Percentages

Phase	Subject 1	Subject 2
Shaping Phase	50%-50%	50%-50%
Titration Phase 1*	46%-54%	56%-44%
Titration Phase 2**	9%-91%	33%-67%
Titration Phase 2***	41%-59%	47%-53%

* RE sessions began at the TA. Steady states shown during Titration Phase 1 were, TA for S1 and TA to TA+2 for S2.

** RE sessions began at TA+10. Percentages occurred outside of the steady state areas shown in Titration Phase 1.

*** Percentages occurred within the steady state areas shown in Titration Phase 1.

Discussion

The results of this experiment have shown that there is an optimal RE-task area distance. Reinforcement in this area appears to be most effective in maintaining a high steady state in task performance. The optimal area for the administration of reinforcement is shown to be the task area itself. During Titration Phase 1, both Ss began and stayed for the mostpart, in the task area for reinforcement. In Titration Phase 2, both Ss began at TA+10 and immediately fluctuated back to the task area. The observation of identical fluctuation in both subjects, established intersubject reliability between S1 and S2. The explanation for the strength of the TA as an area for reinforcement may lie in Premack's Differential Probability Hypothesis (1965). Premack states that a High Probability Behavior (HPB) is used to reinforce a Low Probability Behavior (LPB). The LPB increases in occurrence and strength until it eventually becomes a HPB. That new HPB then has the qualities where it can also be considered reinforcing. After a constant pairing of a task and a reinforcer, the task may take on reinforcing qualities. (Holt, 1971). After a constant pairing of the TA with the RE area, the TA may take on reinforcing qualities, making it a more effective area for the administration of reinforcement.

Another area for consideration is the role of the experimenter as a reinforcer. The aversiveness of the TA in the hypothesis was not supported since the TA was the area in which reinforcement most frequently occurred. The idea of interpersonal distance may be applied in another respect. In administering and scoring the task, the E had most of his interaction with the S in the TA. During reinforcement, the S spent the total time alone in the RE area, since the E was not included in the RE menu. If the S found this interaction with the E reinforcing or viewed him as a positive stimulus, then according to the research on interpersonal distance, the S would tend to maintain a closer physical proximity to him. Because the TA was also used as the RE area, there occurred a pairing of the E with this area during the administration of the task. From this, the RE area would be a stronger area for reinforcement because of its association in proximity with the E.

Dispite the fact that the hypothesis was not supported, certain aspects of its founding were supported by the results of this research. Considering spatial contiguity, the closer the response is to the stimulus, the better is the performance; the farther the response is from the stimulus, the worse is the performance. Similarly, the closer the Ss were to the reinforcement, the better was the task performance; the farther the Ss were from the reinforcement, the poorer was the task performance. The contiguity of the RE area and TA thus increased the tendency for their association to be learned. Learning this association is critical for reinforcement to be effective.

The distance factor in between the TA and the RE area varied as a function of the titration procedure. The manner by which the Ss encountered the distance variances between the TA and the RE area was by walking. Even though walking was minimal and for the mostpart only observed in Titration Phase 2, the aversity of the walking could have made the reinforcement at ground zero in the TA, more favorable. This is another factor that must be given attention.

Lloyd Homme (1970) in his book, How to Use Contingency Contracting in the Classroom, states that in the school setting, "Whether it is essential to have the RE Area geographically separated from the Task Area is not known at the present time." (p.33) Generalizations can be made from the results of this experiment, which may be of great value when applied to the use of operant techniques within the educational setting. A child is put on a contingency contract and is systematically reinforced for his performance in arithmetic, or any other academic area. There is a specific distance where reinforcement administered by the teacher is most effective, to elict a high steady performance by that child. It is then more advantageous for that child's learning, to designate the area of the task (most likely the classroom) as the RE area, rather than some other area outside or down the hall.

Other questions arise from this experiment which are areas for further research. What are the variables, if any, that control the effective distance factor of reinforcement, and under what conditions will that distance factor change?

To answer this question, it would be ideal to replicate this experiment in a school setting, using a cross-section in academic achievement, cronological age, and mental age of subjects, and a variety of different tasks. Will there be a fluctuation in the effective reinforcement area when the subject, the task, the setting, or any combination of these variables are manipulated?

Hochstetter (1973), titrated intertrial interval (ITI) in matching-to-sample tasks using pigeons. One group of three birds started at 0 seconds ITI, and a second group of birds started at 60 seconds ITI. With ITI intervals set at 2 seconds, two consecutive correct matches decreased ITI one interval; a single mismatch increased ITI one interval. The 60 second group worked down to a steady state fluctuation between 0 and 2 seconds, with a mode of 0 seconds. The 0 second group remained close to 0 seconds, similarly fluctuating between 0 and 2 seconds, and exhibiting a 0 second mode. In both experiments, the group beginning from a zero point remained there, while the group beginning at an opposite extreme, fluctuated back to the zero point. These results are interesting in that 0 seconds is shown to be the preferred time interval, corresponding with ground zero as the preferred spatial interval. These similarities between humans and animals in the titration of space and time shows a broad spectrum for future research. Here are just some of the many areas that can be probed in later experiments, initiated by and using these research findings.

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APPENDIX A

SAMPLE TASK UNIT

9 X 7 =

4 X 3 =

2 X 1 =

3 X 9 =

8 X 7 =

6 X 4 =

0 X 5 =

3 X 9 =

2 X 3 =

5 X 6 =

7 X 9 =

0 X 4 =

8 X 2 =

3 X 6 =

0 X 2 =

5 X 8 =

9 X 9 =

3 X 3 =

7 X 2 =

8 X 8 =

APPENDIX B

SAMPLE REINFORCEMENT MENU