Application of Delayed Conditioning Procedures to the Behavior Problems of an Elementary School Child

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APPLICATION OF DELAYED CONDITIONING PROCEDURES TO THE BEHAVIOR PROBLEMS OF AN ELEMENTARY SCHOOL CHILD

by

Michael L. Schwarz

A Thesis Submitted to the Faculty of the School of Graduate Studies in partial fulfillment of the Degree of Master of Arts

Western Michigan University Kalamazoo, Michigan March 1968
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I wish to express my sincere thanks to Dr. Robert P. Hawkins for his invaluable counsel throughout the course of this study. I would also like to acknowledge the helpful assistance of Dr. William Hopkins and Dr. Malcolm Robertson who served as members of my thesis committee. I am also very grateful to Mrs. Marianne Speck, the subject's classroom teacher, for her kind co-operation. Finally, this investigation could not have been possible without the support and encouragement given by the Kalamazoo Valley Intermediate School District and the Director of Special Education, Mr. Marland E. Bluhm.

Michael L. Schwarz
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ABSTRACT

An experiment was conducted in which delayed reinforcement techniques were applied to modify the behavior of a sixth grade child. The following behaviors were chosen for modification: size of numbers, face-touching, posture, and voice loudness. A videotape recorder was used to record the subject's behavior during the school day. The subject was shown these tapes of her behavior after school and was reinforced for desirable behaviors which she had exhibited during the day. The results indicated that the delayed reinforcement procedures could be successfully used in obtaining the desired behavior changes. The findings were discussed in terms of past investigations of delayed reinforcement. Implications for future study and application in this area were presented.
INTRODUCTION

The use of reinforcement principles to modify behavior is an extension of learning principles which have been discovered in the study of behavior in lower animals. The principles used in behavior modification can be divided into two general classifications, namely those of respondent conditioning with their roots in the works of Pavlov, Sechenov, Bekhterev, and Bykhov, and those of operant conditioning which are grounded in the works of Watson, Thorndike, Hull, Mowrer, and Skinner.

Although much work was being conducted on the development of learning principles during the first half of this century, it was almost exclusively performed on lower animals rather than on humans. The most prominent researchers during that time who attempted to apply learning principles to humans were John B. Watson, William Burnham, and Mary Cover Jones (Ullmann and Krasner, 1965). The now famous experiment of Watson and Rayner, (Ulrich, Stachnik, and Mabry, 1966) in which a young child was taught to fear a white rat, was performed as a challenge to psychoanalytic interpretation of behavior. This research demonstrated that maladaptive behavior could arise from more than instinctual sources, as it was then believed.
Jones (1924) also performed an experiment which had important implications for future work. She was able to "cure" a young child of a phobia for animals and fur by presenting a rabbit at a great distance from the child while he was eating. Gradually, the rabbit was brought closer and closer, always while the child was eating. Soon the child was able to touch the rabbit and the complete phobia was "cured." This method was diametrically opposed to views of that time since it was believed that one could not treat a "symptom" effectively without attempting to eliminate the "underlying cause." The idea that one must discover underlying causes for behavior is often referred to as the "medical model" and is one which still has many adherents today. Associated with the medical model is the belief that if a symptom is cured, another will take its place. If this principle held true, it would strike at the heart of behavior therapy. As Ullmann and Krasner (1965) point out, however, there has been no real evidence presented for symptom substitution; on the contrary--evidence is being compiled from the application of conditioning techniques that demonstrates that symptom substitution seldom occurs. When it has occurred, the new "symptom(s)" may merely be a part of a hierarchy of responses, all of which must be dealt with before the more adaptive behavior becomes dominant.
In recent years there has been an increasing number of experiments applying conditioning procedures to humans. The rise has been due partly to the growing realization that psychotherapeutic methods were not so effective as had been hoped, and that the success of the experimental work with animals held promise for similar work with human beings.

The application of reinforcement principles to behavior disorders, sometimes referred to as the "psychological model," is quite different from more traditional approaches.

"On the basis of present evidence, it appears that children's behavior disorders can be viewed most profitably, both in diagnosis and remediation, in terms of the problem behavior itself, rather than in terms of deviant personality types or disease entities. It is further assumed that it is most useful to attempt to conceive of problem behavior in terms of external observable events, rather than internalized hypothetical constructs like the unconscious, the ego, and so on... The goal in treatment is the elimination of the problem behaviors, and when this is achieved, the child is viewed as no longer exhibiting any disorder." (Quay, Werry, McQueen, and Sprague, 1966)

Numerous studies have made use of reinforcement principles to modify a variety of children's behavior problems. With severely disordered behaviors such as autism, expansion of the behavioral repertoire has been possible (Ferster and DeMyer, 1962), as well as the elimination of tantrums, sleeping and eating problems, and
the extension of the verbal and social repertoire (Wolf, Risley, and Mees, 1964; Hewett, 1967). Co-operative behavior has been shaped in schizophrenics (Hingtgen, Sanders, and DeMyer, 1965) as well as in normal children, vocalizations were shaped in a mute child (Kerr, Myerson, and Michael, 1965), vomiting was eliminated in another child (Wolf, Birnbrauer, Williams, and Lawler, 1965), and toilet training was achieved in children who had long resisted training (Giles and Wolf, 1966). With less severely disturbed children, success has been obtained in reducing stuttering (Flanagan, Goldiamond, and Azrin, 1958), thumbsucking (Baer, 1962), and excessive scratching (Walton, 1960; Allen and Harris, 1964).

A number of studies have recently demonstrated the successful use of reinforcement principles in the school classroom. Reinforcement techniques have been found useful in modifying the academic as well as the social behaviors of the child. Several studies have merely used the systematic application of social reinforcement in the form of teacher attention to modify the child's behavior. For example, working in a special classroom for emotionally disturbed children, Zimmerman and Zimmerman (1962) eliminated unproductive behaviors through the use of contingent teacher attention. In the nursery school, researchers have reduced such behaviors as
excessive crawling (Harris, Johnston, Kelley and Wolf, 1964), crying and whining (Hart, Allen, Buell, and Wolf, 1964), isolate play (Allen, Hart, Buell, Harris, and Wolf, 1964), and excessive passivity (Harris, Wolf, and Baer, 1964) by appropriate presentation of teacher attention for these activities or their opposites.

The use of reinforcers other than social has also been demonstrated to be effective in classroom work. Patterson (1965), experimenting in a regular classroom, used lights and a counter on a child's desk to reinforce attention to classwork and, in turn, diminished hyperactive behavior demonstrated by the child. The counter accumulated points which could later be exchanged for candy. Hawkins, McArthur, Rinaldi, Gray, and Schaftenaar (1967), working in both regular and special classrooms, used tokens "backed up" by small toys, play periods, magazine reading time, candy, and social reinforcement as rewards for appropriate classroom behaviors. With these techniques, as well as punishers in the form of time spent in an isolation room, the authors were able to improve attention to schoolwork, reading and writing productivity, handraising, remaining in one's seat, and talking out of turn in class.

Most recently, techniques have been developed for work with the class as a whole. A rather unique demonstration of behavioral techniques was conducted on a
group of nursery school children by Homme, de Baca, De-vine, Steinhorst, and Rickert (1963). They used the Premack principle, which states that a behavior of a high probability can be used to reinforce behaviors of low probability. They showed that when high probability behaviors such as running around the classroom and general rowdy play were made contingent on low probability behaviors of sitting quietly and listening to the teacher, these low probability behaviors were increased in frequency of occurrence.

Quay et al. (1966) attempted to increase the attentiveness of five pupils. The pupils were observed serially for ten second intervals with fifteen such intervals for each child during a given period. A light and counter were placed on each student's desk and each was told that if he was attending to the teacher, a light would go on occasionally and at the end of the period he would receive a piece of candy for each light flash. As the authors stated, the conditioning on a fixed ratio schedule of one to five would allow for greater resistance to extinction after acquisition, but this would also require a greater number of trials to acquisition than a continuous schedule. They hoped, however, that the conditioning of five children at once on the intermittent schedule would be more efficient than the les-
ser number of trials needed for acquisition for each child individually.

Hewett (1967) reports results with a classroom of emotionally disturbed children and describes a design which he feels has general applicability to special classrooms. His primary emphasis is on the teacher as the "behavioral engineer." He describes a hierarchy of behaviors which he feels must be learned by the child to achieve the final goal of being a socially and academically productive person who can be sent back to the regular classroom. The hierarchy includes the programming of materials at the appropriate level of difficulty and proper reinforcement of successively more advanced social and academic tasks. Peter (1965) describes the important implications for behavior modification techniques in regular classrooms. In addition, Quay et al. (1966) state the following:

"Techniques developed in the special class setting should ideally have some general applicability in the regular classroom. In the last analysis, the aim should be that of prevention, rather than that of remediation--of preventing children from becoming discordant enough in their behavior to warrant special class placement, rather than attempting to modify disturbing behavior once the situation becomes intolerable."

Several investigators (Whelan and Haring, 1966; Valett, 1966) have suggested designs for the implemen-
tation of reinforcement techniques in the regular school classroom. Valett presents a special token and star award system incorporating social reinforcement and status awards which can be readily implemented in a regular classroom.

Thus it can be seen that there have been a number of studies and designs for applying reinforcement procedures in the classroom to improve the child's social and academic behaviors. In all studies mentioned above, however, the reinforcement was dispensed immediately after the response. Immediate reinforcement is not always practical in a school classroom, however, and is not even possible for a parent to use when trying to modify the behavior of his child at school. Therefore, delayed reinforcement techniques would be useful to individuals who wish to modify a child's behavior outside of the immediate setting in which the behavior occurs.

The literature on the effects of delay of reinforcement in humans is still quite sparse, but the data available tend "to agree in essence with the data from animal studies" (Renner, 1964). Renner (1964), in a comprehensive review of literature on delayed reinforcement, concludes that "it appears that delay during acquisition limits the strength of a response as long as some learning measure is used; however, when resistance to extinc-
tion is used as a measure, then the effect appears to be similar to the partial reinforcement effect." Renner continues, however, that "the role of cues, both external and response-produced, appears to be important and complex. It was suggested that delay facilitates the utilization of cues, but that the cues may have varied effects, depending upon the experimental conditions."

The majority of human studies have indicated that the acquisition of a motor or verbal response is not impaired by delay of reinforcement (Bilodeau and Bilodeau, 1958; Denny, Allard, Hall, and Rokeach, 1960; Brackbill and Kappy, 1962). Some studies (Greenspoon and Foreman, 1956; Saltzman, 1951; Walters, 1965) have found that delay of reinforcement does impair the rate of acquisition of a response. The discrepancy between these findings has been attributed by Brackbill and Kappy (1962) to the presence or absence of response-produced cues in the experiment. They state the following:

"If the subjects under investigation are capable of making response-produced cues and if experimental procedures allow these cues to be used, then potential deleterious effects of delay on learning efficiency will be reduced by virtue of a bridging or mediating effect from response to reinforcement."

If the subjects are working in the absence of cues in a trial and error manner, then the delay will affect the performance.
Support for Brackbill and Kappy's hypothesis was provided by Lipsitt and Castaneda (1958) who demonstrated that children can learn discrimination tasks with delayed reinforcement, but that they prefer and respond faster to immediate reward. Hockman and Lipsitt (1961) demonstrated that children can learn simple discrimination tasks as well with delayed as with immediate reinforcement. Delayed reward, however, had a deleterious effect on learning when the task was sufficiently difficult. Erickson and Lipsitt (1960) pointed out, however, that if the subject was instructed to pay attention to the goal in a discrimination task, delayed reinforcement did not impede learning of a difficult task.

Another important factor influencing the acquisition of a response is the effect of practice. As the delay of feedback is increased, usually the number of practice trials decreases which, therefore, can hinder acquisition. As Renner pointed out (1964), with short intervals, this may only have limited effects, but when intervals of seven days were used as in the studies of Bilodeau and Bilodeau (1958) and Denny et al. (1960), it becomes an important factor. In fact, Bilodeau and Bilodeau (1958) and Denny et al. (1960) feel that the crucial factor in the performance decrement was the delay between responses rather than the delay of knowledge of
the results.

The effect of delayed reinforcement on retention in humans is similar to results of studies on infrahuman organisms in that delay enhances retention. In Brackbill and Kappy's (1962) study, better retention was demonstrated a day later in subjects whose reinforcement was delayed five seconds over subjects who received immediate reinforcement, and even better retention with subjects with whom a ten second delay had occurred. Subjects with thirty second delay did not show this increased retention effect, which the authors felt was due to lack of strength of response-produced cues. Brackbill and Kappy could show no difference in retention between the groups eight days later. The authors felt that increased retention or resistance to extinction was "enhanced in proportion to the extent that distinctive response cues have been utilized." They described the effect of delayed reinforcement on extinction as analogous to the effect of partial reinforcement.

From the above findings, it appears that if procedures could be developed to apply delayed reinforcement techniques to the classroom, they could serve the useful therapeutic function of modifying a child's behavior outside the setting in which it occurred. Past and present attitudes toward the use of the classroom for therapeutic
purposes, however, have been mostly unfavorable. The usual procedure for dealing with a child's behavior problem has been to send him to clinics and other sources of professional help for therapy. Individual therapy, however, is quite burdensome economically and can only be given for short periods of time a week. The classroom, in contrast, is a setting in which the child spends a great deal of time, and thus provides an excellent opportunity to bring about behavior changes.

The use of the teacher as a behavioral engineer for an individual child during classtime is not always feasible since she must also attend to twenty or more other students. Delayed reinforcement procedures to modify behavior which has occurred during classtime would therefore be of significant value. The most intensive work in modifying behavior is necessary when initially establishing a new appropriate behavior or initially eliminating an undesirable one. Delayed reinforcement procedures would provide school counselors, social workers, psychologists, and teachers with a technique to intensively modify a child's behavior during free periods of the day or after school. Once the behavior is acquired or eliminated, only a minimal effort by the teacher would be required to maintain it during classtime.

Furthermore, delayed reinforcement procedures would
be helpful to parents who wish to modify their child's behavior at school. There has always been difficulty obtaining an accurate, day-to-day record of a child's performance in school from which one could judge his progress and could determine what changes might be needed. Report cards and conferences with the teacher are much too infrequent to be very helpful, and the verbal report from the child is often unreliable. This is especially true of children who are experiencing social and academic difficulties in school. Therefore, it is necessary to develop techniques which would supply counselors, social workers, parents, and teachers with a more detailed and accurate record of a child's behavior. It is also important to design workable programs by which the child's behavior might be modified outside of the immediate setting in which it occurs.

The present experiment was designed to determine whether or not delayed reinforcement techniques could be used to modify the deviant behaviors of a maladjusted child in a regular classroom. It was hoped that the subject's social and academic behaviors could be modified so that she would be able to function more appropriately in her environment.
METHOD

Subject

The subject was a twelve-year-old girl, Karen, who was a student in a regular sixth grade classroom. She was described by her teacher as a very homely child, partly because she was poorly dressed and groomed, her posture was poor, she had a bad case of acne, and she was quite tall for her age (5'7"). The teacher suggested that the subject had a "poor self-image" and was very "self-conscious." The subject sought social interaction with her peers, but was usually ignored by them. Although Karen worked very diligently and received average grades, she took up an undue portion of the teacher's time by asking frequent and sometimes bizarre questions. An example of a bizarre question was given during a Monday morning Mathematics test when the subject raised her hand and asked, "What's on tap for Wednesday?" In Mathematics, Karen made needless errors in her work, which the teacher felt stemmed partly from her writing her numbers too small and failing to keep the numbers in proper columns. Karen usually did her work in a slouching position with her face within three or four inches of her work. Although the girl had often complained that her eyes hurt her, an eye examination
just prior to the study had indicated that she had normal vision. She also touched her face frequently—a behavior which may have been quite irritating to her acne. When reciting in class, Karen spoke at a very low volume which was almost inaudible to others in the room.

Apparatus

The equipment used in the experiment were a Panasonic Videotape Recorder (Model NV-8000), a Panasonic television camera, and a television monitor. The loudness level indicator on a Concord tape recorder (Model 350) was used to measure voice loudness. Several stopwatches were also required. Poker chips, which were exchangeable for gifts, were used as token reinforcers for specific behaviors.

Procedure

An observer was sent to the subject's classroom for several days to determine what specific behaviors were included in the global description of the problem given by the teacher. From these observations and from recommendations by the teacher, the following behaviors were selected for use in this study: (1) the size of the subject's numerals in Mathematics; (2) the amount of time the subject spent touching her face; (3) the sub-
ject's posture while working; and, (4) the subject's voice volume while reciting. One additional behavior, the subject's frequent and sometimes bizarre questions, was also selected for modification, but during the initial weeks of the investigation, the bizarre questions were posed by the subject too infrequently to warrant modification. It was also discovered that Karen most frequently asked questions about Mathematics, a subject with which she was having a great deal of difficulty. During the remainder of the day, she asked no more questions than the other students. Therefore, the frequency of the subject's asking questions and their alleged bizarre quality did not appear to be inappropriate to the investigator.

A television camera enclosed in an inconspicuous box was placed in the classroom several feet from the subject's desk to record her behavior during two periods of the day. The camera was placed in such a way that it appeared to be focused on the class as a whole rather than only on the subject. A microphone was also placed in the classroom three feet from the subject's desk to record her verbal behavior. The camera and microphone were connected to a videotape recorder and monitor which were located in a closet adjacent to the classroom. The apparatus could be turned on in the
closet or from a timer in the teacher's desk.

The teacher turned the timer on for approximately twenty minutes two times a day, thereby obtaining two videotape recordings daily. One recording was made during the Mathematics period, and one during Spelling. The Mathematics period included reviewing the previous day's assignment as well as beginning work on the new lesson. The first twenty minutes of Spelling included dictation of spelling sentences and their correction. These subject areas were chosen because they were presented uniformly throughout the week and involved both writing and recitation.

The data on the behaviors which were studied were gathered in a variety of ways. The size of the subject's numerals were measured by collecting her Mathematics assignments during the experiment and by measuring a sample of 100 numbers from each day's work. The sample was taken by measuring twenty numbers from the problems 1/4, 1/2, and 3/4 of the way through the assignment, as well as the first and last problems of the assignment. An average of the size of each day's numbers was then computed.

The data on the subject's frequency of touching her face and on posture were taken by viewing the videotapes after school. Face-touching was defined as
any contact between an object and the subject's head above her collar. A touch could be made with her hands or any other object such as a pen, book, or desk-top. A stopwatch was used to record the time which the subject spent touching her face. The raw time data were converted into "percent of time touching face."

The data on the child's posture consisted of the amount of time she spent in each of the two posture positions described below. The camera was positioned in a fixed location, and on the wall behind the subject, a line was placed dividing the wall into an upper area and a lower area (Point A, Fig. 1). The subject's desk, with attached chair, was kept in a constant location between the camera and the wall by putting tape marks on the floor and by requesting the subject to keep her desk on these marks. The teacher checked occasionally to see that the subject's desk was positioned on the marks.

Figure 1

Equipment Placement
The amount of time the subject was observed to have her head below Point A was recorded on a stopwatch. These data were converted to a percentage of the total time.

The subject's voice volume was recorded on the videotape and then played into a tape recorder having a loudness indicator. The number of needle inflections above a specified level on the loudness indicator was then counted. A count was also made of the number of words she spoke. Thus, it was possible to calculate the ratio of above-criterion inflections to the number of words spoken. The classroom was quiet enough so that when the subject was speaking, background noise appeared to play little or no role in producing inflections of the loudness indicator.

Periodically, reliability checks were taken to determine the accuracy and objectivity of the data recorded. This was accomplished by having two observers independently view the same tape and comparing their data. A percent agreement for each behavior was computed by constructing a ratio of one of the observer's data on a behavior to that of the other observer and multiplying by 100. The smaller number was always placed in the numerator. The data on reliability checks are shown in Table 1.

The experiment was divided into the following three
## TABLE 1

Reliability Data

<table>
<thead>
<tr>
<th>Day Number</th>
<th>8</th>
<th>22</th>
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### Face-Touching

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<tr>
<td></td>
<td>1. Observer 1</td>
<td>333</td>
<td>747</td>
<td>23</td>
</tr>
<tr>
<td></td>
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<td>339</td>
<td>762</td>
<td>23</td>
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<table>
<thead>
<tr>
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<th>B. Percent agreement</th>
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<td>98%</td>
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### Posture

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<td>1. Observer 1</td>
<td>726</td>
<td>854</td>
<td>33</td>
</tr>
<tr>
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<td>862</td>
<td>25</td>
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<table>
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<td>76%</td>
<td>98%</td>
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### Voice Volume

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<td>0</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>2. Observer 2</td>
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<td>0</td>
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<table>
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<table>
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<tr>
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<th>C. No. words counted</th>
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<th></th>
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</tr>
</thead>
<tbody>
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<td>1. Observer 1</td>
<td>5</td>
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<td>---</td>
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<tr>
<td></td>
<td>2. Observer 2</td>
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<table>
<thead>
<tr>
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<th>D. Percent agreement</th>
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<tr>
<td></td>
<td>100%</td>
<td>88%</td>
<td>---</td>
<td>100%</td>
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phases: a Baseline Phase, a Control Phase, and three sections of an Experimental Phase. During each phase, the subject's behavior during the school periods of Mathematics and Spelling was videotaped. After school, these tapes were viewed by an observer, and data on the four behaviors were recorded.

During the Baseline, these data were collected daily for twelve days. No attempt was made to contact the child, nor did the child view the tapes. The class was told by the teacher that the videotape equipment was there as a part of a study of sixth grade classrooms.

During the Control Phase (days 13-22), the same procedures as in Baseline were followed except that the experimenter met with the subject each day after school for approximately a half hour. During the half hour, the experimenter only attempted to increase the size of the subject's numbers. Karen was not shown any tapes nor told anything about the tapes. Thus, in regard to the writing behavior, this constituted the experimental phase; while in regard to the other three behaviors, it constituted a control for the effect that might be achieved by merely giving the child extra attention and rewards. This technique might be considered by the proponents of the "medical model" (discussed earlier) capable of improving the child's "self-concept" and thereby changing
the "symptoms" exhibited. The Control Phase, then, served the purpose of ascertaining whether or not the special individual attention to the subject and the dispensing of reinforcement had any generalized effect on the other three behaviors which were observed.

The technique for modifying the child's number size was to give her very wide-lined paper on which large numbers were written and to instruct her to trace the numbers. After she traced one line, she copied the same numbers on an adjacent sheet of paper with thinner lines which was similar to the paper used in class. The written numerals were slowly faded to numerals written in dashes, then the dashes slowly decreased in size until they were merely dots. Finally, the subject was instructed to merely copy large numbers on the regular paper used in class. During these sessions, the subject received poker chips for tracing the numbers, and also for writing large numbers on the regular paper used in class. By comparing the size of the numbers on the subject's daily math assignments during the Baseline to their size during the Control Phase, the effect of the after-school work sessions were evaluated. This phase also provided a period in which the poker chips could take on a reinforcing value.

Throughout the experiment, poker chips were employed
as token reinforcers which were exchangeable for other items of value. The items used were a bracelet, a pen, a dress, and hair-styling at a beauty salon. Social reinforcement in the form of attention and praise was also given. The subject earned the bracelet on day 14, the trip to the beauty salon on day 28, and the dress and pen on day 51.

Following the Control Phase, the Experimental Phase began. The experimenter continued to meet with the subject after school, but now the videotape of the day's Mathematics class was shown to the subject. The tapes and data collected during the Spelling period were never shown to the subject. These data were taken to see whether or not the modified behaviors generalized from Mathematics to other periods of the day.

The Mathematics period usually took place during the first part of the morning, so there was a lapse of approximately five hours between the time the behavior was taped and the time when Karen viewed it. Occasionally, the time lapse was shorter, but there was always at least a one hour interval between the Mathematics class and the subject's viewing of the tape. During the tape-viewing sessions after school, the experimental procedures to modify the three remaining behaviors—touching the face, posture, and voice loudness—were
conducted. However, these behaviors were worked on successively rather than all concurrently. Since the child was given no information indicating which behavior was to be worked on second, or even that there would be a second behavior chosen, the Experimental Phase for the first behavior constituted an additional Control Phase for the second and third behaviors. Similarly, the Experimental phase for the second behavior constituted still another Control Phase for the third behavior.

Modification of face-touching behavior was attempted first. When a reliable change occurred in the face-touching behavior, a modification of posture was attempted and a thinning of the reinforcement schedule for the face-touching was instituted. Finally, voice volume was dealt with, and a thinning of the reinforcement schedule for posture was completed.

It should be stressed here that during the Experimental Phase, the reinforcement to the subject was contingent only on the behavior which was being observed on the television monitor. Any behavior which she exhibited--such as face-touching or poor posture--while she was viewing the tape was not taken into consideration for the dispensing of the reinforcement.

The First Experimental Phase was designed to modify face-touching behavior and began on day 22. Until
this time, Karen had not seen any videotape recordings of herself. She was given a stopwatch and was instructed to observe her behavior during Mathematics on the television set. She was told that she should turn on the stopwatch whenever she was not touching her face, but that she would have to reset the stopwatch to 0 whenever she saw herself touching her face. On the first day, she was given a poker chip each time she accumulated 15 consecutive seconds of not touching her face. On the following three days, the time necessary to earn a chip was increased to 30 seconds, then to one minute, and finally to two minutes. On days 26 and 27, the use of the stopwatch for this behavior was discontinued, but the subject was still given occasional token and social reinforcement for the absence of face-touching. After day 27, no more token reinforcement for the absence of face-touching was dispensed, but occasional social reinforcement was presented through day 29, the third day of the Second Experimental Phase. After day 29, all reinforcement for this behavior was discontinued.

Modification of the subject's posture, undertaken in the Second Experimental Phase, was begun on day 26. Again, the subject was given a stopwatch and was instructed that she would receive a chip when she could accumulate 10 consecutive seconds of sitting with her head
above the line drawn behind her on the blackboard (See Fig. 1, Point A). Whenever her head fell below the line, she had to reset the watch to 0 seconds. On the following days, the amount of time the subject was required to spend with her head above the line to earn a chip was increased gradually. On the last day of the Second Experimental Phase (day 33), the subject had to spend three consecutive minutes above the line to earn her chip. On days 34 through 36, only occasional social reinforcements were presented for good posture. After day 36, the experimenter discontinued all reinforcers for good posture.

Modification of Karen's voice volume, which occurred during the Third Experimental Phase, began on day 34. A loudness indicator was placed in front of the subject and she was instructed to observe the needle inflections of the indicator as the videotape was replaying her recitations in Mathematics. She was told that she would receive six chips each time the needle inflections exceeded a specified level. A shaping procedure was instituted on day 36 because the subject had not increased her voice volume sufficiently to produce any above-criterion needle inflections. The shaping was accomplished by adjusting the indicator to make it more sensitive so that the subject could more easily attain the criterion.
voice level and receive reinforcement. On days 37 to 40, the sensitivity of the indicator was reduced progressively until it was placed back at the original level on day 40. The sensitivity was then maintained at the original level through the remainder of the Third Experimental Phase (through day 51). The sensitivity of the indicator was only changed for purposes of reinforcing the subject. The data, however, were always collected at another time by the observer, and the recorder was always adjusted to the original sensitivity level. The number of chips for each inflection over the criterion was reduced from six chips per inflection on the first three days, to 4 on day 37, 3 on day 38, 2 on day 39, and one per inflection on days 40-44.

After day 44, the subject was lacking only one chip to obtain her final reward—the dress. She was told that she could only obtain this last chip when she exceeded the percent inflections per word which she had reached on day 44 (43%). The subject was not able to reach the 43% level for several days (days 45-50) and thus, was not earning any chips. In order that the experimenter could continue to reinforce the child with chips, and yet not reverse the previous decision regarding the 43% criterion, an additional reward—a pen—was offered her on day 47. Therefore, on days 48-51, the
subject was given a chip of another color, blue, for each inflection of the voice volume above the criterion regardless of her failure to reach the 43% inflections on a given day. These blue chips were redeemable for the pen. The one remaining white chip, which the subject needed in order to receive the dress, was only to be given when the subject attained the 43% inflections per word on a given day.
RESULTS

When interpreting the data from Figs. 2 through 5, it should be understood that the modification of each behavior occurred after school. The behaviors used were those which had actually occurred during that same school day. The subject had no prior knowledge of the behavior to be modified by the experimenter. Therefore, only on the day after initially being instructed and reinforced for a behavior could the subject be expected to show a change in that behavior. For example, modification of number size began after school on day 12, but only on day 13 could any change in number size be expected. For the three remaining behaviors which were modified—face-touching, posture, and voice volume—the same conditions apply. Therefore, the data presented for the first day of each phase are really from the day after the new contingencies were put into effect.

It should be noted that there are several days shown on the Figures on which data were not recorded for one or more of the behaviors. The absence of data on these days resulted from two factors: (1) the malfunction of the recording equipment, or (2) the cancellation of Mathematics or Spelling by the teacher on a particular day. In order to facilitate comparison of the Figures,
every session is included on every Figure, even though some data were unavailable.

The results of the initial experimental procedures on the size of the subject's numbers are shown in Fig. 2. During the Baseline, the daily average size of the subject's numbers ranged between 2.5 and 4 twentieths of an inch. During the Experimental Phase, it can be seen that the average height of the subject's numbers steadily increased to a size of 5.6 twentieths of an inch. A follow-up check nine weeks after completion of this phase showed the average size of the numbers to be 4.6. This slight reduction in number size can be attributed to the fact that the teacher thought Karen was writing numbers too large and asked her to write her numbers a little smaller. The size, however, was still 50% larger than the average during the Baseline, indicating that the subject continued writing her numbers larger after reinforcers had been discontinued for some time.

Figure 3 shows the percent of the total time each day which the subject spent touching her face during Mathematics and Spelling. A dramatic decrease in the time spent touching the face can be seen after experimental manipulation was begun on day 22. It can be seen that the behavior decreased in Spelling as well as in
Mathematics, indicating that the decrease in face-touching generalized throughout the day. Furthermore, the low rate of face-touching was maintained throughout the remainder of the experiment (approximately seven weeks after day 29) even though no reinforcers for non-face-touching were given after day 29. A follow-up check one month after the completion of the study indicated that the low rate of face-touching was still being maintained.

Figure 4 depicts the percent of time which the subject spent each day sitting at the low posture level (below Point A in Fig. 1) during Mathematics and during Spelling. The results show a significant decrease in the percentage of time spent sitting at the low posture level after experimental procedures were initiated on day 26. The improved posture was exhibited during Spelling as well as during Mathematics, again indicating that the improvement generalized throughout the school day. The improved posture was maintained throughout the duration of the study. This was approximately three weeks after discontinuing all reinforcers for good posture on day 37. In the follow-up, the good posture was found to have been maintained.

The results of the attempt to modify voice volume are shown in Fig. 5. The data are presented as a ratio.
of the above-criterion needle inflections per hundred words. Data during both Spelling and Mathematics are represented on the graph. During the first two days of this phase (35 and 36), no change in the subject's voice volume was noted. After instituting the shaping procedure on day 36, a general increase in the subject's voice volume was observed in Mathematics through day 40. From day 41 through day 46, a general decrease in the voice volume occurred in Mathematics. This trend reversed itself on day 47. The voice volume began to increase during Mathematics and remained fairly stable throughout the rest of the study. The volume during Spelling was much less variable. After the volume increased during Spelling on the 40th day, it continued to remain high except when it fell on day 45. The follow-up check revealed that the improved voice volume had been maintained.
DISCUSSION

In evaluating the significance of the results, an analysis must be made of certain trends in the data. Some possible explanations for these trends will be presented. The findings of the study will then be related to those of similar investigations of the past. Finally, some implications of these results for future use of delayed reinforcement procedures with humans will be discussed.

A large degree of variability was evident in the posture data (Fig. 4). This was mainly due to the fact that on some days, Karen had to do more written work than on other days, and while doing written work (even with normal posture) it was normal for her head to be below the mark indicated in Fig. 1 as the criterion. In spite of the necessity of bending over while writing, the subject's worst day of posture (day 29) during the Second Experimental Phase was better than the best day (day 23) prior to the modification of the behavior.

As with the posture data, there was considerable variability in the voice volume (Fig. 5). This may be attributed to a number of factors. The break in the upward trend on day 39 was probably related to the fact that a substitute teacher was in charge of
the class on that day. Furthermore, it was noted during the experiment that when the subject's voice level was between approximately 20 and 35 inflections per hundred words, the subject's voice sounded natural and was audible to the class. When the number of inflections was greater than about 35 or 40 per hundred words, however, the subject's voice sounded very strained and unnatural. The teacher commented that when Karen's voice sounded forced, there were snickers in the class. The laughter may have acted as a punisher for speaking loudly and may have been a partial cause for the decrease in the voice volume shown from day 41 through day 46. Thus, the combined reinforcement and punishment contingencies produced an appropriate response differentiation that had previously not existed in the child. It should also be added that when the modification of voice volume was in progress, the subject had already been working for almost two months toward the dress she was to earn and had received no other "back-up" reinforcers in exchange for the tokens during that time. Thus, the poker chips may have been losing some of their reinforcing value.

From Fig. 5 it can be seen that there was much more variability in voice level during Mathematics than during Spelling. This was probably due to the difficulties the subject was having with math assignments at the
time. The subject stated to the experimenter on one occasion that she did not talk as loud that day because she did not want the rest of the class to hear her mistakes. On several other occasions she made similar comments.

In analyzing the changes in the subject's behavior from one phase to the next, the influence of several variables on her behaviors can be considered. The Control Phase was intended to serve several functions. One of the functions was therapeutic—to increase the size of the subject's numbers. Another function was to ascertain any effects from attending to the child in sessions after school and the application of reinforcers. It might have been hypothesized that all of this positive attention would have improved the subject's "self-concept" and therefore would have caused changes in the symptoms she exhibited. As shown in Figs. 3 through 5, however, no observable changes in any of the behaviors occurred between Baseline (days 1-12) and the Control Phase (days 13-22). Therefore, the response-contingent material and social reinforcement must have been responsible for the increased size of the subject's numbers. Furthermore, there is no evidence that the reinforcement of one behavior had any effect on the other behaviors. Changes in each behavior occurred only when consequences
were made contingent upon the behavior.

The data also provide information which indicates that the subject's viewing of her own behavior on the monitor was not sufficient in itself to produce the behavior changes which later occurred. This is made clear in Fig. 4. It can be seen that while the subject was viewing the tapes during modification of face-touching (days 23-26), no observable change in the subject's posture level from previous phases was evident. The same fact is also indicated in Fig. 5. Here it should be noted that while the subject was viewing and hearing herself during the face-touching phase (days 23-26) and posture phase (days 28-34), no change occurred in voice volume. These data suggest that merely watching the videotapes was not sufficient to produce the behavior changes which occurred and that additional variables--instructions and/or consequences--were also necessary. Instructions, in this case, were the specific directions that the experimenter gave the subject at the beginning of each phase, such as telling her that if she sat up straight, she would be rewarded.

It is apparent that the verbal instructions and the reinforcers acted together to produce the behavior changes. The data do provide some information as to the separate effects of these two variables--instructions and
consequences—on both the posture and voice volume behaviors. The classroom teacher had a conference with the subject's parents after school on day 21. During the conference, the teacher mentioned that an attempt would be made to improve Karen's posture in the future. It can be seen in Fig. 4 that following this conference, on days 22 and 23, the subject's posture showed some improvement. After day 23, however, the subject reverted back to her original poor posture level. This suggests that instructions from the subject's parents did produce a behavior change, but the behavior was not maintained, probably because of the absence of reinforcement contingencies for the improved behavior. However, when instructions were given during the experiment in conjunction with the presentation of reinforcers for the improved posture, the behavior was maintained. Karen was able to maintain this good posture after the removal of all reinforcers for several possible reasons. First of all, reinforcers were presented for a sufficient length of time to allow the subject to learn the new posture. Secondly, the reinforcers were faded out slowly by a gradual thinning out of the reinforcement schedule, and finally, other reinforcers in the environment, such as less eyestrain and social reinforcers from the subject's teacher and parents, probably helped maintain
the improved posture even though many of these were probably only accidentally contingent on good posture.

The voice volume data (Fig. 5) also supply information on the importance of reinforcers in bringing about and maintaining behavior change. Throughout the period previous to the voice volume phase, the classroom teacher constantly requested the subject to speak louder when reciting. This often brought about a momentary increase in the subject's voice volume, but, as seen in Fig. 5, no overall lasting change in the subject's voice level occurred until the experimental procedures were instituted. Also, at the beginning of the voice volume phase, the experimenter requested the subject to speak louder to receive her reinforcers, but, as seen in Fig. 5, no improvement took place through day 36. Only when the shaping procedure was instituted (day 36) and the subject actually began receiving reinforcers, did a change in voice level occur. These facts suggest, then, that instructions can help bring about some kinds of behavior changes, but that appropriate contingencies need to be applied before some behavior changes will be effected and maintained.

It was noted that several of Karen's behaviors changed besides those specifically designated for modification. These changes were observed by the experimen-
ter, by the subject's teacher, and by others who had contact with the subject. First, within two days after the decrease in face-touching behavior, there was a dramatic improvement in the girl's acne. Secondly, the teacher stated that the subject's posture while walking was also much improved. Thirdly, it was reported that Karen stopped complaining about eyestrain. When she was asked about her eye problems after the completion of the experiment, she stated that she no longer was having these difficulties. This apparent reduction in eyestrain may be related to the general improvement of Karen's posture while seated at her desk. That is, the eyestrain may have been a result, rather than a cause of her holding her head so close to her work. A fourth change, for which only subjective data are available, was that she was speaking much louder at all times of the day. Her teacher stated that Karen was speaking louder not only during recitations in class, but also when conversing individually with others in the room. Such extensive changes occurred in Karen's behavior after the completion of the experiment that the teacher recognized a new "sense of personal dignity" in her.

The anticipated improvement in the subject's academic achievement in Mathematics which was expected to result from increasing the size of her numbers did not
take place. In this case, it was found that the subject was severely lacking in some basic Mathematics skills. After completion of this investigation, the experimenter worked with Karen in an attempt to teach her some of these skills.

The results of this study provide evidence that the behavior of a child can be modified under conditions of delayed reinforcement. The experimenter employed the findings of Brackbill and Kappy (1962) which suggested the need for response-produced cues to mediate the interval between the response and the reinforcement. Two types of cues were utilized. One group of cues included goal-oriented cues in the form of instructions given the subject. Also, and probably more important, were the cues which were produced while the subject was watching the tapes and receiving reinforcement.

While watching the videotape of a specific behavior, such as sitting up straight, some muscular responses and proprioceptive stimuli associated with these responses may have occurred which were not observable to the experimenter. These responses and stimuli were probably similar to muscular responses and stimuli which actually occurred during the act of sitting up straight. Physiological experiments by Jacobson (1932) support this hypothesis. He attached electrodes to the arms of sever-
al subjects and instructed them to think of hammering with the right arm. Jacobson's instruments showed two bursts of impulses from the right arm muscles corresponding to the imagined hammering. Jacobson concluded that when the subjects imagined they were hammering, they moved their muscles in a manner characteristic of hammering, even though their arms remained in a resting position. Therefore, it could be hypothesized that in this experiment, covert muscular responses occurred while the subject was viewing a specific behavior on the videotape. These responses were paired with reinforcers—poker chips and praise. Therefore, the stimuli associated with the covert muscular responses became conditioned reinforcers. In the classroom setting, the subject's actual response may have been reinforced by these response-produced cues which had become conditioned reinforcing stimuli. In this way, the response-produced cues provided a mediating effect between the delayed primary reinforcers and the actual responses. Furthermore, it could be added here that imitative behavior may be produced in a similar manner. Additional experimentation in this area is needed in order to test these hypotheses.

The data of the present study also support the findings of Bilodeau and Bilodeau (1958) and Denny et
al. (1960), discussed earlier, which suggested that the crucial factor in the performance decrement often observed in delayed reinforcement procedures was the delay between responses rather than the delay of consequences. In the experiment described in the present paper, the behaviors were free operants, that is, the subject could continually respond without delay. Only the reinforcers were delayed. Therefore, the fact that the responses could be continuous, in spite of the delayed reinforcement, may partially account for the success of the techniques employed in modifying the behaviors dealt with in the present study.

This study has shown that delayed reinforcement procedures can succeed, not only in the laboratory, but in a practical classroom situation. From its results, significant implications can be drawn. The use of the videotape, as in this experiment, would be an excellent means of supplying accurate reports of a child's behavior to teachers, counselors, school social workers, school psychologists, and parents. Although presently this technical equipment is economically unfeasible for general use, it could be made available through a school guidance office, and, in special cases, could be loaned to parents for short term use. Once the initial modification of the behavior occurs, the behavior could be
maintained by sending home the child's completed daily assignments or daily progress reports as a substitute for the videotapes. Further studies are needed in which the classroom teacher, counselor, school social worker, school psychologist, or parent serves as the behavioral engineer, using delayed reinforcement procedures to modify the subject's behavior. Investigations should be made of media which are possibly simpler and less costly than the videotape recorder, yet which produce similarly accurate and detailed feedback regarding a child's behavior.
FIGURE 3

FACE TOUCHING BEHAVIOR

MATHEMATICS

SPELLING

DAY

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FIGURE 5

VOICE LOUDNESS

Baseline  Control  Experimental  Follow-up

MATHEMATICS

SPELLING

NUMBER OF CRITERION NEEDLE INFLECTIONS/100 WORDS

DAY

5  10  15  20  25  30  35  40  45  50

weeks

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REFERENCES


