Modification of Control Related Behaviors in Juvenile Diabetics: A Parent Training Class Approach

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MODIFICATION OF CONTROL RELATED
BEHAVIORS IN JUVENILE DIABETICS:
A PARENT TRAINING CLASS APPROACH

by

Robert J. Sheppard

A Thesis
Submitted to the
Faculty of The Graduate College
in partial fulfillment
of the
Degree of Master of Arts

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Robert J. Sheppard
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WESTERN MICHIGAN UNIVERSITY, M.A., 1979
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INTRODUCTION

Juvenile-onset Diabetes Mellitus is a disease which renders the pancreas incapable of producing insulin, thus blocking the body's ability to properly metabolize glucose. Diabetes is the third most frequent chronic ailment of children, and is preceded only by heart disease and cancer on the list of causes of death for adults (Ott, 1976; Juvenile Diabetes Foundation, 1978; Knapp, Note 3). Estimates of the prevalence of diabetes in school age children range from 1.3 per 1000 (U.S. Dept. HEW, 1975) to 1.89 per 1000 (Kyollo, 1978).

The treatment regimen which keeps this disease under control requires that the child emit a number of behaviors which include taking daily insulin injections, testing urine for glucose level, adherence to dietary restrictions, and regulating exercise (Travis, 1976; Sandler & Sandler, 1977). Immediate consequences of poor control may include insulin overdose, or the onset of a potentially fatal coma. Long term consequences of not keeping diabetes controlled include cardiovascular disorders, kidney failure, nerve degeneration, infections, cataracts and blindness (Sandler & Sandler, 1977).

It is vital that the juvenile diabetic perform the behaviors involved in keeping these consequences to a minimum on a daily basis. Estimates of the rate of compliance with all patients in general, however, show that patients fail to comply with 30% to 50% of their treatment regimens (Davis, 1966, 1968). Getting the diabetic child to consistently perform behaviors related to the control of the disorder is frequently a problem for parents and physicians (Mattson, 1966).
While hospital diabetic education programs teach the parents about diabetes and its treatment, studies show that knowledge about an illness and its treatment does not necessarily increase compliance to the corresponding treatment regimen (Marston, 1970; Sackett & Haynes, 1976). It appears that what is needed is additional training for the parents regarding how to get the child to consistently perform the control related behaviors.

An extensive amount of data are available to indicate that parents can be trained to effectively modify a variety of behaviors exhibited by their children, including enuresis (Bucher, 1972), tantrums (Williams, 1959), withdrawn behavior (Allen et al., 1965), and autistic behaviors (Mathis, 1971), among others. It has also been demonstrated that parents can be trained to do this in groups or classes (Hall et al., 1972). More recent research indicates that parents will be more effectively trained to modify a variety of behaviors if they are taught general principles and techniques, as opposed to focusing on the modification of two or three particular behaviors (Koegel et al., 1978).

Operant techniques have been found to be effective in modifying a variety of behaviors related to medical treatment. These techniques have been used in increasing compliance to treatment in problems including fluid intake in hospitalized patients (Fowler et al., 1969; Sand et al., 1970, 1973) and dietary restrictions for juvenile hemodialysis patients (Magrab, 1977). Asthmatic children were taught to use respiratory therapy equipment through the use of shaping and reinforcement, thus demonstrating that chronically ill children can
be taught to perform rather complicated self care behaviors (Renne & Creer, 1976). Parents have also been trained to utilize operant techniques in modifying their children’s health related behaviors. Parents have been successful in decreasing coughing and wheezing in an asthmatic child (Neisworth & Moore, 1972), in decreasing the frequency of hospitalizations of an asthmatic child (Creer et al., 1974), and in increasing the amount of Lofenalac intake in a child with PKU (Fox & Roseen, 1977).

Although the successful control of diabetes is highly dependent upon the performance of a number of behaviors, studies relating behavioral principles to the management of diabetes are scarce. Fowler et al. (1976) demonstrated an improvement in the physiological status of a 20 year old diabetic after EMG relaxation training. The experimenters measured urine glucose level, frequency of acetone spill, number of insulin units required, and frequency of hospitalizations in evaluating the effect of this treatment on the subject’s diabetic control.

Two studies demonstrate that contingency management systems can be effective in modifying control related behaviors in children with diabetes. Knapp (Note 3) taught a 6 year old diabetic to perform urine tests independently using reinforcement and prompts. Lowe and Lutzker (In Press) applied a point system in modifying the control related behaviors of a 9 year old female diabetic. Employing a multiple baseline across behaviors design, the experimenters demonstrated an increase in the child’s compliance to footcare, urine testing, and diet. No physiological dependent variables were measured in either of these studies.
While family members were involved in carrying out the intervention in the Lowe and Lutzker study, the experimenter took an active role in the home in designing and executing the program. Only one study is reported in which an individual other than the therapist is trained to carry out the modification of treatment related behaviors of a diabetic. Soderberg (1972/73) reports that a visiting nurse was taught how to use differential reinforcement in working with a 73 year old female diabetic. Through contingent prolonged visitations and social praise, the nurse increased the subject's compliance to dietary restrictions and urine testing, resulting in an improvement in the subject's daily urine glucose level.

The purpose of the present study is to evaluate if parents can effectively modify control related behaviors in their diabetic children as a result of participating in a parent training class. In evaluating this program, two experimental questions are asked. First, can parents improve behaviors involved in the management of diabetes as a result of participating in this class? Secondly, will parent training result in an increase in the control of the child's diabetes as measured by several physiological variables?

In this study, three mothers carried out behavior change projects with their diabetic children while participating in a 10 week behavior management training class. The mothers recorded observations on these behaviors. An across behaviors multiple baseline design is employed in evaluating the mothers' ability to modify these behaviors. The effect of these behavior changes on the child's diabetic control is also evaluated by monitoring a number of physiological variables.
for changes which may occur concurrent with behavior changes. Maintenance of behavior changes are re-examined at a 1 month follow up period.

This study is designed to build on previous research in several ways. First, while parents have been shown to be effective primary behavior change agents for children with asthma and PKU, this has not been demonstrated with parents of juvenile diabetics. Secondly, while all of the previous studies on parent training with chronically ill children have utilized one to one parent training, the present study evaluates training in a group format. Finally, while the Fowler et al. relaxation training study and the Soderberg visiting nurse study included an evaluation of physiological variables, studies on contingency management with diabetic children did not. The present study includes the measurement of several physiological variables.
GENERAL METHOD

Subjects

The subjects were 3 Caucasian males, ages 5, 6, and 7, from middle class families with both parents in the home. The mothers volunteered to participate in the study after being informed about it by their pediatricians. All the subjects met the criterion of having been diagnosed as an insulin dependent diabetic for at least 1 year. This criterion was set in order to avoid the potentially confounding influence on the dependent physiological variables of the relatively extreme physiological variability that typically occurs during the first year following onset (Travis, 1976).

While all three mothers had completed a course on the physiological aspects of diabetic management, none had ever received special training in parenting techniques, or in the use of behavior modification.

Setting

The study was conducted in a midwestern city of approximately 90,000 people, in cooperation with a 500 bed hospital which serves that city and the surrounding rural area. The classes were held in the hospital diabetic education classroom. This provided the parents with a familiar setting that was associated with the responsible care of their children, as recommended by Jackson and Terdal (1978). All behavior observations and projects were carried out in the home, since
this was the setting in which the behaviors of interest occurred most frequently.

Personnel

The trainer for the class, a male graduate student, taught the classes and provided individual contact to two of the mothers. The assistant trainer, a female graduate student, attended several of the classes and provided individual consultation to one of the mothers. A clerk was present at each class to record data on homework assignments, behavior records, and physiological records. A registered nurse, who is in charge of the hospital's diabetic education program, also attended several of the classes in order to advise the parents and trainers when medical issues were involved. Finally, one of the three referring physicians served as a medical consultant to the program, although he did not attend the classes.

The mothers functioned as the primary observers in the home, and for one project an older sibling collected data. The mothers were taught simple observation, recording, and interobserver agreement check procedures during the first few classes. Quiz scores and interobserver agreement checks with the trainers indicated that they could carry out these procedures quite accurately. The parents in this study had learned how to collect physiological data in the classes they had taken through the hospital. The only contact between the trainers and the children occurred during home visits for interobserver agreement checks. During these visits the trainers focused all attention on carrying out these checks and had only minimal contact with the children.
Procedure

Mothers attended 10 2 hour classes that were held over the course of an 11 week period. The classes centered on teaching behavior management skills such as how to pinpoint, observe and record behaviors. Mothers were also taught how to use reinforcement and some punishment procedures. These skills were taught through lectures, discussions, behavior rehearsals, audiotapes, and readings from handouts. Parents also read Parents Are Teachers by Wesley Becker (1971). The film, Who Did What to Whom, by Robert F. Mager was also used in training behavioral principles. In addition, each mother received approximately 10 to 15 minutes of individual consultation during each class.

Each mother made a $40 deposit that was returned to her in weekly portions according to the terms of a signed contract. This contract included provisions for attending class on time, completing homework assignments, and collecting behavioral and physiological data. This technique has been cited as an effective way to increase compliance with program requirements by Eyeberg and Johnson (1974) and Hirsch and Walder (Note 2). Classes missed due to illness were made up through home visits, which resulted in a deposit reimbursement.

Each mother was required to carry out three behavior change projects in the home. At least two of the projects had to involve behaviors related to the control of diabetes. The third project could involve any behavior of the mothers' choice. Each mother was given supervision on all three projects, however, they were encouraged to develop each project as independently as possible.
Each mother was requested to obtain at least 2 weeks of baseline data before initiating an intervention on each project. Mothers were instructed to begin collecting baseline data on the first project at the second class. The two remaining projects were initiated on an individual basis, according to each mothers' ability and willingness to assume the responsibility of additional data collection. For two of the mothers this resulted in an additional 3 weeks of contact beyond the last class in order to obtain data.

Dependent Variables

Four categories of dependent variables were measured. The first, behavioral measures, involved observations of changes in each of the targeted behaviors. Interobserver agreement checks were done on at least 13% of all the data collected. Whenever possible, a trainer visited the home to make observations simultaneously with the mother. For behaviors which occurred at inopportune times of the day, interobserver agreement checks were carried out by two family members. Details regarding these checks are presented in the individual case study reports.

The second category of dependent variables includes six different physiological and physiologically related variables. First, a fasting blood sugar level was drawn on each subject prior to the initiation of the classes and again after the program had ended.

Parents kept daily records of each child's urine glucose level, which provides an indication of the blood glucose level, using either the "Diastix" or "Clinitest" method (see Travis, 1973 for details).
Subjects and their parents were asked to perform two to four of these tests per day.

The results of samples tested by the "Clinitest" method in this study were converted to "Diastix" scores. Urine glucose is reported as being either negative, trace, 1 plus, 2 plus, 3 plus, or 4 plus. An ideal range of scores for a young juvenile diabetic is trace, 1 plus, or 2 plus (Travis, 1973, 1976). Urine test results were calculated in terms of the percentage of daily samples which fall within this range. These percentages were calculated only for days on which at least two tests were reported.

Interobserver agreement checks were done on these testings for at least 20% of the days in which data were collected. Checks were carried out by either a trainer and a parent, or by two family members. Family members only carried out interobserver agreement checks without a trainer present after they had been checked several times by a trainer and were found to produce agreement scores of at least 80%. In addition, these family members were checked against a trainer on at least 25% of all agreement checks they made throughout the study to insure they were maintaining at least this 80% agreement. Interobserver agreement checks were carried out by having two persons observe the testing procedure and independently record the results. Overall interobserver agreement was calculated by dividing the number of agreements on the test result by the number of agreements plus disagreements.

Parents also recorded the number of hyperglycemic and hypoglycemic reactions which occurred each day. A hyperglycemic reaction indicates
that blood glucose is excessively high, whereas a hypoglycemic reaction indicates that blood glucose is too low. Either type of reaction can be identified by a specific set of symptoms (Travis, 1973, 1976; Ames, 1977; Sandler & Sandler, 1977; Upjohn, 1977). Since these reactions occur on a low rate unpredictable basis, no reliability checks could be obtained.

The number of insulin units required each day was also recorded by the parents as an indirect measure of the child's physiological status. This record also gives an indication of whether the number of urine test results in the ideal range change as a function of changes in insulin, or as a result of a change in control related behaviors.

Interobserver agreement checks on insulin units administered were carried out on at least 18% of all administrations by either a staff member and a parent, or by two parents. Parents only carried out interobserver agreement checks without a trainer present after they had been checked several times by a trainer and were found to produce agreement scores of 80% or greater. Interobserver agreement checks by two family members were made by having each member independently record the amount of insulin in the syringe both before and after the injection. Since injections were given at an inopportune time for outside observers, early each morning before the family ate breakfast, staff agreement checks were done by an analogue method. This involved filling the syringe with water and independently recording the number of units. A second reading was independently recorded after the water had been squirted out. For both of these
methods interobserver agreement was calculated by dividing the number of agreements on readings by the number of agreements plus disagreements.

The final dependent variable measured as a reflection of physiological status was frequency and duration of hospitalizations. Parents reported information on any hospitalizations which may have occurred for a period of time lasting from one month prior to the first class to the follow up date. Occurrences were then verified by a hospital staff member.

The third major type of dependent variable was objective tests. Mothers were administered multiple choice quizzes on eight occasions to determine how well they were learning the material. Quiz scoring was checked for reliability by having the trainer regrade 21% of the quizzes approximately 3 months following the end of the course. Reliability was calculated by dividing the number of agreements on the scoring of each item by the number of agreements plus disagreements. All checks resulted in a score of 100% agreement.

Also in the objective test category was a test consisting of five written vignettes which was administered at pre-course, post-course, and 1 month follow up intervals. With this test, parents described how they would handle problems in the areas of behavior deficits, behavior excesses, measurement, and evaluation of projects. Tests were scored according to an answer checklist in a blind fashion so that the scorer did not know the name of the mother or the phase of the study during which the test was administered. A reliability check was done on 22% of these tests by having the rater rescore the
tests in a blind fashion 6 weeks after the initial scoring. This resulted in a reliability of 91.7%.

Self report measures, including the Walker Problem Behavior Identification Checklist (Walker, 1970), the Juvenile Diabetes Problem Checklist, and a program evaluation survey, make up the final category of dependent variables. The Juvenile Diabetes Problem Checklist, designed by the trainer, is a list of problems frequently seen in juvenile diabetics and other chronically ill children. Both checklists were administered at pre, post, and follow up intervals.

These checklists were also scored in a blind fashion, and reliability checks on the scoring were run on 22% of them approximately 6 weeks after the initial scoring. Reliability was calculated by dividing the number of agreements on the scoring of each item by the number of agreements plus disagreements. In order to avoid inflated reliability scores caused by the fact that relatively few items on the checklists were endorsed by the mothers, only those items resulting in the recording of a check mark on at least one of the reliability scorings were used in defining agreements and disagreements. This resulted in a reliability of 100% for both the Walker and the Juvenile Diabetes Problem Checklist.

The program evaluation survey was administered in order to assess the program from the perspective of the consumer. It was designed to give the experimenter a view of how applicable such a program might be as a regular service.
Design

A multiple baseline across behaviors design (Baer, Wolf & Risely, 1968) was used in assessing the effects of the program on each mothers' ability to modify three behaviors. Reversals were avoided because returning to baseline responding could be detrimental to the subjects' health. The multiple baseline design was effectively used by Lowe and Lutzker in their study on behavior management with juvenile diabetics. Also, Hall et al. (1970) identify this design as an effective way of evaluating programs run by parents in applied settings.

While mothers were told to collect baseline data for at least 2 weeks, and to check with the trainer before implementing any condition changes, on two occasions mothers implemented interventions at inappropriate times. While this weakens the design to some extent, in each of the cases at least two interventions were implemented in a staggered fashion.

Measures on four of the physiological variables (urine glucose, insulin, hyperglycemic and hypoglycemic reactions) were taken continuously throughout the experiment, and they were displayed in time against the interventions to evaluate any concurrent changes that may have occurred.
CASE STUDIES

Subject A

Seven year old Subject A, a diabetic since age 5 1/2, has also been diagnosed by a physician as being hyperactive. His parents had also received several complaints of disruptive classroom behavior from his teacher. Prior to this study he had been on a regimen of Ritalin, however, his mother discontinued the administration of this medication because she was concerned about side effects.

Subject A's mother worked part time as a nurse aide in a nursing home, and his father was employed as a factory worker. While the subject's mother missed four of the 10 classes as a result of illnesses in the family, these classes were made up through home visits by the trainer. However, as a result of interruptions from these illnesses, contact with this mother lasted 3 weeks beyond the formal class.

Method

Project 1. The purpose of the first project was to decrease frequent deviations the subject made from his prescribed diet, and decrease the frequent requests the subject made for food at inappropriate times. This would also teach Subject A to discriminate appropriate times for eating, and appropriate amounts of food he could eat. It is vital that a juvenile diabetic eat only specified amounts of food at specified intervals in order to maintain a balanced level of glucose in his body (Travis, 1973; Ames, 1977; Sandler & Sandler, 1977).
In order to cover these problem areas, the dependent variable, inappropriate requests, was defined as: (a) ingesting or taking food without asking a parent first; (b) taking food after being told he could not have it; (c) asking for food at a time other than a scheduled meal or snack; or (d) asking for more food immediately after he had been given the appropriate amount. Asking for food at a time other than a scheduled meal or snack was not scored as an inappropriate request if physiological signs indicated that he did require sugar intake at that time.

The subject's mother identified 7 to 9 PM as the most difficult time period, so she observed and recorded the number of inappropriate requests made during this time period each evening. A tally mark was made on a scoring sheet each time she observed this response.

All interobserver agreement checks were carried out by the trainer and Subject A's mother, with the exception of one check during which the mother and a neighbor compared observations. Checks were carried out by having two observers sit in different areas of the room and independently record the number of inappropriate requests they observed.

Checks were carried out on 12.5% of the data points in the baseline condition. A total frequency method, dividing the smaller number of observations by the larger, was used in calculating agreement percentage. Checks were carried out on 18% of the observations during the intervention phase. Agreement was calculated by dividing the number of agreements of whether or not the response occurred by the number of agreements plus disagreements. Nonoccurrences are included in the calculation because the intervention virtually eliminated
the behavior being observed, and the observers were consequently un­able to compare observations of occurrences. The same method was used in calculating interobserver agreement for 25% of the observa­tions during the follow up.

Since nonoccurrences are included in the calculations, and the behavior almost never occurred during interobserver agreement checks, a somewhat inflated measure of agreement is likely to result. While more conservative measures have the disadvantage of involving only 7% of the observations, agreement was also calculated using only sessions which involved occurrences. For this method, interobserver agreement was calculated by dividing the number of agreements of an occurrence by the number of agreements plus disagreements of an occurrence.

A token program designed by the subject's mother, in which Subject A received a star for going for specified periods of time without making a request, was the intervention for this project. During the 1 hour criterion condition the subject was required to go 1 hour to earn a token. He was required to make no requests for 2 hours during the 2 hour criterion phase. The 2 hour criterion was implemented after the subject exhibited stable responding for 2 weeks under the 1 hour criterion condition. The star tokens could later be exchanged for small gifts of the child's choice. At the 1 month follow up this program had been faded out and the subject received only social reinforcers for making no inappropriate requests.

Project 2. In order to develop self care skills, and to facili­tate social development, diabetic children should be encouraged to independently carry out control related tasks as soon as they have
the skills to do so (Ames, 1977; Brunner & Suddarth, 1974). While Subject A knew how to do urine tests, and he carried out one test a day at school, he refused to execute these tests at home. In order to increase the child's independent self care skills, it was decided to develop a program to increase the number of urine tests done independently by Subject A in the home for the second project.

Independent testing was defined as correctly carrying out a urine test within 5 minutes of a verbal cue given by the subject's mother. An independent testing was also scored if Subject A carried out the test within 10 minutes of the testing time before a cue was given. The verbal cue was given only once at each testing time. This cue did not involve a specific reference to urine testing, rather it was designed to focus the child's attention on events which were associated with testing. For example, Subject A's mother would cue the bedtime test by saying, "It's time to get ready for bed." These cues provided an anchor in time to use in defining the response, and also ensured that there was consistency in the mother's behavior in observation sessions across conditions. It was also felt that a cue which made no specific reference to testing could be more easily faded out in the latter stages of the project. Before baseline recording was initiated, the subject's mother discussed this cue system with him, and told him when he was expected to do the tests.

Subject A's mother recorded whether or not the urine test was carried out on three occasions each day. Tests were to be done at breakfast, at suppertime, and at bedtime. She also recorded whether or not she gave the cue.
Interobserver agreement checks between the trainer and subject's mother were carried out on 16% of the baseline observation sessions, 17% of the intervention observation sessions, and 20% of the follow up observation sessions. All checks were carried out at the bedtime testing by having two observers in different areas of the room independently record whether or not the child carried out an independent testing. Agreement was calculated by dividing the number of agreements on occurrence or nonoccurrence by the number of agreements plus disagreements. Since occurrences and nonoccurrences were each recorded approximately 50% of the time throughout all conditions, this method provides an accurate measure of agreement.

A reinforcement program using stars as tokens was also used as the intervention for this program. Stars were earned for carrying out independent urine tests. The stars could later be traded in for a variety of back up activity reinforcers. Throughout the intervention, Subject A was gradually required to complete more tests per day to earn a token. This project is quite similar to one of the projects in the Lowe and Lutzker (In Press) study in which a point system was used in increasing compliance to urine testing in a 9 year old female diabetic.

Project 3. Subject A's 4 year old nondiabetic brother was the subject in project 3. While this is somewhat of a deviation from the standard multiple baseline design, Subject A's mother was allowed to do a project with him for several reasons. First, she had demonstrated with two consecutive projects that she could modify control related behaviors. Secondly, she described this child as being much more of
behavior problem than Subject A. Third, she stated that this child's behavior was very disruptive, and this is likely to have a detrimental effect on Subject A's need for a calm, scheduled daily routine.

Finally, it had been decided that the mothers could choose whatever behavior they wished as a target for their third project in order to give them experience in modifying behaviors other than those related to diabetes.

The problem focused on in this project was that this child would frequently be noisy and get out of bed each night. While his mother reported that she had previously tried using rewards and punishments to change this behavior, she stated that she usually responded by allowing the child to sit in the living room and watch TV with her to quiet him down. A physical cause for sleeping problems had been ruled out by a physician. She also noted that if the child could stay in bed for 5 to 10 minutes, he would usually fall asleep.

Given this information, the dependent variable was defined as the length of time that passed from first putting the child to bed to when he actually fell asleep in bed. The subject's mother recorded this by checking on him approximately every 10 minutes and writing down whether he was awake or asleep. Sleep was defined as at least 1 hour of uninterrupted sleep.

Interobserver agreement checks were carried out by the trainer and the subject's mother on 18% of all baseline sessions, 20% of all intervention sessions, and 20% of all follow up sessions. Each observer independently recorded whether the child was awake or asleep at the end of each of three consecutive 10 minute intervals.
Agreement was calculated by dividing the number of agreements of the occurrence or nonoccurrence of sleep by the number of agreements plus disagreements.

Since the subject's mother had been reinforcing his out of bed behavior by letting him stay with her and watch TV, it was decided to use a time out procedure to remove these reinforcers. The child was given 5 minutes in the bathroom immediately after getting out of bed, and his mother was instructed to return him to bed as soon as the time out period ended. She was instructed to repeat this procedure each time he got out of bed. She also agreed to give him a favorite breakfast food as a reinforcer each morning if he stayed in bed on the previous night.

Interobserver agreement checks were done on urine tests by the trainer and subject's mother on 22.5% of all observation days. Interobserver agreement checks on insulin administration were carried out on 20% of all observations by the trainer and Subject A's mother using the analogue method. Checks for both of these physiological measures were carried out at least once a week throughout the study.

Results

The upper section of Figure 1 shows the number of inappropriate requests per hour exhibited by Subject A. The mean number of inappropriate requests made during the baseline was .625 per hour. During both the 1 hour criterion and 2 hour criterion intervention phases no requests were observed. Responding during the 4 days of observations at the 1 month follow up had again increased to a mean
Figure 1: Number of inappropriate requests made per hour and percent of 3 possible daily urine tests performed independently by Subject A are represented in the upper portions of the graph. Number of minutes latency between the request to go to bed and falling asleep for Subject A's brother is represented in the lower portion.
FIGURE 1

DAYS

FOLLOW UP

123 128

10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90

REQUEST TO SLEEP FROM 600 MINUTES

REQUESTS PER HOUR INAPPROPRIATE PERCENT OF TESTS

BASELINE

TIME OUT

TOKENS

NO TOKENS

TWO HOUR CRITERION

ONE HOUR CRITERION

BASELINE

4 3 2 1 0

100 75 50 25 0

160 120 80 40 0

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of .625 per hour. The token program had been faded out at the time of the follow up observations.

A high degree of variability is evident in both the baseline and follow up data. During the baseline the number of inappropriate requests ranges from 0 responses to 2.7 responses per hour. During the follow up, responding ranges from 0 to 1.5 responses per hour.

Interobserver agreement for baseline observations was 75% using the total frequency method. Agreement during the intervention was 91.7% using the modified occurrence/nonoccurrence method previously described. This method also produced a 100% agreement for the follow up checks. Calculating agreement using only sessions in which a response was recorded, the most conservative method, results in an overall agreement of 60%. However, this only takes into consideration 7% of all the observations.

The center section of Figure 1 shows the percentage of the three possible daily urine tests which were independently carried out in project 2. During the baseline the subject carried out a mean average of 9% of the tests, with a range extending from 0% to 67%. After the token program was introduced responding increased to a mean of 31%, with a range of 0% to 100%. With the program still in effect at the 1 month follow up, the subject carried out an average of 60% of the tests independently. Responding ranged from 0% to 100% during this phase of the study. Interobserver agreement was 100% on all checks made.

While there is a high degree of variability across all phases of this project, there is a fairly obvious shift in the percentage of
high and low data points after the intervention is introduced. During the baseline 79% of the observations result in no independent testing, while in the intervention condition only 25% of the observations result in no responses. At the follow up only 20% of the observations result in 0% responding.

Minutes of latency between initially putting the subject to bed and observing the subject sleeping is exhibited on the lower section of Figure 1. While the mean latency during the baseline is 91.5 minutes, this is surrounded by values ranging from 25 minutes to 150 minutes. After the introduction of the time out procedure, latency decreased to an average of 66 minutes, with a range of 30 to 90 minutes. Since observations indicated that the subject's mother was not consistently following through with the procedure, she was given further instructions prior to follow up observations. During the follow up the latency had further decreased to 30 minutes, with a range of 15 to 60 minutes. The data appeared to be in the beginning of an upward trend when observations were discontinued because the mother had fulfilled her obligations for the study. Interobserver agreement was 100% for all checks.

Figure 2 displays the daily units of insulin, the percentage of urine samples in the acceptable range, and the daily number of hypoglycemic and hyperglycemic reactions. Interobserver agreement checks on the urine testing procedure and the insulin administration analogue each produced 100% agreement.

Before any interventions occurred, the subject received 20 units of insulin each day, with the exception of 21 units on 2 days.
Figure 2: Daily number of insulin units required, percent of urine test results falling in the acceptable range, and number of hypoglycemic and hyperglycemic reactions for Subject A.
FIGURE 2  DAYS

UNITEDS OF INSULIN

PERCENT OF SAMPLES IN RANGE

NUMBER OF DAILY REACTIONS

HYPERGLYCEMIC

HYPOLGLYCEMIC

INTERVENTION PROJECT 1

INTERVENTIONS PROJECT 2

PROJECT 3
Between the initiation of interventions for projects 1 and 2 the subject received an average of 21.36 units per day, with a wider range of variability than during the baseline (18 to 27 units). Units received is stable at 21 units between interventions 2 and 3. After the third intervention is introduced, units received increases to an average of 22.14 units, with a range from 21 to 25 units. At the 1 month follow up, units received has stabilized again at 20 units. In summary, there is a slight increase in the number of units of insulin received, along with an increase in the day to day variability in units received, corresponding to the introduction of behavior change projects.

While there are no obvious changes in the percentage of urine samples which fall within the acceptable range between the baseline data and the data generated during the first intervention, there is a somewhat declining trend following the second intervention. The percentage of urine samples in range drops from an average of 16.6% during the first intervention to 12.5% during the period of time between interventions 2 and 3. This decline continues to only an 8.33% average between intervention 3 and the follow up. However, during the follow up the percentage of samples in range increases back to the 16.6% average.

No significant changes are readily apparent in the data on hypoglycemic and hyperglycemic reactions. No data were available for any of the physiological variables from day 29 to day 42 because illnesses in the family resulted in the subject's mother not keeping any official records.

Subject A's fasting blood sugar level decreased from 400 mg % during the pre-course testing to 300 mg % at the follow up testing.
Only one hospitalization, lasting 2 days, occurred for this subject. About a week and a half following the initiation of project 1 the subject was hospitalized for ketoacidosis, which occurred as a result of contracting chicken pox.

Subject A's mother endorsed 18 items on the pre-course administration of the Juvenile Diabetes Problem Checklist, 11 items on the post-course administration, and 15 items at the follow up. While 20 items were initially endorsed on the Walker Problem Behavior Identification Checklist, the post-course and follow up administrations yielded endorsements on 8 and 7 items respectively.

Subject A's mother had a mean score of 81.6% across all 8 weekly quizzes. While she only earned 2 points on the initial administration of the 20 point vignette test, 3.5 points were earned on the post-course administration, and 5.5 points were earned on the follow up.

Discussion

Subject A's mother applied a token program in gaining control of inappropriate food requests and independent urine testing, however, this control was maintained only for urine testing at the 1 month follow up. While the token program was still in effect for the urine testing project at follow up, all extrinsic reinforcers had been faded out for the food requests project prior to the follow up. The mother's report on this project indicates that she may have faded out the tokens for food requests too abruptly, resulting in a loss of control over responding.

These results suggest that long lasting behavior changes for Subject A may require the application of extrinsic reinforcers for
much longer periods of time than that used in the food requests project. It is possible that the permanent application of extrinsic reinforcers is required to maintain diabetic control behaviors, since there are no apparent naturally occurring reinforcers to maintain them. Support for this is found in Knapp's (Note 3) report in which extrinsic reinforcers were required to maintain just one urine testing a day with a 6 year old diabetic. Also, there are not likely to be any immediate punishing physiological consequences for failing to do regular urine testing, or for exhibiting excessive food requests. Consequently, the child is not likely to maintain such behaviors to avoid these delayed aversive consequences. The development and validation of behavioral interventions which can produce relatively permanent behavior changes is an area requiring much more research. Programming environmental variables to provide reinforcement for the parents' consistent use of the techniques taught would appear to be a necessary step in maintaining behavior changes in their children.

While there are no reported studies on the frequency of food requests available, both Lowe and Lutzker (In Press) and Knapp (Note 3) report increasing the frequency of urine testing with juvenile diabetics using cues and reinforcers. The findings of the present study are generally consistent with the results of these studies. It is noteworthy that some form of cue or prompt was required in increasing urine testing in the present study as well as in the two previously noted studies. It appears that increasing the frequency of urine testing in diabetic children may require more than just implementing reinforcing consequences for performing this behavior. It also may
be necessary to set antecedent variables so that more obvious cues
to perform the desired response are given.

Only 75% interobserver agreement was obtained during the baseline
phase of the food requests project. It is possible that this low
percentage of agreement was a result of having too many responses in­
cluded in the definition, thus making observing difficult to learn.
Improvements in agreement during the intervention and follow up could
indicate that the observation system took a long period of time to
learn. Since the subject's mother tended to record higher fre­
quencies of responding on days when the trainer was present for agree­
ment checks than on other days during the baseline, this low reli­
ability may reflect an underestimation of the actual baseline fre­
quency. That is, the poor reliability suggests that the subject's
mother may have failed to record occurrences during other baseline
observations. Since reliability was much higher during the inter­
vention, the decrease to zero responding may be more significant
than the present data suggests.

While some studies demonstrate improvements in physiological
control concurrent with the modification of control related behaviors
(Soderberg, 1972/73; Fowler et al., 1976), no such improvements were
noted with Subject A. This was not unexpected, however, given that
the subject's mother chose behaviors not directly related to physio­
logical control. Actual eating behaviors only comprised a small part
of the inappropriate requests definition, and the independent urine
testing project only produced a change in who performed the tests.
The apparent decreases in physiological control noted in the results
are most likely due to the subject contracting chicken pox, as well as being exposed to other illnesses in the family. Previous research indicates that there are a number of potential benefits in studying how behaviors can be modified to produce physiological effects for diabetics. Future research should focus on behaviors directly related to physiological control in addition to targeting those behaviors which are important to social growth, and those behaviors which are indirectly related to physiological control.

While the subject's mother was able to get control over the child's bedtime behaviors for project 3, several retraining sessions were required in teaching her to use the time out procedure at home. In addition, the trainer's observations during home visits show that she was inconsistent in applying this procedure. This probably accounts for the highly variable data in the intervention results. These observations suggest that while the use of some techniques may generalize to the home setting from the class setting, generalization must be actively programmed when dealing with other techniques. In vivo coaching or modeling may facilitate this process. Also, a more active, systematized method for maintaining the parents' compliance in utilizing these techniques should be incorporated into the parent training program. This is especially vital when the parent is using techniques such as time out, which require more of an initial response cost on their part. Including spouses in monitoring, providing feedback, and providing reinforcers contingent upon maintaining the use of these techniques would all be procedures worthy of future exploration in this area.
In conclusion, Subject A's mother was able to improve control related behaviors as a result of participating in the course, but these behavior changes produced no notable physiological effects. In addition, results of the written measures indicate that she increased her knowledge of operant principles, and that she may have used these techniques in dealing with additional, non-targeted behaviors.

Subject B

Six year old Subject B, diagnosed as diabetic at age 1 1/2, was also diagnosed as epileptic prior to the initiation of this study. This child was very knowledgeable of diabetes for a 6 year old. For example, he knew how to do urine tests, what the results mean, and he could explain why he shouldn't eat food at unscheduled times. Nevertheless, his mother reported that she still has many difficulties getting him to follow through with appropriate behaviors for diabetic control.

Subject B's mother, an elementary school teacher, attended 7 of the 10 classes. The three classes that she missed, as the result of an illness which temporarily impaired her hearing, were made up by supplying her with audio tapes of the lectures she missed. As a result of this illness, contact with Subject B's mother lasted 3 weeks beyond the final class.

Method

Project 1. As with Subject A, Subject B's mother chose to focus on inappropriate requests for food for her first project. As with
Subject A, Subject B frequently ate food at inappropriate times, or in amounts not consonant with his prescribed diet. He also frequently "nagged" his mother for food, which she found quite aversive. Consequently, the purpose and rationale for attempting to modify this behavior is the same as that described in the project for Subject A. The definition of "inappropriate requests" is also the same.

Observations were made by the subject's mother or 10 year old sister each day from approximately 4 to 5:30 PM. This was a difficult period of time because it involved the interval between the subject's return from school and supper, during which he was not allowed to eat. This same period of time was used when observations occurred on weekends to maintain consistency across observation periods. To record this behavior, the observer remained in the same general area of the house as the subject, and she placed a tally mark on a recording form each time a defined inappropriate request was observed.

Interobserver agreement checks were carried out on 29% of all baseline observation sessions. Approximately 1/2 of these checks were done by two family members, while the rest were done by a family member and the trainer. Checks were carried out by having two observers independently record occurrences of requests from different areas of the room. Since the home observers had not yet been trained to carry out interval recording, a total frequency method was used to calculate percent of agreement during the baseline condition.

Interobserver agreement checks were carried out between the home observer and the trainer on 23% of all intervention sessions. About 1/2 of these included the subject's sister, while the other half included the subject's mother. Checks in this condition were carried
out using an interval method with three to four 15 minute intervals per check. Long intervals were used in order to increase the chance that a response would occur, since this response was occurring at a relatively low frequency. Since this behavior was virtually eliminated during the intervention, the only way to obtain agreement figures was to calculate agreement for occurrences and nonoccurrences. This method is likely to result in a somewhat inflated agreement percentage.

A token program with back up activity reinforcers, similar to the intervention initiated for Subject A, was initiated as the intervention for this project. During Phase I of the intervention the subject was required to make no inappropriate requests for 15 minutes to earn a token. During Phases II and III the time limits were increased to 30 and 90 minutes. Phase changes occurred on a weekly basis, provided the responding stabilized, until the tokens could be faded out.

**Project 2.** The goal of project 2 was to increase Subject B's compliance to receiving daily insulin injections in a variety of sites on the body. While he exhibited no noncompliant responses to receiving injections in the buttocks, attempts to inject him in other areas of the body resulted in his refusal to cooperate with the injection procedure. Consequently, he was receiving injections in the buttocks each day. Consistently receiving injections in only one area over long periods of time is undesirable from a physiological perspective because it results in the breakdown of healthy skin tissue, and the build up of scar tissue (Travis, 1973). It is also undesirable for the subject to allow injections only in this area because he must use other sites when he begins to give his own injections.
The dependent variable for this project was the number of complies to nonbuttocks area injections. A response was scored as a comply if the subject made no physical attempt to stop or avoid the injection. Avoidance was defined as not being available for the injection with 5 minutes of the request.

All observations for this project were made by the subject's mother. Each morning she recorded what site she requested, whether or not the child complied, and the resulting injection site. No forced shots were given throughout this project. That is, if the child did not comply with the nonbuttocks site request, he was given the injection in the buttocks.

Interobserver agreement checks were carried out on 17% of all baseline days, 41% of all intervention days, and 40% of all follow up days. Two observers stationed in different areas of the room independently recorded the site requested, whether or not the child complied, and the resulting site. Percent of agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements. Since injections were given early each morning, all checks were carried out by two family members.

A token reinforcement program was also used as the intervention for this project. Each week the subject's mother drew a human figure and labeled seven injection sites with days of the week. The subject was required to comply with the injection site marked for the day to earn a token. He was allowed only one buttocks injection each week on this schedule. In addition to the token program, Subject B could also earn a small immediate reinforcer, a stick of sugarless gum, each day that he complied with the injection site request.
Project 3. Project 3 was initiated for the purpose of increasing Subject B's cooperation in saving urine samples for testing. His mother reported that he would usually urinate without either saving a sample for testing, or without informing her that an opportunity for testing was available. This was a rather dangerous behavior deficit since ideally four samples a day should be tested in order to monitor the child's physiological status (Ames, 1977).

The dependent variable for this project, saving a urine sample, was defined as collecting a urine sample at the appropriate time and informing a parent that it is available for testing. Each day the subject's mother recorded whether or not a sample was saved and reported on four occasions. These were: (a) in the morning before school, (b) after school, (c) before supper, and (d) immediately before bedtime.

Interobserver agreement checks were carried out on 15% of the days on which data were collected. Two observers independently recorded whether or not a sample was saved and reported during the specified observation period. While 80% of these checks were carried out by two family members, they were found to be reliable when checked against the trainer. Percent of agreement was calculated by dividing the number of agreements on whether or not a sample was saved by the number of agreements plus disagreements.

Three different intervention programs were carried out in this project. Phase I consisted of giving the child only feedback on this response through the placement of a star on a chart for each sample saved. Phase II was a combination cue-reinforcement procedure. A
cup with 4 pennies was placed in a visually strategic location in the bathroom. The child was allowed to take one penny each time a sample was saved. These first two phases were designed on the basis of the subject's and mother's report that he was not saving samples because he simply forgot. When it appeared that this was more of a problem of reinforcement than one of providing cues, Phase III was introduced. This phase again incorporated a token program in which the child earned tokens via ticket punches. These could later be exchanged for activity reinforcers.

All interobserver agreement checks on urine tests and insulin administrations were done between the trainer and family members who carried out these procedures. These occurred approximately once a week. Checks for urine tests were carried out for 65% of the days that results were reported. All checks on insulin administrations were carried out using the analogue method. These checks were carried out on 25% of all administrations.

Results

Figure 3 displays the data for the three projects carried out with Subject B. The top section of Figure 3 shows the number of inappropriate requests made per hour for project 1. During the baseline the subject made a mean average of 4.29 inappropriate requests per hour, with a range extending from 0 to 8 requests per hour. There is a large degree of variability in responding with an apparent downward trend evident in the first half of this data.
Figure 3: Number of inappropriate requests per hour, cumulative number of compliances to injection site requests, and percent of four possible daily urine samples saved by Subject B. Illness prevented data collection from day 22 to day 45. Subject B's mother failed to collect data for projects 1 and 3 at the 1 month follow up.
Subject B's mother became quite ill following the last baseline data point, and was consequently unable to continue collecting data for several weeks. This period is deleted from the graph (note hatch marks in Figure 3). Upon recovering from her illness she was requested to collect more baseline data prior to initiating an intervention, however, she did not do this. Consequently, no data on baseline responding immediately prior to the intervention is available.

During the 15 minute criterion phase of the intervention the subject emitted an average of 1.14 requests per hour. The range of responding for this phase is 0 request to 2 requests per hour. Under the 30 minute criterion no inappropriate requests were observed for 5 consecutive days. Only one of the observations during the 90 minute phase resulted in the detection of an inappropriate request. No follow up data were collected for this project due to the mother's heavy work schedule.

Interobserver agreement for baseline sessions was 100% using the total frequency method. For the intervention sessions 100% agreement was obtained on interobserver agreement checks using the occurrence plus nonoccurrence method described in the methods section.

For project 2, the number of complies to nonbuttocks injections is plotted in a cumulative fashion on the middle section of Figure 3. Subject B complied on only one occasion during the baseline phase, yielding a 7% compliance ratio to nonbuttocks injection requests. An increase in compliance to 88% is reflected by an immediate, sharp increase in the slope of the data following the introduction of the
intervention. The follow up data reflect a 100% compliance ratio. Days on which the weekly buttocks injection was allowed are not included in this data. Interobserver agreement checks for site requested, comply/noncomply, and resulting site all resulted in 100% agreement.

The percentage of urine samples saved for testing each day is displayed in the lower section of Figure 3. An average of 7% of the samples were saved during the baseline, with zero samples saved on the first 5 days, and one sample saved on each of the last 2 days. The feedback only phase of the intervention is characterized by a wide range of variability with an average of 25% of the samples saved in this condition. However, on 2 days 50% of the samples were saved, while on 2 of the other days no samples were saved.

After the cue plus penny phase was introduced, responding decreased to zero and remained stabilized there until the token program was introduced. It is interesting to note that Subject B also exhibited his lowest degree of compliance to nonbuttocks injections during the same period of time. While the introduction of the token program is accompanied by an increase to 27% of all possible samples being saved for testing, there is never any consistency in responding established. Percent of samples saved ranges from 0 to 75, with no observable pattern of responding established. Interobserver agreement checks for this project produced 100% agreement.

Figure 4 displays the major physiological variables for Subject B. No data are available for the weeks during which the subject's mother was ill. While Subject B required only 15 units of insulin
Figure 4: Number of insulin units required, percent of urine tests falling in acceptable range, and number of hypoglycemic and hyperglycemic reactions for Subject B. An insufficient number of tests were performed each day of the 1 month follow up to determine percent of in range samples.
FIGURE 4  DAYS FOLLOW UP

PROJECT 1  INTERVENTIONS  PROJECT 2  PROJECT 3  FOLLOW UP

UNITS OF INSULIN

PERCENT OF SAMPLES IN RANGE

NUMBER OF DAILY REACTIONS

HYPERGLYCEMIC  HYPOGLYCEMIC

DAYS  FOLLOW UP
a day when the baseline was initiated, this was increased to 18 units just prior to the intervention for project 1. Units required remained stable at this level until a decrease to 16 units occurred about half way into the interventions of projects 2 and 3. At the 1 month follow up the subject was still receiving 16 units per day. Interobserver agreement checks for insulin administration resulted in 74% agreement for measuring the syringe with fluid in, and 100% agreement with fluid out. While 74% is a somewhat low agreement percentage, the observers never differed by more than one unit in all observations.

There is very little data available on the percentage of urine samples which were within the ideal range because the subject's mother usually only tested about one sample a day. The data available is insufficient for discovering patterns in the results. One hundred percent agreement was obtained on all checks for urine testing. This subject was observed to have only two hyperglycemic reactions and one hypoglycemic reaction throughout the study. There are no obvious changes in these variables across conditions.

No hospitalizations were required for this subject during the period of time in which this variable was measured. There was a decrease in the subject's fasting blood sugar level from 411 mg % at the pre-course testing to 280 mg % at the follow up testing.

No items were endorsed on all administrations of the Walker Problem Behavior Identification Checklist. Subject B's mother identified six problem behaviors on the pre-course administration of the Juvenile Diabetes Problem Checklist, nine problems on the post-course administration, and 15 problems on the follow up.
Subject B's mother had an average score of 85% on the 8 weekly quizzes, with a range of scores from 53% to 100%. While she scored only .5 on the pre-course vignette test, she scored six points on the post-course administration. Her score dropped to three on the follow up testing.

Discussion

Subject B's mother successfully applied token programs in decreasing inappropriate food requests and in increasing compliance with injection rotations. While the 29 day delay between baseline and intervention in the food requests project requires that these results be interpreted cautiously, the effects of the token program on injection compliance are immediate and notable.

No definitive conclusions can be drawn about the effects of the token program alone for the urine sample saving project, since three different consecutive interventions were applied without replications. Both the token and feedback only conditions result in notable increases in responding compared to the baseline and cue plus penny conditions. The high degree of variability in the data suggest that neither condition exerted powerful control over responding.

As was mentioned in the discussion for Subject A, the existing evidence indicates that extrinsic reinforcers would be required to maintain increased responding with control related behaviors such as this. However, given the similarities in the average response rates under the feedback only and token conditions in this project, it would be beneficial to examine the long term effects of the feedback only
system on the percent of samples saved. In addition, while there were no changes in the criteria for the number of samples required for earning a reinforcer in this project, the effect of a gradual increase in the number of samples required to earn a reinforcer would be a worthwhile area for future study. Both token and back up reinforcers might have been earned more immediately in this project if the subject initially had to save only one sample a day. The resulting more immediate reinforcement would be expected to exert more powerful control over responding. Once control was established, the criterion for earning reinforcers could be gradually increased.

Of the three projects carried out with Subject B, the urine sample saving project is the only one that might be expected to influence physiological status. Saving urine samples for testing is one step in a chain of responses leading to physiological control. Decisions about diet, exercise, and insulin dosage are made on the basis of tests done on these urine samples. Adjustments based on these decisions will affect the diabetics' physiological status. Since this response is one of the initial steps in a chain of responses leading to improved control, the natural consequences for failing to maintain this behavior may be too delayed to influence responding. While four samples a day should be saved and tested to get the ideal amount of feedback upon which to make such decisions (Travis, 1976; Sandler & Sandler, 1977), Subject B was saving only 7% of this number of samples for testing prior to the interventions. Although the subject saved an average of only one sample a day during the two most effective interventions, this does represent a notable
increase in the amount of physiological feedback upon which to make decisions about diet, insulin, and exercise.

Since these decisions can be made on the basis of more complete feedback, increasing the number of urine samples saved may be expected to have some impact on the subject's physiological status. While there is insufficient data on urine test results to identify any effects, the subject's insulin requirements do decrease by 11% shortly following the initial intervention for project 3. Since a 10% change in insulin dosage is sufficient to affect diabetic control (Travis, 1973), this reflects a significant improvement in the subject's physiological status. This is also evidenced in a decrease in the subject's fasting blood sugar level when the pre-course and follow up results are compared. Although there is no definitive evidence in the data that these improvements were directly related to behavior changes, the results look promising, and indicate a need to study this issue further.

The interpretation that increasing the number of samples saved may be responsible for physiological improvements, as a result of increasing the opportunities to obtain physiological feedback, is consistent with the Soderberg (1972/73) results. While Soderberg did not measure insulin intake, it was reported that an increase in dietary compliance and in the frequency of urine testing improved daily urine glucose test results.

It is interesting to note that a nearly simultaneous decrease to 0% compliance occurs across both the injection rotation project and the urine sample saving project following the introduction of the
cue plus penny condition in project 3. This occurs while all three projects have interventions in progress. Since Subject B's mother reported difficulties in finding a variety of back up reinforcers to use in running three projects simultaneously, it is quite possible that Subject B became satiated on the limited number of reinforcers available. A state of deprivation may have reoccurred once extrinsic rewards for project 1 were faded out, since the subject then returned to higher rates of responding. The mother's verbal report also indicated that the response cost for complying with three separate projects at a time was too high. According to her, the subject reported several times that he was tired of keeping up with all three projects at once. Again, this problem seemed to be alleviated by dropping the formal intervention for project 1.

These observations indicate that too many projects were initiated within too short a period of time to effectively maintain responding. It appears that for some subjects there is a limit to the number of behaviors that can be modified within given time periods. Since treatment frequently involves interventions focused on more than one response, the effects of satiation, response cost, and the timing of interventions on responding would be a fruitful area for future research in applied settings.

In conclusion, while the timing of interventions makes it difficult to make definitive statements about behavioral control, the available data indicates that the subject's mother was able to gain some control over behaviors related to diabetic management. While there are some indications that this resulted in improved diabetic
control, the evidence is not conclusive. Further research on physiological effects is indicated.

Subject C

Five year old Subject C was diagnosed as a juvenile diabetic at age 3 1/2. Both parents are elementary school teachers, however neither had been involved in projects specifically related to behavior modification in the past. While Subject C's mother attended 90% of the classes and did the majority of the work on behavior change projects, his father also attended about half the classes and was involved in some of the home projects. Subject C's mother was able to complete the course requirements in the scheduled 11 weeks. Consequently, 6 weeks had passed for this family by the time the follow up was initiated.

Method

Project 1. The first project chosen by the subject's mother was an injection rotation project. As with Subject B, this child only allowed injections in the buttocks area. The purpose and rationale for this project is the same as that stated for Subject B. In addition, all observation and recording procedures, as well as the definitions used, were identical. As with Subject B, no forced injections were given. That is, any time the subject resisted attempts to give him injections in nonbuttocks areas, the injection was given in the buttocks and a noncomply was scored. Interobserver agreement checks were carried out for 17% of all baseline observations, and 14% of all
intervention observations, using the same method as that used for Subject B. No agreement checks were carried out during the follow up.

During the intervention the child was given tokens in the form of ticket punches. These could later be traded in for back up reinforcers. The subject was allowed one injection in the buttocks each week which was not scored as a noncomply or comply.

Project 2. While several authorities on juvenile diabetes suggest that children carry out as many of the testing and treatment procedures as possible on their own (Brunner & Suddarth, 1974; Ames, 1977), Subject A had not yet learned how to do urine tests. It was decided to teach him how to execute these tests for project 2 in order to increase his repertoire of self care skills.

The dependent variable for this project was correct or incorrect performances in carrying out the urine test. A correct response involved: (a) dipping the test stick in a urine sample, (b) waiting 30 seconds, then (c) correctly matching the resulting color on the test stick with the color code printed on the Diastix bottle (Ames, 1977; Upjohn, 1977).

Subject C's mother carried out all observing and recording for this project. During the baseline, she observed whether the child was able to correctly discriminate 30 seconds, and whether or not he was able to correctly carry out the color matching task. Since he was unable to do each of these tasks on repeated occasions, she did not attempt to observe him attempting the whole testing procedure. During Phase I of the intervention a correct response was scored.
even if the child received cues and prompts from his mother in executing the test. During the second intervention phase a response was scored correct only if the test was carried out with no cues or prompts.

Interobserver agreement checks were carried out on each of the two baseline observations by the assistant trainer and Subject C's mother. Interobserver agreement checks were run on 17% of all intervention observations and 17% of all follow up observations. While some of these checks were carried out by the mother and father alone, 60% of all the checks included the assistant trainer. These checks showed the parents to be reliable in their observations. Checks were run by having two observers watch the child do the procedure and then independently record whether it had been carried out correctly or not. Percent of agreement was calculated by dividing the number of agreements that the child did the test correctly or incorrectly by the number of agreements plus disagreements.

Utilizing a variety of prompts, cues, and social reinforcers, the subject's mother designed a shaping procedure to use in training the child to do the test. Time discrimination was taught by placing a strip of tape across the face of a clock, thus dividing the face in half, to help the child discriminate a 30 second sweep of the second hand. During the no prompts phase this was removed. Color discrimination, and correct sequencing, was taught by using physical prompts, verbal cues, and social reinforcers for successive approximations of the desired goal. Prompts and cues were removed after the child was able to carry out the procedure correctly on 5 consecutive days.
Project 3. Since chronically ill children must depend so heavily on their parents' attention for a variety of needs, often related to survival, these children may often develop a deficit in independent behaviors in general (Mattson, 1972; Appelboom-Fondu et al., 1974; Prazar & Felice, 1975; Creer & Christian, 1976; Christian, 1977; Sandler & Sandler, 1977; and Christian & Knapp, Note 1). In order to increase Subject C's repertoire of independent behaviors, his mother chose independently boarding the school bus as the focus of project 3. While Subject C rode the bus to school each day, he would not leave the house to board the bus unless his mother accompanied him.

A response was defined as an "independent boarding" if the subject left the house and boarded the bus without requiring that his mother accompany him. The subject's mother recorded whether or not he boarded the bus independently each day that he was required to ride the bus. Interobserver agreement checks were carried out on 32% of all of the observation sessions by the mother and the bus driver. Subject C was given a sticker in the form of an animal by the bus driver each day that he boarded the bus independently. On days in which interobserver agreement checks were carried out, the subject's mother compared her morning recording with the presence or absence of a sticker. Percent of agreement was calculated by dividing the number of agreements that the subject did or did not independently board the bus by the number of agreements plus disagreements.

A token reinforcement program was also instituted as the intervention for this project. The subject's teacher gave him a peanut
each time he showed her one of the animal stickers given to him for an independent boarding by the bus driver. These animal stickers were also placed on a public chart in the home each day.

Interobserver agreement checks on insulin administration were carried out on 24% of all observations. Of these checks, 26% were done by a parent and the assistant trainer using the analogue method. The remaining 74% were carried out by both parents during regular insulin administrations. The parents were allowed to do these checks after the assistant trainer found them to be at least 80% reliable. In addition, checks with the assistant trainer were carried out during initial and latter phases of the study to ensure the parents remained reliable.

Interobserver agreement checks on urine testing were carried out on 26% of the days on which observations were made. Thirty-five percent of these checks were carried out by a parent and the assistant trainer. The remaining checks were carried out by the parents. As with insulin checks, checks with the trainer were spread throughout the study.

Results

The results of the three projects carried out with Subject C are displayed in Figure 5. The upper section of this figure shows the number of compliances to nonbuttocks injections in cumulative form. The planned weekly buttocks injection, which was not scored, is not included in this data. Only compliances and noncompliances to nonbuttocks site requests are reported. Subject C initially complied
Figure 5: Cumulative number of compliances to injection site requests, percent of urine tests done correctly, and cumulative number of independent bus boardings for Subject C, including 6 week follow up.
**Figure 5**

The diagram illustrates the change in cumulative injection complies, percent of correct urine testings, and cumulative independent boardings over time.

- **Baseline** shows a steady increase in complies and no change in testings and boardings.
- **Tokens** phase sees a rapid increase in complies and a slight decrease in testings and boardings.
- **Follow-up** indicates a less significant increase in complies and minor changes in testings and boardings.

The diagram highlights the effectiveness of token reinforcement compared to baseline conditions.
with 43% of the requests for injections in nonbuttocks sites. After the token system was introduced, this increased to 95% compliance. No noncompliances occurred following the first week of the intervention. The subject complied with 100% of all injection site requests during the 6 week follow up. One hundred percent interobserver agreement was obtained on all checks.

The results of project 2 are displayed in the center section of Figure 5 in the form of percent of correct trials in carrying out the urine testing procedure. During the baseline observations the subject made five attempts at time discrimination and one attempt at color discrimination during each of the two observation sessions. The results show he was unable to successfully carry out either of these on all trials. During the prompts phase of the intervention the subject was able to successfully carry out both tasks in performing the procedure. In the no prompts condition, the subject was able to carry out both time and color discrimination correctly, and in the correct sequence, with no assistance from his mother. This responding continued into the 6 week follow up, during which he was doing at least one test a day on his own. All interobserver agreement checks resulted in 100% agreement that the tasks were or were not being done correctly.

The data between the baseline and the first intervention phase may be viewed more as a pre-post type data than as a learning curve. Subject C's mother did do some training, using the shaping procedure, in between the last baseline day and the initial intervention day shown in Figure 5. She did not collect any formal data during this
training. There is no data missing between the prompts phase and the no prompts phase however, suggesting that these tasks were learned quite quickly.

The number of independent bus boardings for project 3 are presented in cumulative fashion in the lower section of Figure 5. The subject made no independent boardings during the baseline condition, but made all boardings independently during the intervention and follow up. The days which have no data represent days during which school was closed. There was 100% agreement on all interobserver agreement checks made.

The multiple baseline design for this subject is somewhat weakened by the fact that the subject's mother initiated an intervention on project 3 only one day after beginning formal observations on project 2. Consequently, there is no overlapping of data from different conditions on these two projects.

Data on insulin intake, urine tests results, hypoglycemic reactions, and hyperglycemic reactions are presented in Figure 6. With the exception of the follow up, no significant changes in the amount of insulin required occur across the course of the study. Prior to any interventions, the subject received an average of 10.5 units per day. There is a very slight increase to a mean of 10.9 units for the interval between interventions 1 and 2, and another slight increase to a mean of 11.1 units for the interval following interventions 1 and 2 prior to the follow up. During the follow up phase the subject required a mean of 13.25 units per day. Interobserver agreement for all checks on insulin administration was 100%.
Figure 6: Number of insulin units required, percent of urine tests falling in acceptable range, and number of hypoglycemic and hyperglycemic reactions for Subject C, including 6 week follow up.
While there is a noticeably high degree of variability across the study for percentage of urine samples falling in the acceptable range, some differences are observable when these results are compared with respect to the interventions of behavior change projects. While a mean of only 26% of the samples fall within this identified range prior to the onset of any interventions, 46% of the samples collected following intervention 1, and prior to intervention 2, fall within the acceptable range. Between the intervention of project 2 and the follow up there is a slight drop to 37% of the samples falling within range. Samples collected during the follow up decrease to only 22% in range. It is important to note that the increases in percent of samples in range occur while there is very little concurrent change in the amount of insulin received by the subject. This figure also shows no noticeable changes in the rate of hypoglycemic or hyperglycemic reactions. One hundred percent agreement was produced across all interobserver agreement checks for urine testing.

No hospitalizations occurred for this subject during this study. While the pre-course fasting blood sugar was 176 mg %, the sample tested during the follow up was 252 mg %.

One item was endorsed on the Juvenile Diabetes Problem Checklist on the pre-course administration. Two items were endorsed on the post course administration, and one was checked at the follow up. While seven items were initially endorsed on the Walker Problem Behavior Identification Checklist, three problem behaviors were checked for post course administration and only one item was checked for the follow up.
Subject C's mother had a mean score of 93.25% on the 8 weekly quizzes. She earned 2 points on the pre-course vignette test, 9.5 points on the posttest, and 10.5 points on the follow up test.

Discussion

Along with the three projects described in the methods section, the subject's mother also implemented an exercise program for Subject C. No data were graphed for this project because the subject complied with 100% of all requests to carry out specific exercises during the baseline. While it had been planned to implement a token program as an intervention, the baseline observations indicated that verbal requests and social reinforcers were sufficient in increasing exercise to the desired level. Two interobserver agreement checks carried out by the mother and assistant trainer resulted in 100% agreement that compliances were occurring.

Although there are studies available on increasing the frequency of urine testing in diabetic children (Lowe & Lutzker, In Press; Knapp, Note 3), there are no reports on the use of behavioral techniques in teaching the acquisition of this skill. The results of project 2, however, show that the shaping procedure developed by Subject C's mother was effective in teaching the 5 year old child to complete the testing procedure with no prompts or cues. It is also noteworthy that this was maintained at 100% correct responding at the 6 week follow up.

These results are quite significant in view of the fact that this procedure involves time discrimination, subtle color discrimination,
and the proper sequencing of at least three separate tasks. Given this information, this project may be seen as an extension of the Renne and Creer (1976) study, in which asthmatic children were taught to use inhalation therapy equipment via shaping. It appears that shaping can also be effective in teaching diabetic children to perform rather complicated self care procedures at a very young age. The benefits of having chronically ill children carry out self care procedures include decreasing the chance that they will become excessively dependent upon their parents (Prazar & Felice, 1975; Knapp, Note 3), and the development of a clearer understanding of how their behavior affects their illness (Creer & Christian, 1976).

The data on physiological variables show a notable increase in the mean number of urine tests falling within the acceptable range following the initiation of the exercise project and the intervention of the injection rotation project. Data on insulin dosage show that there were no concurrent significant increases in insulin intake. Consequently, this improvement in urine test results was not due to changes in insulin. While the injection rotation project would not be expected to have a direct influence on physiological indicators of diabetic control, increased exercise is recommended as a way to burn up excess glucose (Travis, 1973; Brunner & Suddarth, 1974; Bricklin, 1976; Sandler & Sandler, 1977). The exercise program was initiated on day 12, just prior to the beginning of an increasing trend in the number of urine tests in range. Given these results, it appears likely that the exercise program was at least partially responsible for the noted physiological improvement. Unfortunately, while it is frequently
recommended that exercise will improve diabetic control, no controlled studies reporting the modification of exercise behaviors in diabetics are available. The present results indicate that further research in this area should be pursued.

The 6 week follow up data show that the improved physiological status was not maintained after formal course participation ended. This is reflected in an increased insulin dose, an increased fasting blood sugar level, and a decrease in the percentage of in range urine test results. This data were collected immediately following the Christmas holidays when, according to the subject's mother, the family routine was off schedule, the child was getting less exercise due to the cold weather, and he had been straying from his diet as a result of the holiday celebrations. While each of these factors would be expected to have a negative impact on diabetic control, the follow up data indicate that maintenance of behavior changes and parental consistency in carrying out such programs must be actively programmed. With the diabetic child, it appears that failure to do so results in not only behavior change setbacks, but physiological setbacks as well. As was noted before, the paucity of information on increasing the maintenance of behavior changes and parental consistency reflects an area in which further research would provide valuable data.

Emotional factors are also reported to have an influence on the diabetics physiological status (Lachman, 1972; Mattson, 1972; Travis, 1976). Fowler et al. (1976) showed that physiological status improved for a diabetic who was given relaxation training via EMG feedback. Bauer and Kenny (1975) report that training the family of a diabetic
child in conflict resolution skills, and giving the child relaxation training, produced a drastic reduction in the number of hospitalizations for ketoacidosis. For Subject C, the injection rotation project produced a significant increase in compliance to nonbuttocks injections, thus eliminating the need to physically force injections on the child. While it is also possible that the decrease in aversive parent-child interactions which accompanied forced injections may have played a part in improving physiological status via the improvement of emotional factors, the available data are not extensive enough to support this potential explanation.

While interventions were initiated almost simultaneously for projects 2 and 3, there are at least two staggered interventions followed by immediate behavior changes. Consequently, while there are shortcomings in this design, the available data does indicate that the behavior management projects were responsible for the behavior changes observed. The difficulties in controlling the proper timing of interventions for both Subjects B and C suggest that home based research projects need to be closely monitored to insure adherence to research design constraints.
GENERAL DISCUSSION

Two experimental questions were examined in this study. First, can parents modify diabetic management behaviors exhibited by their children as a result of participating in a parent training class? Secondly, will these behavior changes produce an improvement in physiological indicators of diabetic control?

The results indicate that the parent training class can be an effective means of helping parents improve diabetic control related behaviors in their children. The results obtained with behavioral interventions appear to be fairly representative of the magnitude of results found in prior research on group parent training. In addition, all three mothers reported using the techniques in managing behaviors outside of class initiated projects. The mothers also demonstrated an ability to modify behaviors resulting from the "illness trap," such as excessive dependent behaviors and social skill deficits (Creer & Christian, 1976; Christian, 1977, Knapp, Note 3). Token programs were employed as interventions for most of the projects because of the flexibility such programs hold for using a variety of reinforcers and for adding new behavior change projects.

The deposit system appeared to be quite effective in getting the parents to complete classes and data collection assignments. All three mothers received the 10 training units through either class attendance or make-up home visits. Only one of the mothers lost money, about $3.50, for failing to complete the required data collection assignments.
While close supervision was required for most of the mothers in implementing projects, the available follow up data indicate that for most projects they were able to maintain improvements after formal contact with the trainer was discontinued. In the few cases in which behavioral or physiological effects were not maintained, lack of maintenance was primarily due to inconsistent application of the procedures by the mothers. As was previously mentioned, this is an area in which further research is badly needed.

Previous studies show that parents can be successful primary behavior change agents in modifying medical treatment behaviors exhibited by their children (Neisworth & Moore, 1972; Creer et al., 1974; Fox & Roseen, 1977). The results of the present study not only support these findings, but also indicate that parents can be trained to do this using a group format. The present study also supports and extends the findings of previous studies on diabetics in particular. While these studies (Lowe & Lutzker, In Press; Soderberg, 1972/73; Knapp, Note 3) show behaviors related to diabetic control can be improved via the application of operant techniques, the present results indicate that parents can be trained in a group format to utilize these techniques in modifying control related behaviors exhibited by their children. Since parents can be trained to modify these behaviors as a result of group training, such a program could be incorporated into existing diabetic education classes without having to modify the format. It should be noted, however, that for each class in this program there were never more than three sets of parents in attendance. Consequently, caution is required in
generalizing the effectiveness of such a class to programs which may involve larger numbers of participants.

The physiological data show that some improvements in physiological indicators of diabetic control occurred concurrent with the mothers' class participation for two of the subjects. Subject B had a significant decrease in insulin requirements, and Subject C showed an increase of urine test results in the acceptable range. These results are consistent with previous findings, which show that behavior modification techniques can produce extensive enough behavior changes to result in physiological improvements (Soderberg, 1972/73; Fowler et al., 1976). While physiological changes in the present study are neither dramatic nor immediate enough to make any definitive conclusions about their relation to behavior changes, they do suggest that this issue be studied more extensively in future research. This may be best accomplished by targeting behaviors which would be expected to have an immediate effect on physiological control, such as exercise and dietary compliance. Modification of behaviors such as these may involve projects directed at parental behaviors, as well as the childrens' behaviors. Behaviors such as prompting exercise, having only appropriate foods available, and actively enforcing contingencies for dietary compliance at meals would involve more of a response cost to the parents than many of the projects included in this study. Consequently, contingencies for the parents' responding may be required to maintain consistency in carrying out interventions on such behaviors.

Given the results of this study in conjunction with previous findings, it appears that including behavior management training as
part of the education of parents of diabetics would prove beneficial. In an evaluation survey completed by the participants of this study, all three mothers stated that a program in behavior management should be a routine part of diabetic education. Each also stated that they would recommend such a program to other parents of diabetic children. An ongoing program such as this would involve less of a response cost to the parents and trainer than that involved in this study, since there would be no requirements for reliability checks and formal data collection. Consequently, a program such as this may appear even more attractive to service deliverers and consumers as an ongoing service.

The success of this program also suggests that adults required to follow strict medical regimens may benefit from courses in behavior management which focus on training self control techniques. As Knapp and Peterson (1976) and Lowe and Lutzker (In Press) point out, it would also seem beneficial to train more physicians in the use of behavior management techniques. While this could be incorporated into an existing medical school program, training physicians already in practice could prove to be a fruitful topic for future research.

The application of behavioral principles to diabetic management is an area in which a number of issues need to be explored. More extensive study of the maintenance and generalization of effects should be carried out. The area of cost/benefit analysis has yet to be studied. It would be beneficial to study the application of self control techniques in improving diabetic management, particularly with
adolescents. Although adolescence is seen as the most difficult time for juvenile diabetics (Appelboom-Fondu, 1974; Sandler & Sandler, 1977), no published experiments on behavior management have been done with this population. Finally, although parents carry the major responsibility for performing the daily tasks of management with very young diabetics, no work has been done on increasing their compliance with the prescribed medical regimen.

It is estimated that 45% to 70% of diabetics are in poor control (Williams et al., 1967). Good control, however, can only be attained by achieving the proper balance of insulin, food intake, and energy expenditure. Each of these factors involves the performance of specific behaviors by the patient or the patients' parent. The present study demonstrates that behavior modification techniques can be successfully employed by parents in helping their child achieve this essential balance of behaviors.
REFERENCE NOTES


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