BEHAVIORAL MODIFICATION OF TRAINABLE
MENTALLY RETARDED CHILDREN

by

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ABSTRACT

BEHAVIORAL MODIFICATION OF TRAINABLE MENTALLY RETARDED CHILDREN

by

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In Experiment I, contingency management was employed with five non-institutionalized trainable retardates (mean MA=4.1, CA=9.9, and language age=2.6) in a classroom situation. Empirically determined high probability behaviors were displayed as colored cartoon figures in a reinforcement menu. Tasks from the Peabody Language Development Kit defined the behavior strengthened during 15 one-hour sessions. A quantity of low probability task behavior had to occur in order for subjects to emit 4 minutes of high probability reinforcing activity. Through contingency management, amount of task per reinforcement was shaped from a low ratio to a high ratio. Significant gains in language age (p<.01) were obtained. A posttest administered 6 months after termination of the experiment indicated the gains in language age were maintained.

In Experiment II, the five children of Experiment I and another trainable retardate served as subjects. Dependent upon the behavioral change desired of the subject in the classroom situation, each subject had to meet the criterion of increasing or decreasing the specified behavior to receive the reinforcement menu and engage in 4 minutes of high probability reinforcing activity. Contingency management
over 15 one-hour sessions was successful in reducing and possibly ex-
tinquishing the rate of aggressive acts, delays in starting work, 
shouting, leaving the desk during lessons, and refusing to obey teacher 
instructions. Frequency of task relevant vocalizations was also in-
creased by this technique. During an unsystematic observation of the 
subjects 6 months after termination of the experiment, the undesirable 
behaviors occurred once an hour on the average, a rate far below the 
baseline frequency. Task relevant vocalizations which had been shaped 
to a high frequency during the experiment were emitted at a rate high-
er than the rate obtained during the baseline period.
Mental retardation is the most widespread of childhood disorders in America with approximately 126,000 retarded children born each year (Richmond and Garrard, 1966, p. 16). The present trend is to view the retardate as more than a statistic. A pertinent dynamic interpretation of mental retardation states:

Each mentally defective person must be considered, not as belonging to a homogenous category called mental deficiency, but as an individual; his subnormal intellectual functioning must be looked on, not as an isolated phenomenon, but as part of his total presenting situation and history; his condition must be considered, not as constitutionally or organically determined, but as an interdependent complex of constitutional or physiologic processes, interpersonal processes, and socio-cultural processes; and from a research standpoint, the mental defective must be approached, not with an assumption of irreversibility and permanence, but with the assumption that benevolent intervention may lead to reversibility or improvement of the condition. (Perry, 1966, Pp. 350-351)

Further, mental retardation can be considered to be "... a total situation complex, integrated on the basis of presumed or observed subnormal intellectual functioning" (Perry, 1966, p. 354).

Mentally retarded children present serious behavioral and learning problems to their parents and as the children reach school age, these difficult problems are in turn presented to their teachers and administrators. Trainable retarded children are characteristically restless, aggressive, unpredictable, and difficult to manage. Teachers tend not to welcome the presence of such children in their classrooms. Home discipline and training have often failed to create children willing and able to care for their personal hygiene and to follow instructions of those
persons responsible for their behavior. The problems of "... nega-
tivistic, stubborn, hyperactive, hostile, destructive, and sometimes
aggressive behavior" are those most frequently brought to the consul-
tants by special education teachers (Berlin, 1966). Specifically,
problems exist in the areas of mobility, perception, eyehand coordina-
tion, language development, and social abilities, all of which are in-
volved in educating the retarded child.

Environmental control has been suggested as a possible solution to
these behavioral problems. Zeaman and House (1963) postulated the
secret in training retarded children lies in the engineering of the
retardates' attention. Ellis (1963) was of the opinion that the appli-
cation of "shaping techniques" to retardates could increase the behav:
ioral repertoires of the retardates. Ayllon and Michael (1959) and
Williams (1959) developed a new technique employing behavioral engi-
neers. Zimmerman and Zimmerman (1962), Barrett and Lindsley (1962),
and Wolf, Risley, and Mees (1964) also used behavioral engineers to
program acquisition and maintenance of desirable responses in children
such as listening attentively as a lesson was presented in class.

One of many techniques available for behavioral control which
grew out of early attempts at systematic environmental control of hu-
mans was a contingency management system as adapted by Homme et al.
(1963). Specifically, it was taken from Premack's differential prob-
ability principle: "For any pair of responses, the more probable one
will reinforce the less probable one" (Premack, 1965, p. 132). The
phrase "any pair of responses" implies the form of the behavior is ir-
relevant and that response probability is the most important feature
of the relationship between the two responses. Thus, in an applied
sense, contingency management is the manipulation of a relationship between responses so that a quantity of low probability behavior must occur in order to have the opportunity to emit a quantity of high probability reinforcing activity. Homme (1965) and Addison and Homme (1966) have described these reinforcing activities with stick figures arranged in the form of a reinforcement (RE) menu. Thus, in this form of contingency management exist the ingredients for behavioral management with a relatively unlimited source of reinforcing activities available from man's rich behavioral repertoire.

The Premack principle was effective as employed in the control of nursery school children (Homme et al., 1963); preschool, non-English speaking Indian children (Homme, 1965); adolescents (Homme, 1964); and a young, nontalking retardate (Homme, 1966). Contingency management had also been successfully applied to school-like tasks (Homme, 1964; Homme, 1965) and behavioral tasks (Homme et al., 1963; Homme, 1966). Accordingly, two experiments were designed to extend systematically the applicability and effectiveness of contingency management in the areas of development and behavioral management with trainable mentally retarded children in a classroom situation.
CHAPTER II
REVIEW OF THE LITERATURE

General background

The principles for analysis of behavior by operant conditioning were derived primarily from experiments on infrahumans (Hilgard, 1956). In the 1950's, operant conditioning was increasingly applied to analyzing human behavior. Lindsley (1954) extended behavioral control to psychotic adults and children using candy and picture reinforcements for responding on a lever to visual stimuli in an operant conditioning paradigm. He reported successful use of variable interval, fixed ratio, fixed interval, and mixed schedules with psychotic subjects. In 1956 Lindsley extended his analysis of chronic schizophrenic behavior by increasing the available reinforcers to include cigarettes, coins, and food morsels. This research was also conducted in a specially constructed laboratory. Lindsley concluded that an operant analysis was probably impractical for short-term investigations of behavior due to large financial and temporal investments in laboratory facilities, need of highly skilled technicians for equipment maintenance, and necessity for special training sessions for patients in use of the equipment in order to obtain useful response rates (Lindsley, 1956).

Azrin and Lindsley (1956) employed operant conditioning techniques to develop cooperative behavior between normal children. Two children were required to respond simultaneously on the levers. This cooperation by the children was achieved without specific instructions to develop such action using jelly beans as reinforcing stimuli. Hence,
presentation of a single reinforcing stimulus developed and maintained the desired cooperative response in twenty normal children whereas withholding the jelly beans eliminated the cooperative response.

Ferster (1958) argued for treating the mental patient's behavior as the prime subject matter of therapy. He emphasized the use of positive reinforcement and intermittent reinforcement to control behavior and hinted that operant conditioning techniques could effectively be employed to control human behavior outside the laboratory:

To the extent that behavioral processes are reversible, it should be possible to change any performance by manipulating the relevant factor within the context of the same process in which it originally was generated. (Ferster, 1958, p. 118)

He indicated the possibility of using large numbers of individuals to program reinforcements and punishments contingent upon another individual's behavior.

Further extension of operant conditioning techniques to humans

Flanagan, Goldiamond, and Azrin (1958) used response-contingent consequences to obtain control of stuttering behavior. Stuttering was intensified by making escape from an aversive tone or shock contingent upon stuttering. Suppression of stuttering in three male subjects was achieved when the presentation of aversive stimuli was contingent upon stuttering. The authors noted that reinforcing stuttering with aversive stimuli on a variable-interval schedule could constitute a therapeutic program for stutterers.

A study by Bullock and Maline (1958) compared the behavior of retarded and non-retarded children in a "work-for-reward" situation using candy reinforcement. Both normal and retarded subjects of a higher
mental age tended to respond at higher rates and to exhibit less intra-individual variability in response rates. It was found that overall group response rates and rates during the conditioning and extinction periods were not significantly different between the non-retarded and the retarded groups of subjects. Orlando and Bijou (1960, 1961) within a laboratory setting used variable interval, fixed interval, variable ratio, and fixed ratio reinforcement schedules with institutionalized children of various diagnostic categories. The schedules' effects corresponded to those found with infrahuman subjects (Orlando and Bijou, 1960). Ellis, Barnett, and Pryer (1960) demonstrated stability of schedule control with retardates. Explorations of multiple-schedule performances of retarded children were undertaken which lead to the conclusion: multiple-schedules could be used effectively with such subjects for rapid acquisition of discriminations (Orlando and Bijou, 1961). Stability of schedule control was good with retardates with the kinds and values of the schedules determining the response rates. A standard lever and candy reinforcements were used in all three experiments.

Ferster, in an experimental analysis of behavioral deficits of autistic children, emphasized that the large majority of the "atavistic" behavior of autistic children was under stimulus control of social environmental consequences (Ferster, 1961). This control was maintained by specific stimuli and not by generalized stimuli. Changes in the environment weakened the child's probability of responding, and thereby was reinforced, because the novel environment required slightly different forms of behavior from the child (Ferster, 1961). Due to the
parents being the source of social reinforcers for the young child, the parents were also responsible for controlling the child's performance to the extent that the child's behavior was weakened as in autism.

An investigation of the acquisition of operant discrimination and differentiation in retarded children was conducted by Barrett and Lindsley (1962) with institutionalized children. A laboratory setting which contained two plunger operanda and a wall panel with two lights was used to generate differentiation, discrimination, and a combination of differentiation and discrimination processes using retarded subjects. Pennies and various candies were used as reinforcements. Response differentiation generally occurred before stimulus discrimination with patterns of acquisition which ranged from rapid acquisition to no acquisition of the response (Barrett and Lindsley, 1962).

Thus experiments by Lindsley (1954, 1956); Azrin and Lindsley (1956); Flanagan et al. (1958); Bullock and Maline (1958); Ellis, Barnett, and Pryer (1960); Orlando and Bijou (1960, 1961); Ferster (1961); and Barrett and Lindsley (1962) were examples of the successful extension of operant conditioning techniques to psychotic adults and children, normal children, stutterers, and retarded children.

**Development of behavioral engineering programs**

In the late 1950's an attack was made upon the problem of having to use elaborate equipment in laboratory settings to control behavior when operant researchers began to extend operant principles to field studies. Ayllon and Michael (1959) were among the first experimenters to use behavioral engineers by programming psychiatric nurses to perform operant conditioning with selected inmates of a mental hospital. The nurses
generally were required to make time-sample observations for those behaviors not involving patient-nurse contact and to record the frequency of those behaviors involving patient-nurse interaction. Instructional emphasis for the nurses was centered on the operation of the nurses' giving or withholding social reinforcement contingent upon a desired class of patient behavior. Usually reinforcement was given on a fixed interval schedule with a limited hold due to the use of time-sample observations. Programs applied by the nurses to undesirable patient behaviors included extinction, extinction combined with reinforcement for incompatible behavior, strengthening incompatible responses, strengthening weak behavior by escape and avoidance conditioning, and weakening strong behavior with a combination of extinction for social attention and stimulus satiation. Though not as efficient nor reliable as the usual laboratory components for recording and programming behavior, the nurses were effective in bringing about desired behavioral changes in the subjects. Ayllon and Michael concluded the nurses' failures to carry out experimenter instructions were unsystematic with respects to the results of the experiments.

Another study using behavioral engineers was the work of Williams (1959) who explored the use of parents and an aunt as behavioral engineers when he programmed them to extinguish tantrums in a 21 month old boy. Extinction was achieved after the engineers carried out instructions not to reinforce the tantrums by refusing to re-enter the boy's room despite his crying and screaming after putting him to bed. The implications of these two studies were that operant conditioning could be successfully used to control human behavior outside the laboratory.
setting and that individuals other than scientists could be quickly and effectively trained to carry out operant conditioning programs efficiently.

Ayllon and Michael (1959) used psychiatric nurses again as behavioral engineers while exploring use of food as a reinforcer for controlling psychotic behavior in mental patients with eating deficits. The authors' analysis was that nurses' social reinforcement was responsible for shaping patients into eating problems. Accordingly, nurses were instructed to remain apart from the patients at mealtimes. Following the development of food as a reinforcer, nurses shaped development of a coin as a discriminative stimulus for patients to gain access to the dining room when access to the room was limited to 5 minutes from the time of meal call. On the first day of the experiment, nurses used some verbal shaping to elicit the desired responses from the patients (Ayllon and Haughton, 1962). In a third experiment, a social response involving the cooperation of two patients to operate a light-buzzer device was required to obtain the coin to enter the dining room. The nurses were used to shape the desired patients' responses. Results of the three experiments indicated the nurses were effective in conditioning the desired patient responses. Another use of behavioral engineers was in an experiment by Sulzer (1962). He used the social reinforcement provided by an alcoholic's two friends to create a program to strengthen the alcoholic's nondrinking behavior. The friends were instructed to serve as contingency managers by remaining with the "patient" in a social situation only as long as the "patient" ordered or drank soft drinks. Sulzer reported the program was effective as cessation of the alcoholic's drinking behavior was effected. Ayllon
(1963) continued to use psychiatric nurses as behavioral engineers. He programmed nurses to control towel hoarding in patients through stimulus satiation and to control clothes hoarding through making meals contingent upon removal of excess clothing.

Operant conditioning techniques were extended to the classroom when Zimmerman and Zimmerman (1962) shaped and maintained productive classroom behavior in two emotionally disturbed boys by removing social reinforcement for undesirable behaviors. Tantrums, irrelevant verbal behavior, and baby talk were effectively eliminated by the manipulation of social consequences within the classroom situation. Other behavioral control studies conducted in a school setting included the training of nursery school teachers to use social reinforcement to reinforce differentially play relationships in a young girl who showed marked isolate behavior (Allen et al., 1964). Nursery school teachers were programmed to provide social reinforcement contingent upon walking and social interaction in a child who had regressed to crawling (Harris et al., 1964). Hart et al. (1964) were also able to train nursery school teachers in differential application of social reinforcers to extinguish operant crying in two nursery school boys.

Wolf, Risley, and Mees (1964) developed programs to be used by an autistic boy's attendants and parents to control his tantrums, manner of eating, verbal behavior, and wearing of glasses. In the programs, emphasis was placed on provision of differential reinforcement by the attendants and parents for desirable behavior such as wearing glasses. Removal of all social reinforcers for a period of time was made contingent upon undesirable behavior such as temper tantrums. Six
months after the boys's discharge from the mental hospital, he was still wearing his glasses, eating properly, and not producing tantrums which indicated the treatment was highly effective.

Davison (1965) reported on a program from training undergraduate university students to operate as reinforcers for autistic children in a daycare center. Differential reinforcement using attention, praise, and candy provided by the student was the basic procedure used in the program for the autistic children. The students received 1 month of classroom training in behavioral modification techniques and then completed training at the day-care center. Davison concluded one major result of the study was that students had been adequately trained in a short time to perform as behavioral engineers with autistic children (Davison, 1965).

Other behavioral control studies conducted outside a laboratory included one using the withdrawal of social reinforcement to extinguish vomiting in an institutionalized retarded girl (Wolf et al., 1965). Birnbrauer et al. (1965) also used operant techniques to shape and maintain good study habits in children in a classroom for educable mentally retarded children. Behavior problems were handled by ignoring undesirable behavior and by reinforcing desirable behavior with praise and token reinforcers in the form of paper stars.

Premack principle of reinforcement

A restatement of the nature of reinforcement by Premack (1959) also became an impetus for researchers to extend behavioral control to humans outside the laboratory.
Reinforcement results when an R (response) of a lower independent rate coincides, within temporal limits, with the stimuli governing the occurrence of an R of a higher independent rate. (Premack, 1959, p. 219)

Premack concluded: "... any response A will reinforce any other response B, if and only if the independent rate of A is greater than that of B" (Premack, 1959, p. 220). By careful analysis of response contingencies and the ranking of responses along a rate continuum, a researcher could develop a ranking of reinforcement values and thereby avoid having to use weak reinforcers.

**Extension of Premack principle to contingency management**

Homme et al. (1963) extended the Premack principle of reinforcement to control behavior of nursery school children. Low probability behaviors such as sitting quietly for a period of time were reinforced by making high probability behaviors such as running or screaming contingent upon performance of the low probability behavior. Within a few hours the experimenters had strong control of the children's behavior.

Premack (1965, p. 132) amplified his emphasis on the reinforcing response: "... of any two responses, the more probable response will reinforce the less probable one." Considerable laboratory support was presented for this concept. He also indicated the probability of any one response could change over time, thereby bringing about a change or even reversal in the reinforcement relationship between any two responses. Thus, by applying the differential probability principle of Premack, a researcher would have available to him an unlimited number of reinforcers from man's behavioral repertoires.
Refinement of contingency management techniques

Homme and Tosti (1965) further refined the Premack principle for use in a contingency management system of motivation. They stressed reinforcing some amount of defined task or low probability behavior by making some period of high probability or reinforcing behavior contingent upon emission of the task. Homme (1965) used the principle to manage contingencies of preschool, non-English speaking, Indian children. Low probability behaviors consisting of using English vocabulary items were strengthened by high probability behaviors such as working a puzzle or coloring. The question of how to present a large number of reinforcing (RE) choices to the subjects was answered by representing those high probability behaviors with schematic line drawings which were presented in a "menu-like brochure." The idea of the reinforcing event (RE) menu was further developed by Addison and Homme (1966) to serve as a prompting device for the contingency manager and the subject by presenting in pictorial form all the available RE choices.

Whelan and Haring (1966, p. 283) presented an article in which they urged the teachers of special education classes to adopt contingency management techniques: "The challenge for educators is to utilize behavioral principles to modify undesirable and maintain desirable behavior in emotionally disturbed children." Walder (1966) also advocated the use of contingency management techniques in the special education classroom due to results of his training parents of public school children and parents of autistic children to modify their children's behavior. Individual therapy sessions and "group educational meetings" were occasions for instructing the parents in techniques of extinction,
positive reinforcement, and shaping. Walder concluded that parents with such training could be used as "helping" teachers in a day treatment center for autistic children. "The parent who has learned principles of behavior modification would, under supervision, be an ideal aide" (Walder, 1966, p. 6).

Summary of contingency management research

Homme (1966) effectively summarized research pertaining to contingency management. He underscored the fact that efficient contingency managers can be trained in a very short time due to the central theme of contingency management being the manipulation of a behavior's consequences. By requiring a small amount of low probability behavior to be emitted and then permitting a short time of reinforcing activity to be performed, the contingency manager can shape and maintain a desired low probability behavior of an individual. Contingency management has been widely applied. Homme has effectively used the technique with normal nursery school children (Homme et al., 1963); high-school drop-outs (Homme, 1964); preschool, non-English speaking, Indian children (Homme, 1965); poverty-stricken children (Homme, 1966); a young, non-talking retardate (Homme, 1966); and a psychotic blind girl (Homme, 1966). Contingency management was applied successfully to both school-like tasks (Homme, 1964; Homme, 1965) and to deviate behavior (Homme et al., 1963; Homme, 1966).
CHAPTER III
METHODS

Subjects

The subjects were five trainable mentally retarded children of whom four were taken off tranquilizers for the experiments of 15 sessions each. The subjects (Ss) were as follows:

Subject 1 (S-1) was a short mongoloid of Chronological Age (CA) 10-1, Mental Age (MA) 5-3, and had a Language Age (LA) 2-10. It was suspected that he was partially color blind. He related well to people and had a sense of humor. He was easily distracted, tired quickly, and had a very short interest span. When given an assignment, he delayed and often had to be urged or isolated in order to do any work. He had been known to severely attack other children, frequently hitting, pinching, and shouting at them.

Subject 2 (S-2) was a small, highly withdrawn girl of CA 8-1, MA 3-4, and LA 2-6. Her diagnosis was Down's Syndrome and a congenital heart defect. She tired easily and was extremely quiet. Normally a very cooperative child, she could be quite stubborn.

Subject 3 (S-3) was a restless mongoloid. She had a 9-0 CA, 4-1 MA, and 2-2 LA. Her vision had been corrected by glasses which she disliked wearing. She was noted by her teachers for aggressive behavior and hyperactivity. She would attack S-1 at the slightest provocation. She enjoyed being the class leader and worked fairly well despite her short attention span.
Subject 4 (S-4) was an obese, active girl of CA 10-1, MA 4-0, and LA 2-3. Her diagnosis was mongolism. Her work was slowly done once she decided to do it. She was moody, had extremely contrary attitudes, and was difficult to discipline, often refusing to obey instructions of people responsible for her behavior.

Subject 5 (S-5) was a shy, obese boy of CA 11-8, MA 4-0, and LA 2-9. There was a diagnosis of mental retardation, possibly of a genetic nature with unknown etiology. Indications of organic involvement were present; they hampered his perception and made almost any learning and problem-solving task difficult. He showed little interest in academic or work tasks. He was hyperactive, highly distractible, and frequently engaged in purposeless motor activity which distracted others. The previous year's teacher considered him to be a total loss, characterizing him as being highly unreliable and dangerous in his relations with his peers.

Experimental environment

The experiments were conducted in the children's regular classroom at the Cache Valley Day Care and Training Center with no changes being made in the physical arrangement of the room for the experiments. The small room contained a wall blackboard, shelves on which were placed a phonograph and various toys, and a built-in cupboard which held teaching materials. S-4 and S-5 sat at desks placed at the ends of a large table. The other subjects were seated at the sides of the table.

Apparatus

The reinforcement (RE) menu was composed of watercolor cartoons of high probability events determined by frequency counts of the children's
activities. The cartoons were displayed one per page on a black paper background. These mounted cartoons were inserted in plastic covers for protection. Placing the plastic-covered pages in a red, hardbound notebook facilitated presentation of the RE menu to the children. The RE menu items, presented in Figure 1, were cartoon caricatures of the subjects. In Figure 1 the RE items were shown mounted on a cardboard backing.

The RE materials, provided especially for the experiments, were: two inexpensive coloring books; two boxes of eight crayons each; two preschool cardboard puzzles, one a picture of Little Bo-Peep and her sheep and the other a picture of a cat riding a child's rocking horse; three little storybooks, titled *Jack and the Beanstalk*, *The Three Bears*, and *Johnny's Pets*; a black plastic toy telephone (the size of a real telephone); a box of small wooden alphabet blocks; a set of ten colored pencils; and standard size lined and unlined notebook paper. The paper was used for both writing and drawing by the subjects. An automatic timer with a buzzer was used to signal the end of the RE period.

The Utah Verbal Language Development Scale (UVLDS) was used as a measure of the subjects' verbal achievement during the language development experiment. Developed by Mechem, Jax, and Jones in 1965, the UVLDS was a direct, untimed test used to assess overall "expressive" and "receptive" language skills, i.e. pronouncing specified words, carrying out three commissions, reciting numbers, identifying pictures, naming colors, repeating a 12-syllable sentence, etc. The subtests ranged from a I-II year level to a X-XV year level. Reliability of the UVLDS, determined by use of a split-half correlation, was .937. The scale
validity was checked by the calibration technique. The UVLDS was administered and scored in a manner similar to that used with the Stanford Binet Intelligence Scale. The total raw score was obtained by summing the total number of pluses scored above the basal score (age) and adding that number to the basal score. Tables were used to convert the raw scores to a language age. The testing was terminated by seven consecutive failures by the subject.

The low probability tasks used in the language development experiment were derived from lesson plans and materials in the Peabody Language Development Kit (PLDK). The lessons were based upon the child's receiving and responding to auditory, visual, and tactual stimuli. The child was required to extend or simplify information presented, to determine relationships between presented stimuli, and to respond to stimuli with words and/or gestures. Lesson activities included the following: identifying and describing objects, determining relationships between concrete items and/or ideas, memorizing short poems and rhymes, and following oral and pantomimed directions. For example, during a lesson the children would name the foods shown in colored pictures. Then they would sort the pictures according to the categories of breakfast and luncheon foods. Finally, they were required to describe what they had eaten for breakfast that particular day.

Procedure

The high probability activities were determined by observing and recording the subjects' activities throughout the school day for one week. Those activities highest in frequency were designated as high probability events (HPEs) and assumed to be reinforcing as an increase
occurred in behavior followed by a high probability activity. The HPEs were described by colored cartoon figures to form the items for the RE menu.

Next, following test directions the UVLDS was administered individually to each subject in a 45-minute interview. This test score was used as a pretest assessment of each subject's use of verbal language before the initiation of control of language development.

Due to scheduling limitations imposed by the Director of the Cache Valley Day Care and Training Center, sessions during both experiments were held one hour a day, four mornings a week. In the first session the RE menu was presented to the subjects by holding it up and turning to each cartoon. The subjects were encouraged to name the activity illustrated. The children were then told:

You are going to be able to have time to do whatever you want to do that is in this book. Every time you finish your work, you will be able to look at our book and pick what you want to do for four minutes. I will tell you when your time is over to do what you want to do.

Lesson I in the PLDK was presented and upon its completion by all the subjects, the children were told:

Here is the book. Now you can pick what you want to do for four minutes. Our things are here and are only for this time when we use this book. No one else can use them.

The subjects were shown the RE materials, allowed to make a choice of activity, and the timer was set four four minutes. Upon the ringing of the buzzer at the end of the four minute RE time, the RE materials were collected, a notation was made on a record sheet of the RE chosen by each subject, and another lesson period was held.

The upper left photograph of Figure 2 showed the subjects working at an assigned language task during a lesson period. The upper right
Fig. 2. Photographs are as follows: upper left, Ss working at an assigned language task; upper right, S working on sample line-drawing task; lower left, S using the RE menu; lower right, Ss engaging in RE activities.
photograph was a close-up of a subject following instructions to connect dots in a specific pattern. In the lower left photograph a subject was using the RE menu which was presented in book form. In the lower right photograph the subjects were engaging in their preferred high probability activities: coloring, drawing on the board, and writing. During both the lesson periods and the RE periods the children remained at or near their seats because the classroom was quite small as may be seen in the photographs of Figure 2.

The behavior strengthened in 15 one hour sessions in a classroom situation was defined by tasks from the PLDK. Behavior such as classifying clothing as a boy's or girl's, describing food eaten for breakfast that morning, identifying objects, memorizing nursery rhymes, and telling stories about pictures are samples of low probability tasks that were taken from the PLDK. The PLDK lesson plans followed in the order given, therefore the PLDK manual was used as a record of the type of tasks and the order presented. All subjects had to complete all of the tasks assigned during a lesson in order to use the RE menu. All subjects successfully met that criterion and exhibited no signs of restlessness or inattention during the lesson, therefore the lesson period was lengthened. The presentation of the lesson activities and the RE menu remained the same throughout the experiment as in the initial session. Following the fifteenth session the UVLDS was re-administered as a posttest measure of language achievement changes.

A sixth subject was added for the experiment extending contingency management to control deviate behavior in retardates in a classroom situation. Subject 6 (5-6) was a thin girl of CA 12-3 and MA 5-8. She was diagnosed as suspected familial retardation with
sub-cultural factors. Her speech was limited. She was quite hyper-active with a short attention span and limited tolerance for cooperating with others. She was seated at one side of the large table.

Due to the addition of S-6, the procedure used for presentation of the RE menu and RE materials during the initial session of Experiment I was repeated. Low probability tasks were defined as changes desired in deviate behaviors of the subjects. The PLDK tasks from Experiment I were not used. The behavioral changes desired during the experiment were listed in Table I.

The procedure used during Experiment I was modified in the following manner during Experiment II. The lessons were presented by the regular classroom teachers. Lessons included practicing printing the numbers 1-8 and the alphabet A-E; coloring objects according to the printed name of the color; and naming colors and objects. The experimenter controlled the use of the RE menu and RE materials and recorded RE activity choices of the subjects. Records were also kept of the lesson content and order. Each subject had to complete all tasks assigned during a lesson and meet the criterion of increasing or decreasing the frequency of each behavior, as specified in Table I, to receive the RE menu and materials. All subjects successfully met the criterion for reinforcement and exhibited no signs of restlessness and inattention during the lesson, therefore the lesson period was lengthened. The experiment was terminated after 15 sessions due to the closing of the Cache Valley Day Care and Training Center for the Christmas holidays.
Table I. Changes desired in behavior of subjects

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-1</td>
<td>delay in starting tasks</td>
</tr>
<tr>
<td></td>
<td>aggressive acts</td>
</tr>
<tr>
<td>S-2</td>
<td></td>
</tr>
<tr>
<td>S-3</td>
<td>agressive acts</td>
</tr>
<tr>
<td>S-4</td>
<td>failure to obey teacher instructions</td>
</tr>
<tr>
<td>S-5</td>
<td>leaving desk during lessons</td>
</tr>
<tr>
<td>S-6</td>
<td>shouting during lessons</td>
</tr>
<tr>
<td></td>
<td>oral participation in class</td>
</tr>
</tbody>
</table>
CHAPTER IV

RESULTS

The proportion of time each reinforcement was chosen during Experiment I varied greatly from the RE baseline generated by frequency counts of the children's activities taken at the beginning of Experiment I. A comparison of RE selections during the baseline and contingency management conditions was presented in Figure 3. The proportion of time all subjects spent in the most frequent activities during the baseline period was represented by the open bars. The time spent in each RE by all the subjects during Experiment I was delineated by the filled bars. Dancing, coloring, listening to a record, and writing were the activities most frequently selected by the subjects during the RE period. The subjects ascribed reinforcing properties to the menu itself in excess of those associated with some of the baseline high probability events, i.e. looking out the window.

The second major result of Experiment I was an increase in task length per reinforcement and a decrease in time spent in reinforcement as a function of sessions. This result was graphed in Figure 4. Time spent in RE activities by sessions and lesson length per RE period are indicated on the graph. For example, in Session 11, the lesson length was 30 minutes and there was a total RE time of 8 minutes. Since the RE periods were always 4 minutes long, the total RE of 8 minutes indicated there were two 30-minute lessons in Session 11. In contrast to this result, during Session 1 there was a lesson length of 5 minutes each and four RE periods.
**Fig. 4.** INCREASE IN TASK LENGTH PER REINFORCEMENT AND DECREASE IN TIME SPENT IN REINFORCEMENT AS A FUNCTION OF SESSIONS.
The major result of Experiment I was the major gain in language age which each subject made with a mean gain of 2 years and 4 months being made by the subjects. A comparison of the pre- and posttest scores on the UVLDS for all subjects was presented in Figure 5. Along the abscissa were plotted the pre- and posttests for each subject and along the ordinate the language age in years and months was indicated. For example, S-1 on the pretest was scored as having a language age of 2 years and 10 months while on the posttest administered after 15 one hour sessions of language development tasks using contingency management, he scored as having a language age of 5 years and 1 month. An analysis of the gains in language age was performed by testing the difference between the pretest and posttest means. The analysis yielded a .01 significance level exceeded by a t value of 4.60.

During Experiment II a further shift from the baseline determination of subjects' selection of RE activities was noted. These changes were presented in Figure 6. The proportion of time the children spent in the most frequent activities during the baseline determination period was indicated by the open bars. The time spent in each RE activity by all the subjects during Experiment II was represented by the filled bars. As indicated by item w, the subjects continued to ascribe reinforcing properties to the RE menu. The pattern of RE activity selection was different from the selection pattern generated during Experiment I as would be indicated in a reexamination of Figure 3 and Figure 6.

As lesson length increased during Experiment II, the total RE time decreased. This result, graphed in Figure 7, indicated a low ratio
Fig. 5. Pre- and posttest scores on VLDS for all Ss.
Fig. 6. Proportion of time all Ss engaged in each RE during baseline and contingency management conditions. Letters refer to the reinforcements: A, TALKING, B, WRITING, C, COLORING, D, DRAWING, E, READING, F, SWINGING FEET, G, RECORD, H, HUGGING, I, DANCING, J, WALKING, K, DRAWING ON BOARD, L, TELEPHONING, M, PUZZLE, N, BLOCKS, O, JUMPING, P, DRINKING, Q, USING COLORED PENCILS, R, SINGING, S, SWINGING ON DOOR, T, MOVING CHAIR, U, ERASING BLACKBOARD, V, LOOKING OUT WINDOW, W, RE BOOK.
Fig. 7. INCREASE IN TASK LENGTH PER REINFORCEMENT AND DECREASE IN TIME SPENT IN REINFORCEMENT AS A FUNCTION OF SESSIONS.
of task per reinforcement was effectively shaped to a high ratio of task per reinforcement. A comparable result was demonstrated in Experiment I in Figure 4.

The course of the changes during Experiment II in subjects' deviant behavior were also graphed. The decrease in S-1's frequency of hitting, biting, kicking, pinching, pulling on, and otherwise attacking other children was presented in the upper portion of Figure 8. During the baseline condition S-1 averaged 9.2 aggressive acts per hour. Such behavior was dropped from his repertoire in Session 15 and was not re-instanted during the remaining five sessions. Depicted in the lower portion of Figure 8 was the decrease in S-1's delay in starting tasks which ranged from the baseline average of 18.8 minutes delay to absence of delay in Session 14. S-1 did not resort to delaying during the next four sessions.

The upper portion of Figure 9 was a record of shaping S-2 to respond with relevant verbalizations during her turn to answer questions and supply information during lessons. Her baseline average was 1.6 task relevant vocalizations per hour during her turn to speak. By Session 20 she was making 12 such responses per hour. The lower portion of Figure 9 depicted the change in S-3's frequency of aggressive acts. During the baseline period she emitted an aggressive act approximately 6.6 times per hour. By Session 15 she ceased responding aggressively. Aggressive acts did not reappear in her behavioral repertoire during the remaining five sessions.

The change in S-4's rate of refusing to obey teacher instructions was presented in upper Figure 10. Her acts of disobedience decreased from the baseline average of 3.8 refusals per hour to no refusals.
FIG. 8. UPPER, FREQUENCY OF AGGRESSIVE ACTS (HITTING, BITING, KICKING, PINCHING, AND PULLING ON OTHER Ss) DURING LESSONS; LOWER, DELAY IN STARTING TASKS.
FIG. 9. Upper, task relevant vocalizations during S-2's turn to respond during lessons; lower, frequency of aggressive acts (hitting, biting, kicking, pinching, and pulling on other Ss) during lessons. Dotted line indicates S was absent that session.
FIG. 10. Upper, Failure to follow teacher lesson directions. Dotted line indicates $s$ was absent that session; lower, number of times per hour $s$ left his desk during lessons. Dotted line indicates $s$ was absent that session.
during Session 17. This behavior was also absent during Session 18 - 20. Illustrated in lower Figure 10 was the change in $S$-5's rate of leaving his desk during lessons. As indicated in the graph during the baseline condition he left his seat approximately 9 times per hour. In Session 17 he remained in his seat for the entire hour and this behavior was maintained during the remaining three sessions.

Figure 11 was a presentation of the changes in $S$-6's rate of shouting during lessons. A decrease in rate from 15.8 shouts per hour to no shouts during Session 15 was obtained. During the remaining five sessions she did not disrupt the class by shouting.
Fig. II. Number of shouts emitted by S during lessons.
CHAPTER V
DISCUSSION

The results of Experiments I and II indicated contingency management could be systematically extended to trainable mentally retarded children in a classroom situation. Evidence that a low ratio of task per reinforcement could be shaped to a high ratio of task per reinforcement was presented in both experiments. Data from Figure 7 indicated the maximum lesson length of 30 minutes used in Experiment I was an experimental artifact. During that experiment a practice of keeping the lessons almost identical in length was followed, thereby setting an artificial ceiling of 30 minutes on lesson length. In Experiment II this practice was not followed with the result that lesson length was successfully increased to the full 60 minutes allotted for experimental use. Since this hour time limit was also a constraint on increases in lesson length, there is a possibility that trainable retarded subjects can be conditioned to attend to tasks for intervals longer than 60 minutes.

Of primary importance is the fact use of these contingency management techniques resulted in great increases in the attention spans of these retarded children. Data from Experiments I and II indicated the increase was from a period of 5 minutes to a period of 60 minutes.

Shifts in rates of high probability activities from the baseline to REs chosen during Experiment I and Experiment II occurred as documented in Figures 4 and 7. There were also shifts in response probabilities from Experiment I to Experiment II. Therefore, the pattern of subjects' choices of RE activities confirms Premack's idea that the
reinforcement properties of any one event can, and do, change over a period of time (Premack, 1965). Highly popular REs in Experiment I such as dancing decreased in frequency of times chosen in Experiment II while activities neglected by the subjects during Experiment I, i.e. looking out the window, were chosen in Experiment II as REs. Such results supported the fact that with contingency management using an RE menu, the experimenter does not find himself limited to only one reinforcer for which his subjects are already satiated. By using an RE menu the experimenter always has a wide array of reinforcements available for use no matter what the deprivation or satiation state of his subject.

An idea of the subjects' reactions to the RE menu and contingency management was obtained through the use of anecdotal records which were kept during the experiments. The subjects said they liked the idea of choosing what they wanted to do. S-5 especially considered using the RE menu to be a highly desirable activity as he said, "With the book I get to do just what I want!" The children's attention was maintained during the lessons and the subjects became very enthusiastic about the tasks and would run to meet the experimenter at the door, asking, "What are we going to do today to get to use the big book?" Several reversals in response probabilities were noticed during the experiments, i.e. S-5 who would seldom volunteer an answer to a question during class chose talking as his RE activity several times. Before the start of Session 8 of Experiment I, the Director of the Cache Valley Day Care and Training Center mentioned S-3 was very irritable and unable to say two words in a row without stuttering. However, during the experimental session S-3 answered clearly questions directed to her,
volunteered answers to questions directed to the entire class, and did not stutter. Mrs. Douglas and Mrs. Godfrey, regular teachers for the class, commented many times upon the speed, neatness, and accuracy with which the children completed their assignments during the contingency management condition of the experiments.

As stated earlier, the cartoon figures used as RE menu items were caricatures of the subjects. The children recognized this fact immediately. For example, after seeing the cartoon of the girl coloring, S-4 responded, "Me coloring." and S-5 identified himself in the picture of the boy walking. The subjects' excellent reception of the RE menu was perhaps due in part to the recognition of the cartoon figures as self-images.

During both experiments the task area and RE area were physically the same place in the room, varying only in the temporal relationship to each other. However, no problems were encountered with subjects' discrimination of task time and RE time. No subject failed to relinquish RE materials at the end of the RE period nor did any of the subjects refuse to return to working on a task. The sharply defined temporal separation of the two periods was marked by the verbalization "Now it is time to put away our work and have the book" and by the buzzer of the timer which signaled the end of the RE period. It is indicated that these stimuli were adequate to enable subjects to discriminate easily between the two periods.

The most important inference which could be drawn from Experiment II pertains to the curves of Figure 8, lower Figure 9, Figure 10, and Figure 11. Those curves bore a close resemblance to extinction curves. Four pieces of evidence supported the supposition extinction
curves were produced by use of contingency management. First, the shape of the curves corresponded closely with examples of extinction curves (Woodworth and Schlosberg, 1954; Ferster and Skinner, 1957). Secondly, the procedure for operant extinction of undesirable behaviors as practiced by Ayllon and Michael (1959) was followed by withholding social reinforcement for undesirable behavior. Thirdly, the termination of behaviors such as hitting others was maintained over several sessions. The strongest argument in support of the extinction theory lay in the fact behaviors incompatible with the responses dropped from subjects' repertoires were shaped by means of differential reinforcement. For example, attending to one's work for 25 minutes was clearly incompatible with hitting other children and the latter was controlled by reinforcing the former response. Such a procedure and results were consistent with data reported by Ayllon and Michael (1959), Zimmerman and Zimmerman (1962), and Birnbrauer et al. (1965).
CHAPTER VI
SUMMARY AND CONCLUSION

Summary

In Experiment I contingency management was employed with five non-institutionalized trainable retardates (mean MA=4.1, CA=9.9, and language age=2.6) in a classroom situation. Empirically determined high probability behaviors were described by colored cartoon figures forming a reinforcement menu. Tasks from the Peabody Language Development Kit defined the behavior strengthened during 15 one-hour sessions. A quantity of low probability task behavior had to occur in order for subjects to emit 4 minutes of high probability reinforcing activity. Contingency management effectively shaped a low ratio of task work per reinforcement to a high ratio of work per reinforcement and was accompanied by highly significant gains in language age (p<.01). A post-test administered 6 months after termination of the experiment indicated the gains in language were maintained.

In Experiment II the five children of Experiment I and another trainable retardate served as subjects. Dependent upon the behavioral change desired of the subject in the classroom situation, each subject had to meet the criterion of increasing or decreasing the specified behavior to receive the reinforcement menu and engage in 4 minutes of high probability reinforcing activity. Contingency management over 15 one-hour sessions was successful in reducing and possibly extinguishing the rate of aggressive acts, delays in starting work, shouting, leaving the desk during lessons, and refusals to obey teacher
instructions. Frequency of task relevant vocalizations was also increased by this technique. During an unsystematic observation of the subjects 6 months after termination of the experiment the undesirable behaviors occurred once an hour on the average, a rate far below the baseline frequency. Task relevant vocalizations which had been shaped to a high frequency during the experiment were emitted at a rate much higher than the rate obtained during the baseline period.

Conclusions

In both experiments contingency management greatly increased attention spans of subjects who had previously been unable to attend to a task for more than a few minutes at a time. One subject whose maximum attention span was 5 minutes before the experiments had an attention span of 60 minutes at the end of Experiment II. Adding this result to the impressive gains in language development and behavioral control made by the subjects indicates large, dramatic changes can be made in the behavioral repertoires of trainable mentally retarded children under control of contingency management. Especially noteworthy was the fact that neither experiment required elaborate and expensive equipment nor any alterations in the physical environment of the classroom.

The contingency management technique is therefore simple enough, as stated by Homme et al. (1963) and Addison and Homme (1966), that any teacher of trainable retardates can quickly be trained as an effective contingency manager capable of setting up and successfully carrying out her own contingency management programs. Due to the simplicity of the technique and following from Walder's results in training parents of autistic children (Walder, 1966), there is an indication that
parents of retarded children could undergo training as contingency managers to program education in self-care procedures for their children. Both inside and outside the environment of the day care and training centers for trainable mentally retarded children contingency management can be beneficial in educating these children more completely and effectively. The contingency management technique has been shown to be effective for coping with such diverse problems as hyperactive, assaultive behavior and language development among other problems which had previously greatly hindered parents and teachers educating retardates in both academic and non-academic areas of life.
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