*MANAGEMENT OF INAPPROPRIATE BEHAVIORS OF
TRAINABLE MENTALLY IMPAIRED STUDENTS
USING ANTECEDENT EXERCISE*

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The effects of several levels of exercise on inappropriate behaviors of four trainable mentally impaired students were observed. Treatment conditions, which occurred as the first daily activity, included: Phase I, daily alternating conditions of warm-up exercises and jogging at a moderate rate for a short distance; Phase II, daily alternating conditions of no-exercise periods and jogging at a vigorous rate for a moderate distance; and Phase III, jogging at a vigorous rate for a moderate distance on consecutive days. For one student two additional conditions occurred, Phase IV, long-distance jogging on consecutive days at a vigorous rate and Phase V, consecutive days of no exercise. Observations of three inappropriate behaviors of each student occurred immediately after, 1 hour after, and 2 hours after each exercise period. Results indicate a decrease in all three inappropriate behaviors for three of four students and an inverse relationship between the level of exercise and the amount of inappropriate behavior for three of four students. Improvements over existing studies are discussed with suggestions for future research.

DESCRIPTORS: antecedent control, exercise, inappropriate behavior, trainable mentally impaired students

Much of the behavior analysis literature clearly demonstrates the management of behavior through the manipulation of response consequences (i.e., reinforcing and punishing stimuli). Studies that effect behavior change by manipulating antecedent stimuli or setting events in the environment are much less common (e.g., Horner, 1980; Wahler & Fox, 1981). The identification and empirical validation of antecedent stimuli and setting events that reliably affect behavior are not only of theoretical significance, but also of practical significance, be-

cause most antecedent control procedures do not require extended periods of vigilance to detect the occurrence of a specific behavior and to deliver a response consequence immediately.

The effects of aerobic exercise on a variety of undesirable behaviors have been studied with developmentally delayed persons. Breuning, Davis, and Hatton (Note 1) documented a decrease in the disruptive behavior of institutionalized women during time periods immediately following an exercise program. Watters and Watters (1980) observed decreases in the self-stimulatory behavior of five autistic boys during language training sessions which succeeded 8 to 10 minutes of jogging. Allen (1980) varied the duration of jogging and reported greater decreases in the disruptive behavior of learning handicapped students as jogging duration increased from 5 to 10 minutes. Unfortunately, these results must be interpreted cautiously because each study suffers from one or more of the methodological weaknesses that characterize the exercise and mental health literature (see Folkins & Sime, 1981 for review).

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This study attempted to replicate and extend the findings of Allen (1980), Breuning et al. (Note 1), and Watters and Watters (1980) by studying the relationship between various exercise levels and a variety of inappropriate behaviors of trainable mentally impaired (TMI) students. A number of methodological improvements on prior studies were incorporated, including: the use of an alternating treatments design (Barlow & Hayes, 1979); recording and reporting individual behaviors for each student; arranging similar activities during each observation period; and having observers and teachers blind as to the arrangement of conditions. The amounts of exercise were equalized across students by calculating and designating individual physical exertion work output rates to be attained during jogging conditions. Additionally, a prolonged, daily jogging condition was incorporated to examine the durability of behavioral effects in the absence of contrasting, alternating conditions.

METHOD

Subjects

Four males, ranging in age from 6 to 16 (mean = 9.0), participated. Each was enrolled in a program for trainable mentally impaired (TMI) students in a public school system. Selection was based on teacher reports of frequent inappropriate behaviors, ease with which behaviors could be observed, and student availability during treatment and observation periods.

Setting

Sessions were conducted in approximately 6 m $\times$ 9 m (20' $\times$ 30') classrooms at the rear of which were observation rooms which were wired for sound to allow monitoring of the classroom. Classroom activities, during which behaviors were recorded, remained similar within and across days. The gymnasium, in which running occurred, was located near each classroom and included no obstructions except for four plastic pylons which marked the run-

ning course during jogging periods. The perimeter of the course was approximately 0.13 km (approximately 0.082 miles).

Dependent Variables

Behaviors were selected for observation based on the following criteria: They were exhibited at high rates; they were suggested as problem behaviors by the teachers; or they interfered with academic activities. Behaviors observed for each student were as follows: Student 1—inappropriate vocalizations, repetitive movements, and off task; Students 2 and 3—inappropriate use of hands, off task, and repetitive movements; Student 4—visual off task, motor off task, and inappropriate vocalizations.

Observation Procedures

Each student was observed from the observation room during 15-minute observation periods which occurred three times per day; immediately following the student's return to the room after the exercise period, 1 hour after exercise, and 2 hours after exercise. Baseline observations occurred during the same time periods and with similar classroom activities as the corresponding observation periods during intervention. Each behavior was recorded using a 15-second partial interval recording system (Bailey, 1977). Data were not recorded during intervals in which visual contact with the student was obstructed.

Observer Training

Prior to the beginning of the study, each observer memorized response definitions pertaining to the student he or she would be observing and practiced scoring behavior samples until the interobserver agreement percentage between experimenter and observer was equal to or greater than 85% for each behavior.

Interobserver Agreement

Interobserver agreement data were recorded during an average of 30.2% of all the observation periods. The mean interobserver agreement percentages (# of agreements/agreements +

disagreements $\times 100\%$) for each student were: Student 1, 94.8%; Student 2, 92.3%; Student 3, 91.9%; Student 4, 93.5%.

Jogging Rate Calculations

"Moderate" and "vigorous" jogging rates were determined by using an exercise training effect formula (Fixx, 1977; Vitale, 1973) to calculate the exercise pulse rates (PR's) for each student that would produce similar training effects (or require equal exercise intensity) across individuals regardless of their age or state of physical conditioning. PR's (beats/minute) for moderate and vigorous exercise levels for each student were: Students 1, 3, and 4, 138 and 174; Student 2, 144 and 180.

Pulse Rate Measurement

Pulse rates detected at the radial artery were recorded by adult trainers when the student arrived at the gymnasium; after warm-up exercises; after each 3-lap interval when jogging; during a cool-down period; and after refreshments before returning to the classroom. Each trainer had practiced measuring 10-second pulse rates until this reading was ± 1 beat of the experimenter's reading on five consecutive 10-second intervals.

Interobserver Agreement for Pulse Rates

On 33% of sessions, the trainer's PR measure was compared with the experimenter's measure taken at the opposite wrist. An agreement was scored if the trainer and experimenter measures were within ± 1 beat per 10-second interval. The average interobserver agreement across individuals on 10-second pulse rates was 95.3%.

Design

The study incorporated an alternating treatments (Barlow & Hayes, 1979) within a multiple-baseline design (Baer, Wolf, & Risley, 1968). Following baseline, Phases I and II, representing two different levels of jogging, were sequentially introduced across two pairs of students. Each experimental phase involved the

alternation of exercise days with warm-up exercises or no-exercise days in a multielement fashion. Phase III consisted of jogging on consecutive days at the same level as Phase II. A third intensity level of jogging, Phase IV, was introduced for Student 2 and consisted of consecutive (nonalternating) days of jogging. Phase V for Student 2 consisted of a no-exercise condition on consecutive days.

Experimental Conditions

Baseline. Each student engaged in the normal classroom routine without special contingencies for the dependent variables.

Intervention. A trainer jogged with each student and adjusted the jogging pace so that pulse rate measures taken after every 3 laps would be close to the assigned rate for the condition. To ensure that teachers and observers were blind to the experimental conditions in effect, the duration of time each student was out of the classroom was held relatively constant across conditions, and students were required to "cool down" before returning to class.

Phase I consisted of two, daily alternating conditions: warm-up exercises in which students completed a series of warm-up exercises; and moderate rate, short distance jogging in which students ran approximately 1.57 km (0.98 miles) at a pace which produced a moderate pulse rate. Phase II consisted of two, daily alternating conditions: no exercise in which students looked at the magazines in the gym and vigorous rate, moderate distance jogging in which students ran approximately 2.37 km (1.47 miles). In Phase III students continued to jog on consecutive days at the same rate and distance as specified under Phase II. In Phase IV Student 2 jogged at the vigorous jogging pace for a distance of approximately 3.15 km (1.96 miles). Phase V for Student 2 consisted of conditions identical to the no-exercise condition in Phase II.

Independent Variable Accuracy

The mean percentage of targeted pulse rates (attained PR/targeted PR $\times 100\%$) was cal-

culated for each student in each phase and ranged from 93.9% to 106.1% indicating that students generally jogged at appropriate levels to reach their targeted PR's.

RESULTS

Figure 1 shows the daily percentage of intervals scored for the occurrence of the inappropriate

behaviors averaged across the three behaviors and three daily observation periods for each student. Baseline responding appeared to be steady for each student prior to the introduction of Phase I. During Phase I, Students 1 and 3 exhibited a decrease in inappropriate behaviors during both the jogging condition and the warm-up-only condition and some separation of the data between the two conditions. In Phase II,

Fig. 1. Mean percentage of intervals scored for occurrence of all inappropriate behaviors in all observation periods for each student.

Students 1, 3, and 4 exhibited consistently lower levels of inappropriate behavior than observed during baseline and some separation in the level of inappropriate behavior occurring on jogging and no-exercise days. During Phase III, when jogging occurred on consecutive days, the level of inappropriate behaviors for Students 1, 3, and 4 declined to their lowest level during the experiment. Student 2 exhibited little change in

the level of inappropriate behaviors across Phases I-IV but did show a slight increase when all exercise was discontinued in Phase V.

Differential effects during each of the three daily observation periods are displayed in Figure 2 which shows the average of all behaviors for each student during the first, second, and third observation period within each phase. The first data point in each phase is the mean percentage

Fig. 2. Mean percentage of intervals scored for occurrence of all inappropriate behaviors during each phase in each observation period.

of intervals for all behaviors averaged across all first observation periods in that experimental condition. The second data point is a similar average for the second observation period of that condition, and the third point is for the third observation period. The data for Students 1 and 3 show that responding generally occurred at the lowest level in the first observation period (immediately after the exercise period). Consistent patterns across observation periods are not as obvious for Students 2 and 4.

Figure 3 shows the mean percentage of intervals with inappropriate behavior averaged across all observation periods within each experimental condition for each student. The experimental conditions are arranged with those requiring the least physical exertion on the left and those requiring the most physical exertion on the right and show a decline in the level of inappropriate behavior as the level of physical exertion increases.

DISCUSSION

These data support several conclusions regarding the relationship between exercise and the level of inappropriate behavior. First, for three of the four students (Students 1, 3, and 4), the level of inappropriate behavior is lower during phases where exercise occurred, even if the exercise was alternated with the warm-up-only and no-exercise days. Further support for the relationship between exercise and the level of inappropriate behavior is evinced in the separation of the levels of inappropriate behavior on days with and without exercise during Phases I and II. The factors responsible for the absence of effects with Student 2 are unclear, though it is worth noting that Student 2 had the lowest and most stable baseline level of inappropriate behaviors of all the students.

The results are consistent with data on the relationship between exercise and self-stimulatory behavior reported by Watters and Watters (1980). They report a mean reduction in the level of self-stimulatory behavior of 32.7% as-

sociated with jogging. The mean reduction in the level of inappropriate behaviors between baseline and the final jogging phase was 20.8% (range of 6.3-38.0%) in the current study. The smaller magnitude of change may be partially due to the inclusion of data from observation periods that were temporally distant from the exercise period and showed less change than the observation period immediately following exercise. This observation suggests that practitioners might derive maximum benefit from exercise periods that precede activities or time periods that are typically characterized by high levels of inappropriate behavior.

The behavioral or physiological mechanisms through which exercise impacts subsequent behavior is open for question. Because decreases in inappropriate behaviors correspond with increased amounts of physical exertion, fatigue resulting from physical exertion could account for the reported results. Because fatigue could be responsible for the behavior decrements it is important that future research monitor both inappropriate and appropriate behaviors (e.g., academic performance) to determine the specificity of exercise effects. Furthermore, the durability of behavioral effects associated with a constant level of exercise should be assessed because of conditioning effects that may occur with prolonged exercise regimens and obvious limitations on increases in the intensity or duration of daily exercise.

The degree of behavior change associated with jogging was modest for all students, and other behavior management procedures (e.g., time-out, punishment, overcorrection, DRO) have produced equivalent or larger decreases in inappropriate behavior. Nevertheless, control by antecedent stimuli and manipulation of setting events is still of theoretical and practical interest. Other behavior control procedures emphasizing the delivery of response contingent consequences are relatively labor intensive, in that they require nearly constant vigilance to detect and deliver consequences for the targeted response. Thus, behavior management procedures emphasizing

Fig. 3. Mean percentage of intervals scored for the occurrence of inappropriate behavior averaged across all observation periods within each experimental condition. Conditions are arranged in order from least to most physical exertion.

manipulation of antecedent and setting events may prove cost-effective when compared with contingency management procedures and may prove to be useful adjuncts to enhance the effectiveness of contingency management procedures (e.g., Horner, 1980; Melin & Gotestam, 1981; Whalen, Henker, Collins, Finck, & Dotemoto, 1979; Sulzer & Mayer, 1972). If the behavioral effects of jogging prove reliable and durable in treatments for inappropriate behaviors, jogging may offer a viable alternative to other treatments whose acceptability is limited by undesirable side effects (e.g., psychoactive drugs) or ethical considerations (e.g., punishment).

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