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THE CHANGING-CRITERION DESIGN: ASSESSMENT OF RUNNING BEHAVIOR OF A HANDICAPPED YOUTH

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Summary.—In a changing-criterion design increased running speed by a handicapped youth was demonstrated by establishing a temporal criterion for running, which changed repeatedly as running matched the criterion. Reinforcement and avoidance procedures were made contingent on running and were effective in increasing running speed. Follow-up data at 3 and 12 mo. indicated maintenance of the increased running speed.

Applied behavioral research has primarily used single-case experimental designs, such as reversal and multiple-baseline procedures (Barlow & Hersen, 1973; Kazdin, 1975). Advantages and disadvantages of these experimental designs have been enumerated by Cuvo (1979), Gelfand and Hartmann (1975), and Kazdin (1976) among others.

The changing-criterion design, initially described by Weis and Hall (1971), is a relatively new addition to single-case methodology. The design has been characterized as a variation of both the multiple-baseline design (Hartmann & Hall, 1976) and the reversal design (Hall & Fox, 1977). The design introduces a series of treatment conditions after a baseline phase, such that each treatment condition is associated with a step-like change in behavior criterion. When behavior consistently matches criteria as a result of the contingencies, experimental control is demonstrated. The change in criterion is an increment or decrement in the frequency or duration of a behavior. Thus, behavior during each phase might be considered the baseline for the following phase, as noted by Hartmann and Hall (1976).

The changing-criterion design has been used in the assessment of programs for decreasing such behaviors as cigarette smoking (Hartmann & Hall, 1976, Case II), coffee drinking (Foxx & Rubinoff, 1979), and prolonged eating (Sanok & Ascione, 1978). Kazdin (1975) reported that the changing-criterion design is particularly suited to behavioral shaping paradigms. Hartmann and Hall (1976, Case I) used the design to demonstrate increased accuracy and production of arithmetic problems of a behaviorally-disordered child. The criterion for number of completed problems was initially set at two (the approximate baseline mean) and increased in increments of one over several sessions to the terminal point of ten. Each criterion was increased after three consecutive sessions of performance at the specified level.

The present study used changing-criterion design to assess the effects of
reinforcement and avoidance procedures on the acquisition and maintenance of running behavior of one handicapped adolescent during physical education. The adolescent, similar to many handicapped youth, exhibited behavioral deficits which limited participation in games and sports. Minimal physical and social skills and the display of stereotypic behaviors during attempted physical activity isolated the adolescent from peers and physical education instructors. The changing-criterion design and associated contingencies were implemented to increase running and facilitate integration into physical activities.

METHOD

Subject and Setting

A 13-year-old mildly-retarded male, who displayed numerous stereotypic behaviors, was the experimental subject. He was enrolled in the combined special education/treatment program scheduled during regular school hours. One of several classes was physical education, conducted in a large gymnasium. Five peers in the physical education class were control subjects. Each was within 1.5 chronological yr. of the subject and diagnosed as mildly retarded, although none displayed deficits in running or stereotypic behaviors. The class consisted of nine special education students aged 11 to 17 yr.

Behavior Description

The subject exhibited all combined behaviors required in running but did not run with sufficient speed to allow integration into group activities. Running speed was associated with impeding, stereotypic behaviors, including hand-clapping, head-rubbing, excessive arm movements, and orientation of the head in the direction of the ceiling. Informal observation suggested that such behaviors occurred with greater frequency and intensity when the subject was instructed to run faster.

Procedure

Baseline data were collected during eight consecutive physical education classes. The time taken to run a circular course, or lap, of 55 m was recorded with a stopwatch. The subject was instructed to stand at a "starting line," designated by a black line on the gymnasium floor, and run a complete lap around the outside of a continuous blue line. The course was the same as that used by the other students. During baseline, the subject was required to run two complete laps each session from the standing start position. After eight baseline sessions, a temporal criterion was established. The subject was instructed to "run as fast as you can" and informed that he must run "below the time limit" on two separate laps, i.e., stopping after each, checking the elapsed time, and running again. Running two laps below the time criterion, with no laps above the criterion, was considered a successful session.

After two consecutive, successful sessions, the time criterion was changed, usually in a 1-second decrement. The changing time criteria were repeated until the subject's running times were near those recorded for control subjects. Lap times for control subjects were recorded at the beginning and end of the treatment phase.

Each lap run below the criterion resulted in reinforcement in the form of "points," exchangeable later in the day for items at a canteen. Also, praise and encouragement were given by the instructor and peers.

Running a lap above the time criterion required running an additional lap. Following the laps run above the time criterion, the subject was instructed to "return to the starting line to try again." The instructor occasionally offered verbal feedback concerning the subject's performance, including prompts and demonstrations of running motions. No direct contingencies were applied to the occurrence of stereotypic behaviors, and no data were collected on their frequency during running.

Follow-up probes to assess running speed were conducted at intervals of 3 and 12 mo. after treatment. The conditions during the follow-up sessions were identical to those of the baseline sessions.

Measures of observer agreement on running times were made by the authors using two stopwatches. A total of 32 laps were scored in four sessions during the treatment phase and 14 laps in seven sessions during 3- and 12-mo. follow-up sessions. Reliability was computed by dividing the smaller time by the larger time. Quotients ranged from 0.96 to 1.00 for all running times scored, with a mean agreement of 0.986.

RESULTS

Fig. 1 shows that mean running times for baseline sessions ranged from 27.8 to 44.8 sec., with an over-all mean time of 33.9 sec.
For the treatment phase, the data in Fig. 1 show the mean running times for all laps required in a session. The initial time criterion was set at 30 sec., well below the baseline mean. A total of 13 sessions, longest in the treatment phase, were required to meet the time criterion successfully. The numerous sessions required suggested that the initial criterion was set too stringently. However, running speed increased, as indicated by reduced mean running times for sessions conducted during the 30-sec. criterion (over-all mean = 29.6 sec.; range = 27.2 to 35.0 sec.). In 95 treatment sessions, a total of 14 changing time criteria were applied. Except for the first change from 30 to 28 sec., changes were 1-sec. decrements, eventually in a time criterion of 15 sec. in Sessions 89 to 95. Mean running times were reduced consistently to 13.8 sec. in Session 88. This was a 59% decrease from the baseline mean.

While the 15-sec. time criterion was successfully met in Session 95, the criterion was not further reduced. The subject had approximated, and in one case exceeded, the running times recorded for peers (see Table 1). Running times of the subject had become hardly distinguishable from those of the rest of the class.

### TABLE 1

<table>
<thead>
<tr>
<th>Subject</th>
<th>Running Time (sec.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Session 8</td>
</tr>
<tr>
<td>1</td>
<td>11.0</td>
</tr>
<tr>
<td>2</td>
<td>11.2</td>
</tr>
<tr>
<td>3</td>
<td>13.3</td>
</tr>
<tr>
<td>4</td>
<td>12.9</td>
</tr>
<tr>
<td>5</td>
<td>17.3</td>
</tr>
</tbody>
</table>

While the subject's running times decreased consistently from the beginning to the end of the treatment phase, running times did not decrease significantly for five control subjects (see Table 1). Even though the control subjects were involved in frequent running activities, only minimal improvement was evidenced in running times for three subjects and none for two others. Comparisons of changes in running speed suggested that improvement in the experimental subject was a function of treatment.

Data in follow-up sessions suggested somewhat slower mean running speed with higher variability. After 3 mo., running times in four sessions ranged from 15.2 to 19.4 sec. (mean = 16.8 sec.). Over the summer months in the absence of physical education classes, running speed became less stable. After 12 mo., running times in three sessions ranged from 13.5 to 15.7 sec. (mean = 14.5.

Changes in running times typically occurred when the time criterion was changed, suggesting that positive reinforcement and avoidance of extra lap-running exerted stimulus control over running speed. By comparing mean running times of the 14 successive criteria, decreases were apparent in all adjacent criteria except three. The exceptions occurred in the latter stages of the study when time criteria were set at 20 sec. or less and may have indicated that running speed had begun to stabilize.

The effects of reinforcement and avoidance were apparent from increased running speed. However, an additional dependent measure of contingency effects was the number of laps necessary to meet the criterion in each session. Two laps, with no additional laps, were run in 45 to 86 sessions. In 26 of the remaining sessions, one or two additional laps were necessary. Thus, in 83% of sessions, the subject ran fast enough to meet the time criterion without running more than four laps.

### DISCUSSION

The present study demonstrated the utility of the changing-criterion design in increasing running speed of a handicapped youth. The application of reinforcement and avoidance contingencies to the changing time criteria was effective in reducing time to run a lap.

Hall and Fox (1977) indicated that changes in criteria function similarly to a series of AB comparisons. That is, the changing-criterion design is functionally a sequence of baseline and treatment comparisons, with each criteria serving as baseline for the next. However, the design differs from other single-case experimental designs in that the subject's behavior determines the timing of changes in conditions, not pre-established parameters. For example, in the present study, running speed determined the changes to successive time criteria, not an independent decision on length of treatment condition. An interdependent relationship between the design, the subject's behavior, and effects of behavioral contingencies was established.

Problems may be encountered in establishing and changing behavioral criteria. The first criterion should not be set too stringently, as was the case in the present study. Instead, the first criterion should be established in relation to baseline measures, such as the mean or median rate of behavior. Changes in criteria should be large enough to demonstrate control by contingency, but not excessive so that at all times the behavior has a high probability of matching the criterion and contacting the contingencies applied.

The changing-criterion design may be susceptible to problems of internal control. As noted by Kazdin (1975), directional changes in behavior may
occur independently of the applied contingencies. It may be posited that matura-

tion (Campbell & Stanley, 1963) accounted for increases in running speed in

the current study. The treatment phase was nearly 6 mo. in length, which

allowed ample time for physical development and improved motor coordination,

independent of the treatment. However, control data on other students did not

indicate appreciable increases in running speed. Applying such procedures in

changing-criterion designs or providing reversals to noncontingent baseline

phases, may assist in controlling for effects of extraneous variables.

It was noted that stereotypic behavior of the subject was presumably associ-

ated with slow running, and indeed, informal observations suggested reductions

in the occurrence of such behaviors as running speed increased. Stereotypic

behaviors during running were not measured, because such measurement was

presumed to be difficult and potentially unreliable. However, it can be inferred

from the increased running speed that motor behaviors were more functional

and appropriate.

The running program was instrumental in developing increased participation

by the subject in physical education activities which facilitated interactions

with peers as the subject joined group games previously not attempted, e.g.,

kickball, softball. The cheering and encouragement from peers during running

seemed related to increased peer-subject interactions in other situations.

The changing-criterion design seems applicable in several situations where

step-like changes in behavior, specifically those yielding measures of frequency

or duration are identifiable. Behavioral deficits or excesses such as limited

work production, slow reading rates, minimal peer interaction, off-task activity,

or negative verbalizations, might be responsive to changing-criterion methods.

The changing-criterion design is an important and practical addition to

applied, single-case methodology and may be used with increasing frequency in

a variety of situations requiring behavioral change.

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