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TRAINED, GENERALIZED, AND COLLATERAL BEHAVIOR CHANGES OF PRESCHOOL CHILDREN RECEIVING GROSS-MOTOR SKILLS TRAINING

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Three preschool children participated in a behavioral training program to improve their gross-motor skills. Ten target behaviors were measured in the training setting to assess direct effects of the program. Generalization probes for two gross-motor behaviors, one fine-motor skill, and two social behaviors were conducted in other settings. Results indicated that the training program improved the gross-motor skills trained and that improvements sometimes generalized to other settings. Contrary to suggestions in educational literature, the gross-motor training program did not produce changes in fine-motor skills or social behaviors. Implications for educators and for the development of the technology of generalization are outlined.

DESCRIPTORS: collateral behaviors, education, generalization, gross-motor skills, physical activity

Perceptual-motor training programs, which concentrate primarily on the training of gross-motor skills, have been widely implemented in schools (Hammill, Goodman, & Wiederholt, 1974). Some professionals are conservative in expounding the benefits of these programs, asserting that the only direct benefit of perceptual-motor training is the improvement of gross-motor skills (Myers & Hammill, 1976, pp. 325–328). Others are much more liberal in asserting benefits, citing improvements in gross-motor skills, fine-motor skills, social skills, intelligence, and academic functioning (cf. Flinchum, 1975, p. 64). As a result of these assertions, many children are screened for perceptual-motor deficiencies and put through hours of gross-motor training, often at the expense of academic activities (Hammill et al., 1974).

Behavioral studies addressing gross-motor activity indicate that training of gross-motor skills can produce improved skill in activities trained, plus generalization of skill improvements to other gross-motor activities in the training situation and surrounding area (Fowler, Rowbury, Nordyke, & Baer, 1976; Hardiman, Goetz, Reuter, & LeBlanc, 1975). Collateral improvements in social behavior have been noted (Buell, Stoddard, Harris, & Baer, 1968), suggesting that this is a possible side effect of increased gross-motor activity. Behavioral research, therefore, provides some support for educators who advocate the use of perceptual-motor training programs.

There are, however, several important disparities between behavioral research and the typical training situations in public schools. Behavioral researchers use less complex training programs and do not measure topography of general motor skills (cf. Fowler et al., 1976; Godfrey & Kephart, 1968; Hardiman et al., 1975). In addition, their subjects have more severe behavioral deficits and they examine fewer collateral changes in behavior (cf. Flinchum, 1975; Fowler et al., 1976; Hardiman et al., 1975). Our study addressed these disparities by working with a group of children in a public school setting, using a more complex training program, using behavioral measures more concordant with educational programs, and investigating a wider variety of collateral behaviors.

METHOD

Subjects, Settings, and Equipment

Three female children ranging in age from 4 to 4.5 years participated in the study. All subjects

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attended the same public preschool class. Baseline assessments of gross-motor skills indicated that none of the subjects had severe developmental disabilities, but all were referred to the gross-motor skills program by their teacher and showed moderate deficits on initial assessments, with average gross-motor checklist scores (see Table 1) that were 2–6 points lower than their classmates. Two of the children (Alice and Jan) were reported by the teacher to be weak in fine-motor skills and one (Alice) engaged in very little social interaction with peers.

Gross-motor training was conducted in the school concourse. Assessments of the training effects were made in this concourse, whereas generalization was assessed in the gymnasium (gross-motor behavior) and the preschool classroom (fine-motor and collateral behavior). The equipment used to train and assess gross-motor behavior included tumbling mats, a balance beam, rubber balls, bean bags, cross-bars, a jumpbox with an incline board, scooter boards, and large pieces of plywood cut into geometric shapes. A series of mazes drawn on paper was used to assess fine-motor behavior.

Data Collection Procedure

Assessment of training effects. Assessments of gross-motor skills were scheduled twice weekly on alternate days from training sessions. Children were taken individually to the training setting and were asked to perform a series of nine tasks. All instructions were general in nature, simply indicating the activity to be performed. The activities were modeled by the experimenter during the first two assessments. Behavior checklists were used to examine the topography of the movement and to assess the presence or absence of the critical features of skilled movement (Table 1).

Generalized motor behavior probes. Two activities, hopping and forward rolls, were assessed during physical education classes conducted in the gymnasium by the classroom teacher. A description of these activities and items examined in rating skill of execution is included in Table 1.

Data for the fine-motor generalization measure, maze-drawing, were collected by the classroom teacher once a week. The teacher presented a maze to each child and asked that she indicate the correct path with a pencil, being careful to stay within the lines of the maze. An error score for maze-drawing was calculated by adding 1 point each time the child's pencil mark touched the sides of the maze and 2 points each time the child's pencil mark actually crossed over the lines of the maze.

Collateral behavior probes. Social play and compliance behaviors were observed in the preschool classroom. A continuous 10-s interval recording system was used. Definitions of social play and compliance are given in Table 1.

Interobserver reliability. Reliability checks for all behaviors except maze-drawing were made approximately every 2 weeks by two observers who were blind to treatment manipulations. Reliability observers stood 2–3 m away from the primary observer, on the same side of the child as the primary observer. The data recording sheet of each observer was not visible to the other, but the child could be viewed from a similar perspective. At least one check occurred during each phase of the experiment. Reliability for maze-drawing was obtained by a second observer, scoring independently.

Experimental Manipulations

Baseline measures were recorded for each child until her behavior checklist score showed no upward trend; then training began. The children came to the training area as a group 3 days a week to participate in the gross-motor program. The 10 motor skills addressed in the program were arranged into four groups and trained sequentially. Training sessions varied in duration from 0.5 to 1.5 hours. More difficult activities required more training time. One to five activities were taught per training session.

The gross-motor training program used in this study was based on a program developed for preschoolers and first graders by Capon (1975). The program was chosen because it was highly structured, used behavioral training techniques, and was reported to be widely implemented in North America (Capon, 1975, p. 2). The program consists of approximately 150 different tasks that ad-

Table 1

Behavior	Task description/behavior definition	Critical features of the movement
	Trained behaviors	
Balanced standing	Stand on one leg, bend forward at the waist and extent the other leg behind. Three s on each foot.	Foot, shoulders, hips in line; body parallel to ground; arms held out; position held for 3 s.
Balanced walking	Walk forward, then backward on balance beam and visually track swinging ball at end of beam.	Shoulders, hips, feet in line; arms held out; eyes follow ball; no pausing or falling.
Ball bouncing	Dribble ball in "figure 8" around traffic cones using only one hand.	Ball pushed; no pausing; ball maintained; figure 8 path tight around cones.
Catching	Stand in front of rebound net, catch bean bag tossed into net by experimenter behind child. Repeat four times.	Bean bag caught in hands only; balance maintained.
Throwing	Execute two overhand throws of bean bag into 65 cm × 65 cm target 1.5 m away.	Hand moves in straight path; wrist snaps; steps forward; hits target.
Crawling	Crawl on hands and knees between rungs of ladder lying on mat.	Hands forward; calves straight; no touching ladder; lateral pattern used; no pausing.
Forward rolls	Execute two forward rolls on mat.	Start, end in squat; back of head placed on mat; body tuck maintained; straight roll.
Hopping	Stand on one foot, hop over crossbar, pause, then hop through two more hoops.	One foot only; pauses; hands off floor; body straight; one hop/hoop.
Running and jumping	Run up the incline board to the jump box, jump into bicycle tire lying flat on floor.	Arms move parallel to sides; straight path; feet straight; no hesitation on incline. Done from run; feet take off, land together; arms used; knees bend; lands straight in tire; hands off ground.
	Generalized Gross-motor and Collateral Behaviors	
Forward rolls	Same as above.	Same as above.
Hopping	Hop, then pause, hop, then pause for a total of 10 hops.	One foot only; hands off floor; body straight; pauses.
Social play	All verbalization to peers constituted social play whether or not exchange of play materials occurred simultaneously.	
Compliance	Redirection of behavior within 10 s of a statement from the teacher specifying the production of a behavior not being displayed or the cessation of a behavior being displayed.	

Note. Gross-motor behavior ratings ranged from 0 to 10 (all critical features present).

dress the gross-motor skills described in the top section of Table 1. The nine assessment tasks were selected from the pool of 150 tasks and therefore serve as examples of the variety of tasks in the program.

In introducing each task, the experimenter described the activity to be performed and identified the critical features of the skilled movement (see Table 1). The task was then modeled by the experimenter and each child, in turn, had an opportunity to attempt the task. Children were given praise and descriptive feedback for demonstrating the critical features of each motor skill. For example, the experimenter might say, "Good! You are keeping your arms out to help you balance." In addition to praise, children were given pats on the head and hugs when they had appropriately completed a task.

The children were also trained to recite the critical features of each motor skill and to use these as verbal mediators. The experimenter provided verbal prompts and reinforcement for correct iden-

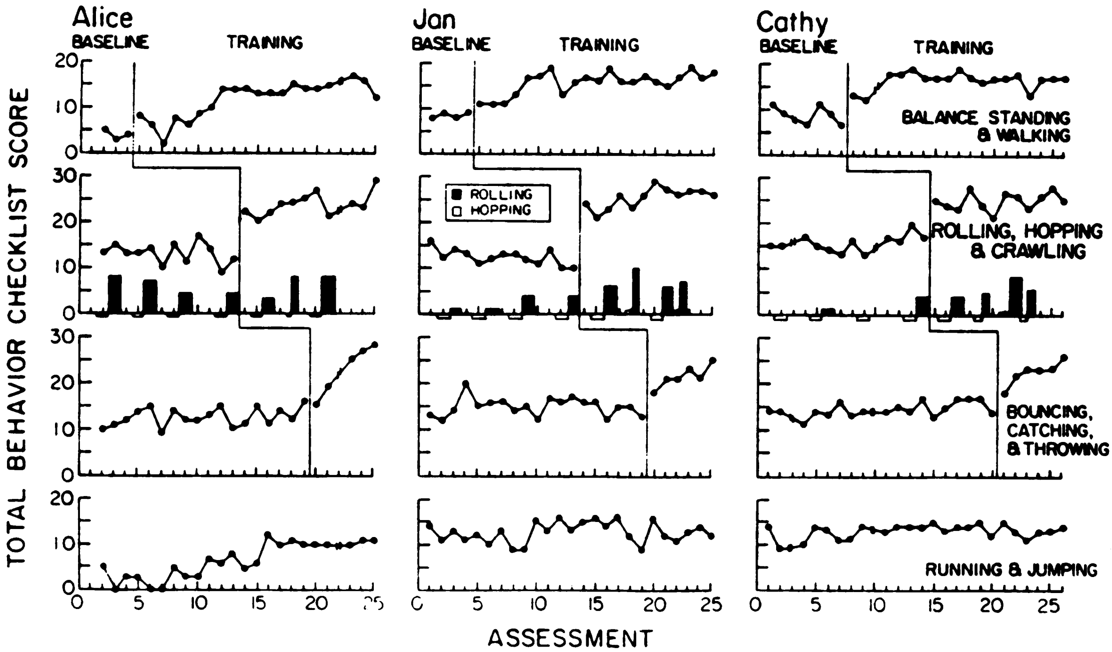

Figure 1. Total behavior checklist score for each child during training assessments and generalization probes. Connected points indicate training data (maximum score possible is indicated on ordinate), and probe data are represented by bars (maximum score possible was 10). Wide bars depict days when only one activity was probed. Narrow bars indicate days when both forward rolling and hopping were measured.

tification of critical features, and children were asked to recite the critical features while they were performing a task. For example, the experimenter would ask "What are you supposed to remember when you are throwing the bean bag?"

When a child had difficulty in executing a task or refused to try a task, equipment or tasks were modified so that less skill was required. For example, the balance beam might be lowered, or the task broken into simpler components and trained in small steps. In addition, physical guidance was offered, then gradually faded as the child's skill increased. Finally, at the end of each session, a tangible reward (e.g., a sticker) was given to each child contingent upon compliance with instructions and participation for the duration of the training session.

Training continued on each task until all children demonstrated all critical features of the motor skill or had executed three trials of the task. The next task was then trained and the mastered task was eliminated from future training sessions. When all tasks in one of the four motor skill groups were mastered, training on the next group began.

RESULTS

Reliability was calculated by dividing agreements on occurrence by agreements plus disagreements and then multiplying by 100. For gross-motor behaviors, agreements were counted for each of the critical elements on the behavior checklist. Mean agreements were 85.7% for training and 90.0% on generalized gross-motor behaviors. Maze-drawing reliability was calculated by adding agreements for each error point assignment. Mean reliability was 92.1%. Agreements on social play and compliance were counted by interval. Reliability for social play was 88.3%. Reliability for compliance was 71.4%, due to disagreement on teacher instructions. When observers agreed on instructions, reliability for compliance was 88.9%.

Figure 1 presents data for gross-motor performance in the training setting as total behavior

Table 2
Mean (and Range) of Performance on Fine-Motor and Collateral Behavior Probes

Behavioral measure	Subject	Training phase			
		Baseline	BSW[a]	RHC[b]	BCT[c]
Maze-drawing error score	Alice	25.5 (22–29)	26.3 (14–32)	16.0 (11–19)	24.0 (7–35)
	Jan	23.0 (20–26)	33.8 (3–64)	21.3 (15–29)	16.3 (12–20)
	Cathy	8.7 (5–12)	16.5 (8–25)	15.0 (10–20)	7.0 (2–15)
Percent of time in social play	Alice	10.2 (2–26)	15.3 (0–48)	7.5 (1–13)	8.1 (0–18)
	Jan	28.3 (15–38)	29.0 (17–55)	33.2 (24–42)	46.8 (29–70)
	Cathy	23.4 (14–43)	21.0 (14–28)	27.7 (16–48)	29.6 (18–42)
Percent of compliance to instructions	Alice	100.0	100.0	100.0	73.3 (40–100)
	Jan	72.9 (20–100)	88.1 (68–100)	95.0 (80–100)	95.0 (80–100)
	Cathy	82.9 (60–100)	100.0	89.9 (67–100)	72.7 (56–100)

[a] Balanced standing and walking.
[b] Rolling, hopping, and crawling.
[c] Bouncing, catching, and throwing.

checklist scores for each group of motor skills. For all subjects, implementation of training procedures resulted in increases in total checklist scores. Most improvements were relatively immediate. Mean improvements for all children ranged from 8.1 to 11.0 points. Terminal levels of responding were usually within 5 points of a perfect score.

The behavior checklist scores for the gross-motor behaviors probed in the gymnasium are presented in the bars in Figure 1. Two subjects (Jan and Cathy) demonstrated upward trends in forward rolling scores, while one (Alice) showed no clear improvement. Unlike the forward roll task, the hopping activity used for this probe was not specifically trained, although many similar hopping tasks received training. Hopping probes, therefore, examined generalization to a new activity in a new setting. No clear improvements occurred.

The maze-drawing performances measured in the classroom examined generalization to a new behavior in a new setting. Table 2 displays mean maze-drawing scores during each experimental condition. No clear improvements in maze-drawing occurred during the experiment. Averaging data across conditions did not obscure any relevant trends.

The dependent measures for social play and compliance are also summarized in Table 2. Examination of the means during each experimental condition suggests some improvement for only one subject, Jan. Examination of trends in Jan's data, however, revealed no clear improvements in either collateral behavior.

DISCUSSION

The data in Figure 1 indicate that the training program produced considerable improvement in gross-motor skills that were trained and measured in the same setting. Improvements in trained behaviors generalized to a new setting for two of three subjects, but improvements in new gross-motor behaviors did not occur. Contrary to suggestions prevalent in educational literature, changes in fine-motor skills or social behavior did not occur.

Three practical implications for educators are: (a) only children with gross-motor deficits should be selected for gross-motor training programs because generalized changes in behaviors such as social and fine-motor skills are not guaranteed by-products, (b) educators should carefully develop gross-motor training curricula to directly train gross-motor behaviors that are essential in current and near-future activities, because gross-motor benefits are specific to behaviors trained, and (c) educators should consider training in a variety of situations in which the behaviors are required, because behaviors may not generalize to new situations.

For applied behavior analysts, our study suggests limitations in the present technology of generalization. Two strategies Stokes and Baer (1977) identified for enhancing generalization (training verbal mediators and training many exemplars) were unsystematically incorporated into the training package used in our study. The finding of very little generalization suggests that careful and systematic analysis of the desired generalization should occur prior to constructing a training program and that further research is needed to build our implicit technology of generalization into an explicit technology that allows greater power, generality, and replicability (Baer, 1982, p. 211).

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