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PRIMES, CONTINGENT ATTENTION, AND TRAINING: EFFECTS ON A CHILD'S MOTOR BEHAVIOR[1]

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The use of primes, contingent attention, and training sessions to assess a child's engagement and skill in six large motor activities was examined using a combination reversal and multiple-baseline design. Assessment was based on four levels: proximity to equipment, touching equipment, unskilled participation, and skilled participation. Before training, priming (suggestion to the child) was more effective than contingent attention for increasing the subject's engagement (but not skill) in five activities and for increasing skilled participation in one activity. Training of four activities in the natural environment effectively increased the subject's skill level in five activities. Thus, training appeared to generalize to one of these five activities in this setting and also to skillfully executed stair climbing in an adjoining setting. After training, primes and contingent attention were sufficient to maintain both the subject's skill level and engagement in all activities. Postchecks in the same setting the following semester with different teachers revealed only slight increases in participation, as compared to previous baselines, but all participation was at the skilled level. Social interaction, which was not experimentally manipulated, did not systematically vary in relation to changes in experimental conditions.

DESCRIPTORS: primes, contingent teacher attention, general teacher attention, preschool children, motor development, training procedures, skill level

A behavioral class that has evoked little interest in the field of behavioral analysis is the development of preschool childrens' motor skills. Most teachers involved in early childhood education are aware of the importance of physical activities in aiding a child's development. However, even when a variety of equipment and materials are available, some children refrain from interacting with the equipment and thus do not develop the skills potentially afforded. This self-restraint from engaging in physical activities may be due to a lack of interest in the activities, a lack of coordination and skills, and/or general slowness in motor development. Regardless of the reason, it is important that these children be exposed to the equipment and that teachers know how to program their attention for demonstration of skill in such activities. A child exhibiting motor problems in preschool merits concern, because the period from birth to 6 yr of age is when basic motor skills are learned (Vance, 1973, pp. 9-12; Espenschade and Eckert, 1968, pp. 103-136; Hurlock, 1964, p. 181).

Contingent teacher attention effectively increases children's use of playground equipment (Buell, Stoddard, Harris, and Baer, 1968; Hall and Broden, 1967; Johnston, Kelley, Harris, and Wolf, 1966). Also, the application of re-

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inforcement and shaping procedures in laboratory training sessions has been demonstrated to develop and increase walking, tricycle riding, swinging, and sliding skills (Meyerson, Kerr, and Michael, 1967; Michaelis and Etzel, 1968; O'Brien, Azrin, and Bugle, 1972; Owen, 1969). These studies demonstrated that teacher attention increased the use of large motor play equipment once the skill was within the repertoire of the child. Some also demonstrated that elaborate shaping procedures were sufficient to build skilled performance of at least one motor skill. However, there was no assessment of how this training affected the development of other motor skills. Additionally, since behavioral shaping is a technological art, replication of such procedures might prove to be difficult.

To expand upon these earlier results, the present study involved first, assessment of the effectiveness of several components of teacher attention to increase performance of several motor skills both before and after implementation of training procedures; second, the development of a simple, easily replicable, training procedure to increase skill levels of motor behaviors in preschool children; third, as training of each skill was undertaken, to assess the effects of training of motor skill upon other untrained skills; and finally, to develop a reliable recording system to assess a child's motor skills on several different developmental levels in a regular playground setting. This recording system measured orientation, *i.e.,* proximity and touching of equipment, as well as unskilled and skilled participation in six different playground activities. Thus, examination of the effects of the several components of teacher attention, as well as the effects of training, could be analyzed on these developmental levels to ascertain the progressive levels of operation of the child throughout the study.

METHOD

Subject, Setting, and Activities

Penny, a 4-yr, six-month-old girl, attended a research preschool class in the Child Development Preschool Laboratory of the Department of Human Development at the University of Kansas. There were 16 other children and five teachers in the class. Penny was medically diagnosed as having cerebral palsy and did not walk until the age of 3 yr. During the first few weeks of school, teachers reported that she spent the outdoor play-time sitting on a low table or standing near a teacher. She rarely approached the climbing equipment, the slide, or the balance board, although she did engage in sandbox activities.

The present study was conducted on the preschool playground during the outside, free-play time. Throughout the study, six large-muscle activities were always available for all children to use: walking along a ladder placed horizontally on the ground; walking across a set of wooden stairs; sliding down a board; rolling down a hill; climbing on ladders and boxes; and walking across a balance board. In addition to these activities, the children also went up and down a series of cement stairs when going to and from the playground each day.

Activity Equipment

Stepping ladder: a runged ladder, 2.3 m long and 41 cm wide with seven rungs, was placed horizontally on the ground.

Wooden steps: the wooden steps on the playground consisted of three ascending steps, 15 cm high and 13 cm wide, and three descending steps with an interposing platform, 1 m square.

Slide: a board, 23 cm wide and 2.1 m long, was supported at one end by a 1.5 m high, runged, wooden box. The other end rested on the ground.

Rolling: a grassy slope comprised approximately one-half of the playground area.

Climbing: the equipment included runged ladders with and without handrails, runged wooden boxes and domes.

Balance board: a board, 23 cm wide and 2.5 m long, was placed horizontally between two supports so that it was elevated approximately 30 cm from the ground.

Cement stairs: the 15 cement steps leading to the playground were 25 cm wide and 15 cm high with a handrail along one side.

Behavioral Definitions

The subject's engagement in each of the specified activities was divided into four levels. Orientation encompassed the lower two developmental levels: (1) being within a radial *proximity* of 2 m to the equipment, and (2) *touching* or sitting on the equipment. Active participation included two skilled developmental levels: (3) unskilled performance, and (4) skilled performance. Table 1 presents the behavioral definitions used to assess unskilled and skilled performances for each activity. The subject's highest level of performance during each 10-sec interval that she was engaged in an activity was recorded.

Social interaction with peers was recorded if the subject talked to or played with another child. If a teacher talked to (*e.g.,* "Penny, you climbed the stairs really well") or physically assisted the subject while she was engaging in an activity, contingent attention was scored. Primes were recorded if a teacher specifically suggested to the subject that she engage in any of the specified activities (*e.g.,* "Let me see you roll down the hill today, Penny"). Any other teacher attention to the subject was scored as general attention.

Observation Procedures

A trained observer was assigned to record with a stopwatch, and pencil on a data sheet divided into 10-sec intervals, the subject's playground activities for 20 min every afternoon, Monday through Thursday. The same recording procedures were used during training sessions that preceded the regular observation time during the outdoor, free-play period.

To assess reliability of the observation procedures, a second observer simultaneously, but independently, recorded the behavioral occurrences at least once in every condition of the study, with the exception of one, one-day baseline probe, for a total of 49 times. Interobserver agreement for the occurrence of each behavior

Table 1
Active Participation Skill Levels for Each Activity

Activity	*Unskilled (Level 3)*	*Skilled (Level 4)*
Stepping ladder	(a) Stepping on rungs (b) Simultaneously placing both feet in an inter-rung space	Walking longitudinally through the ladder by placing one foot after the other in alternating spaces between the rungs
Wooden steps and cement stairs	(a) Simultaneously placing both feet on the same step (b) Crawling up or down the steps (c) Using the handrail	Placing alternating feet on successive steps without using the handrail on the cement stairs
Slide	Holding onto the board too tightly with hands and interrupting the descent	Sliding down the entire length of the board without interrupting the descent
Rolling	Raising the head more than 30 cm from the ground while rolling	Lying on the ground in either a supine or prone position and keeping the head within 30 cm of the ground while turning over
Climbing	Requiring adult assistance to climb higher or to climb down from a ladder or climbing box	Climbing up, down or along a ladder in a reciprocal hands and feet pattern
Balance board	Crawling or creeping along the board	Standing erect on the board and walking forward using only the position of the body and upper extremities to maintain balance

in each category was calculated by dividing intervals of recorded agreement by intervals of recorded agreement plus disagreement and multiplying the quotient by 100. For all large-muscle activities across all conditions, reliability scores ranged from 72% to 100%, with an average of 79%. Reliability averaged 84% for contingent attention and primes, with a range of 33% to 100%. As reliability was computed on the basis of only those intervals in which a defined behavior was recorded, the low score of 33% actually represents a low-occurrence behavior in which both observers agreed that it occurred once out of three recordings. The average occurrence reliabilities for each behavior category across all conditions are shown in Table 2. The average occurrence reliabilities for each condition across all behaviors are shown in Table 3.

Table 2

Occurrence Reliability—All Conditions

Behaviors	*Range*	*Mean*	*Median*
Contingent attention	0-100	76	77
Primes	33-100	92	94
Balance board—skilled level	0-100	87	92
Climbing—skilled level	50-100	77	79
Stepping ladder—skilled level	50-100	81	86
Wooden steps—skilled level	80-100	89	95
Rolling—skilled level	40-100	72	85
Slide—skilled level	33-100	69	70
All Activities—active participation	63-100	84	85
Cement Stairs—active participation	85-100	90	100

Table 3

Occurrence Reliability—All Behaviors

Experimental Conditions	*Per Cent*
Pretraining:	
Baseline	77
Primes	74
Baseline	85
Primes	89
Contingent attention	69
Primes + contingent attention	75
Training:	
Primes + contingent attention Train stepping ladder	73
Primes + contingent attention Train wooden steps	76
Baseline (one-day probe)	86
Primes + contingent attention Train sliding	70
Baseline (one-day probe)	68
Primes + contingent attention Train rolling	79
Baseline (one-day probe)	no reliability check
Posttraining:	
Contingent attention	73
Increased primes + contingent attention	73
Baseline	86
Increased primes + contingent attention	84
Postchecks:	
Baseline	92

Baseline. The subject was free to engage in any activity she chose. Teachers attended to her in a normal manner, but refrained from encouraging her to engage in any of the six specified activities.

Primes. The subject was verbally primed to engage in each of the six specified activities once each session. For example, a teacher would say: "Penny, let's see you roll down the hill", or "Penny, let's see you walk along this balance board", as she pointed to the elevated board. After delivering the prime, the teacher turned away from her or attended to another child. If the subject did engage in the primed activity, the teacher observed from a distance in order to assist if an emergency arose. The sequence of the six activities to which the subject was primed in each session varied across sessions.

Contingent attention. The subject was free to engage in all playground activities. If she engaged in any of the six specified activities, a teacher attended to her briefly, by either praising her or by holding her hand for support while she performed the activity.

Primes plus contingent attention. The subject was primed once to each activity daily. If

she complied, a teacher attended to her briefly while she engaged in the activity. The order of activities to which the subject was primed in each session varied across sessions.

Training sessions with primes plus contingent attention. To assist the subject to develop greater skill in four of the activities, training sessions were started before each regular 20-min observation. Training procedures were successively implemented with four of the activities, stepping ladder, wooden steps, sliding, and rolling, in that order. No training was given for the cement stairs, the balance board, or climbing. During the training sessions the principal investigator, one of the teachers, primed the subject to the equipment for the activity being trained and praised her (*e.g.,* "Good, Penny, you put a different foot on every step"). Limited physical assistance was given only when needed for safety or to show Penny where to place her hands or feet. The actual procedures were developed during the first training period on the foot-placement ladder. The number of skilled performances required for the training session each day was based on an escalating scale with a maximum number of 10. For example, the goal for the first session was always five. When the subject was able to execute five successive skilled performances, this number was increased to eight and finally to 10. The subject tallied her own progress by placing pencil marks on a card following each performance at the criterion level. If the subject attained the criterion number of skilled performances each session, she received a small toy of her choice. A training session ended when the subject had completed the required quota for that session. When the subject could execute 10 successive skilled performances in one session, training with that activity ended. It should be noted that the critical differences between the training sessions and the regular 20-min sessions were increased physical assistance, the implementation of a requirement to participate, and increased teacher attention and primes.

Following each daily training session, observation was continued for about 20 min, during which time the experimental condition of primes plus contingent attention was maintained. After training with the wooden steps, sliding, and rolling, one-day baseline probes during the regular observation period were implemented.

Increased primes plus contingent attention. Primes and contingent attention were delivered in the same manner as during the original primes plus contingent attention condition, but no limit was placed on the number of primes or occurrences of contingent attention per session.

Experimental Design

A combination reversal and multiple-baseline design was used. During the pretraining and posttraining phases, the effects of the component teacher behaviors upon the quantity and quality of the subject's physical activities during the regular outdoor play period were analyzed within a reversal design. This design was judged appropriate to demonstrate reinforcement control of the subject's quantity of participation in the activities during both pretraining and posttraining. However, for purposes of increasing the subject's skill level, it was apparent that training was necessary. Once trained, it was not expected that the subject's behavioral skill level would be reversible. As with many academic tasks (*e.g.,* reading and writing), physical skill acquisition involves a learning and practice process that is seldom reversible. Although some forgetting may occur with such skills, the original acquisition process is never replicable. Therefore, a multiple-baseline design was implemented to demonstrate experimentally the effects of training upon skill acquisition with each activity. The effects of this sequential training were behaviorally assessed during an outdoor free-play time that permitted assessment of the effects of the training situation. That is, skill acquisition during a training period was assessed during a second period in the same physical setting, but during which no training transpired.

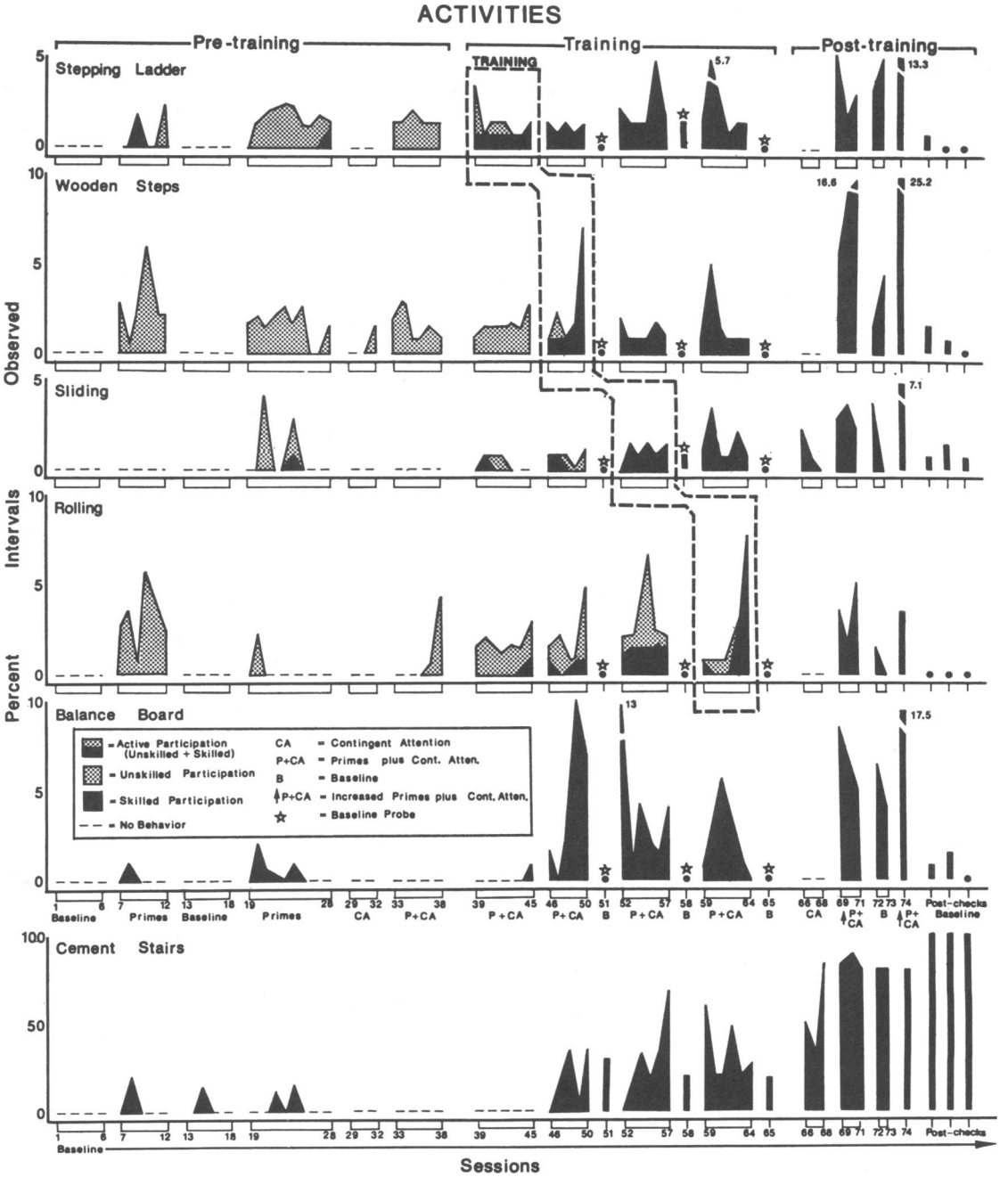

Fig. 1. *Upper five graphs:* the subject's active participation and skilled participation, as a per cent of 10-sec intervals each session, in walking through a stepping ladder, walking up and down wooden steps, sliding, rolling, walking across a balance board. *Bottom graph:* per cent of 10-sec intervals observed on the cement stairs each day during which the subject traversed them at the skilled level of performance. This activity differed from the other five in that engaging in it was required in order to reach the playground.

RESULTS

The upper five graphs in Figure 1 show the subject's active and skilled engagement in each activity per session. These data were calculated for each session by dividing the number of 10-sec intervals in which the subject was actively engaged at the skilled and unskilled levels for each activity by the total number of intervals observed and multiplying the quotient by 100. Thus, the data represent a proportional comparison of the subject's engagement in each activity at the defined, active skill levels. If the subject's active participation were all unskilled, the data are represented by the dotted areas. If she performed an activity at the highest skill level, the data are represented by the solid black areas. All of the data shown in the upper five graphs were recorded only during the regular 20-min outdoor play period and not during training sessions.

The bottom graph in Figure 1 shows the amount of active engagement in ascending and descending the cement stairs (an activity that was required to reach the playground), which was performed at the skilled level of participation. These data were calculated by dividing the number of 10-sec intervals of skilled participation by the number of intervals of active participation and multiplying by 100. Thus, if it took the subject five 10-sec intervals (50 sec) to ascend the steps and six 10-sec intervals (60 sec) to descend the steps one day, and if she executed the stairs at criterion performance during each of the 11 intervals, the graph would show 100% criterion performance for that day.

No active participation occurred in any of the five activities during the two baseline conditions of pretraining. Priming conditions increased the subject's unskilled participation with four of the activities and skilled participation with the balance board. Participation levels in all activities decreased during the contingent attention condition. Unskilled participation increased with the stepping ladder, wooden steps, and rolling during the primes plus contingent attention condition (Sessions 33 to 38).

Even though primes effectively increased overall participation in the activities during pretraining, they did not increase skill with the stepping ladder, wooden steps, sliding, and rolling. On a few occasions, skilled participation was recorded, but it should be noted that these instances represent only a solitary step or slide that occurred at the highest skill level since the subject's highest skill performance which occurred in each 10-sec interval was recorded. Consequently, the training phase was implemented, as shown by the enclosed area labelled "TRAINING" in Figure 1. The per cent of the subject's active participation that was skilled during each training session is shown in Figure 2. These data were calculated by dividing the number of 10-sec intervals of skilled participation by the number of intervals of active (unskilled plus skilled) engagement and multiplying by 100. An average of six training sessions per activity was required for the subject to attain the criterion of 10 successive skilled performances within a single training session. An increase in skill occurred during the training period for each activity, the largest being for sliding. Although the subject reached 100% skilled participation in training Sessions 47 and 49 for the wooden steps and in Session 55 for sliding, the required number of skilled performances was less than 10 at those points. Therefore, training was continued until both 10 successive skilled performances and 100% skilled participation were attained.

In Figure 1, the enclosed area labelled "TRAINING" indicates the days on which training sessions were implemented for each activity. The subject's skills, assessed during the regular 20-min outdoor, free-play period (when no training was occurring) show a sequential improvement with implementation of training for each activity during the training phase. Following training, skilled participation was maintained with the stepping ladder, wooden steps, and sliding. A moderate increase in rolling skill

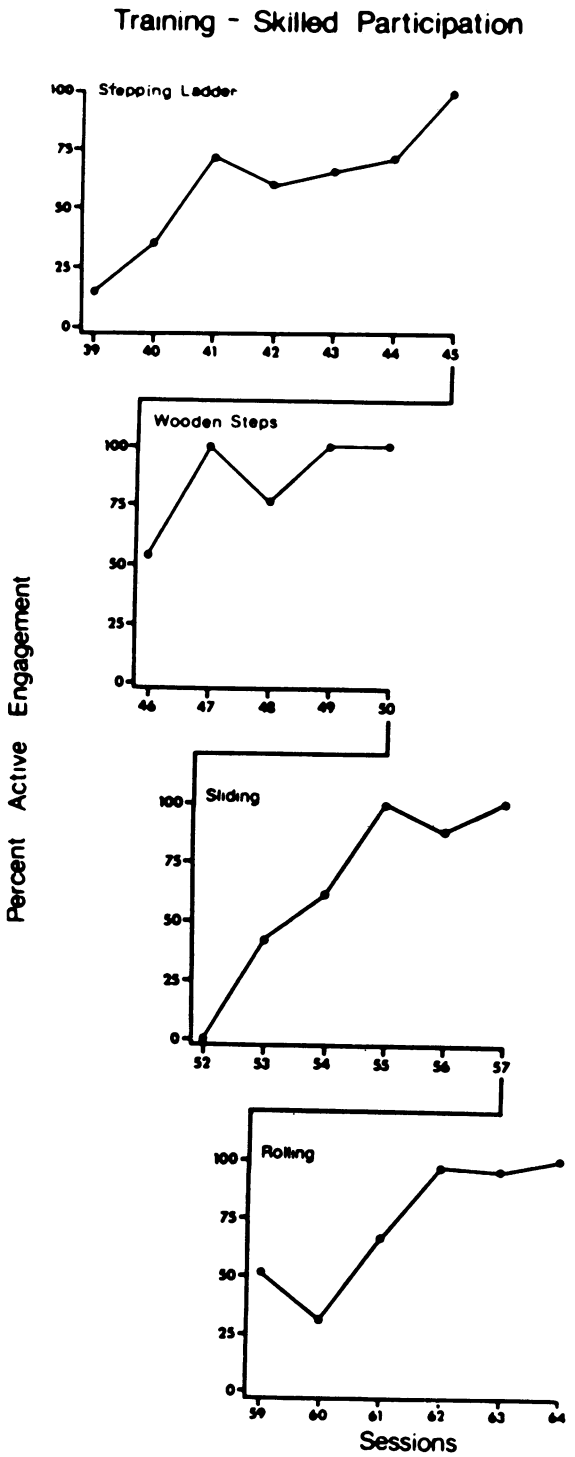

Fig. 2. Per cent of 10-sec intervals of the subject's active engagement that was performed at the skilled level of performance each session during training periods for the stepping ladder, wooden steps, sliding, and rolling.

was produced before training. However, the average skilled performance, as calculated by dividing the number of intervals of skilled performance by the total number of intervals of rolling, during rolling training, was 60%. This was higher than during previous days when training sessions were being conducted with the wooden steps (Sessions 46 to 50) and sliding (Sessions 52 to 57). The average skilled participation for rolling during these previous training periods was 22% and 48% respectively.

Similar skill increases occurred with two untrained activities, the balance board and the cement stairs. A marked increase in skilled participation with the balance board can be seen during Sessions 46 through 50 when training sessions were being conducted with the wooden steps. The increased level of skilled participation continued throughout the study. Also, the bottom graph in Figure 1 shows a skill increase in ascending and descending the cement stairs that bordered the playground following initiation of wooden-step training on the playground (Session 46). This increased skill level continued throughout the study. Three baseline postchecks, conducted two months after the study in the same preschool setting but with different teachers, revealed only slight increases in participation as compared to previous baseline conditions.

Figure 3 shows the averages per condition for total teacher attention, general attention, primes, and contingent attention for large-muscle activities. Total attention is a combination of the three recorded teacher behaviors. These data were calculated by dividing the number of 10-sec intervals of total teacher attention, general attention, primes, and contingent attention of each condition by the number of 10-sec intervals observed and multiplying the quotient by 100. Total teacher attention ranged from 4% to 24% of the total observation time per condition, with an overall average of 14%. The components of teacher attention varied according to the prescribed conditions. During the first baseline, when the general attention per-

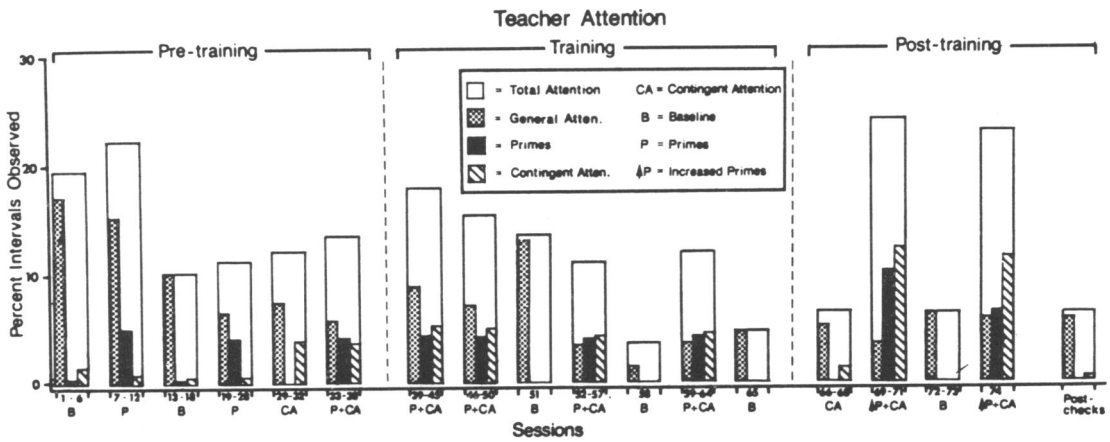

Fig. 3. Per cent of 10-sec intervals of total teacher attention, general attention, primes, and contingent attention to large-muscle activities as averages per condition.

centage was higher than any other teacher attention component throughout the study, there was no active participation in the five playground activities (Figure 1).

The subject's social interaction with peers (not shown) ranged from 0% to 54% of the total observation time, with an average of 11% across the study. Social interaction was not experimentally manipulated throughout the study. Although the highest occurrences of social interaction were during baseline conditions, there were no systematic increases in social interaction related to changes in experimental conditions.

DISCUSSION

Although contingent adult attention and primes for increasing engagement in motor behavior were demonstrated to be effective, such attention was insufficient to increase motor skill. Verbal primes were initially sufficient for increasing the subject's engagement, but not her skill, in playground activities. By contrast, training sessions were effective for increasing motor skill. These results suggest that the universal use of primes and differential attention may not lead to gains in motor skill if a child does not have such skills. Following training, increased primes plus contingent attention were sufficient for maintaining both participation and skill in all activities.

Throughout the study, primes were more effective than contingent attention for increasing the subject's engagement in all activities. Thus, one might conclude that primes were a discriminative stimulus for the subject to engage in the specified activities, as she rarely engaged in the activities during baseline or contingent attention conditions. During conditions using only contingent attention, if the subject did not independently engage in an activity, there was no behavior to reinforce. Thus, the subject controlled reinforcement contingencies during contingent attention conditions. That is, instead of the subject's behavior being controlled by the teachers' behavior (priming), the teachers' behavior was controlled by the minimal occurrence of the subject's behavior. Therefore, primes increased the probability that the subject would engage in the specified activities.

These results also reflected the subject's dependence on teachers. On several occasions, it appeared that she would perform an activity once and then wait for a teacher to prime her to another activity. Even though this dependence on teachers to initiate activities was a recognized problem, it was not the intent of the present study to rectify this. As only six primes were given intermittently in a 20-min period, there was ample time for the subject to engage independently in a playground activity of her choice. Thus, the study was not designed to keep

her active at all times, but to improve her skill in large motor activities and to allow her to have time to engage independently in the specified activities, or in sandbox activities, running, or wheel-toy riding if she chose. There was also sufficient time for her to interact socially with peers. However, there were no collateral changes in her social behavior, as previously reported in a similar study by Buell *et al.* (1968).

As revealed during postchecks conducted several weeks after the study (using baseline conditions of no primes or contingent attention), Penny's overall level of participation was low. However, in contrast to earlier (pretraining) baseline conditions, when Penny did participate in the activities she performed them skillfully.

The subject's skill repertoire increased as a result of training. Initially, she showed a noted preference for climbing, which she could perform at the highest skill level when the study began. The amount of skilled participation in climbing continued throughout training and posttraining as her skill and participation in all of the other activities increased. Thus, her overall motor skills increased without sacrificing participation and skill in a previously skilled activity. Instead, her previous inactivity and unskilled performance in the trained activities were decreased.

The method for assessing motor skill in each activity evolved empirically by observing the performance of other children. Penny often stood watching children sliding, rolling, *etc.* or sat on the climbing equipment and the balance board. These behaviors accounted for much of her orientation to the activities and were considered "potential" engagement levels that were included in this behavioral code. Once Penny actively engaged in an activity, participating with assistance or in a defined unskilled manner was regarded as antecedent to the more skilled behavior usually exhibited by children. Thus, the specification of two levels of orientation (proximity and touching) and two levels of active participation was sufficient for assessing the behavioral acquisition of this subject during the regular 20-min playground periods and the training sessions. The use of the same recording procedures in both settings afforded a more precise assessment of the effectiveness of the training procedures on the subject's performance during the 20-min outdoor play period than when different procedures and behavioral recordings are used in the training and testing environment (Michaelis and Etzel, 1968; O'Brien *et al.*, 1972).

The effectiveness of training procedures with the stepping ladder, the wooden steps, and sliding was readily seen with maximal and maintained skill increases during the regular 20-min playground period. The effectiveness of these procedures was not as clearly demonstrated with rolling, because some skill improvement occurred during the two preceding training periods. This gradual increase in rolling skill before training may have been due to generalization from training other physical skills, or perhaps to the contingent attention that the subject was receiving throughout the training phase for occurrences of skilled rolling during the regular 20-min outdoor period.

The importance of the training procedures can be seen not only with skill increases in the trained activities, but also with corresponding skill increases in two untrained activities, the cement stairs and the balance board. The subject's initial lack of skill and coordination in these two activities was overcome as she gained skill through training on the stepping ladder and the wooden steps. Functionally, these activities were all related in that each required postural control to maintain the body in an upright, balanced position. Thus, as coordination and balance improved through training with the stepping ladder and wooden steps, perhaps these skills generalized to the cement stairs and balance board, which explains the covariation of the latter two. Skill in these activities continued to improve as teachers primed and praised the subject for executing the related, trained activities (stepping ladder and wooden steps) on the playground. This apparent demon-

stration of skill generalization across activities and settings further supports the importance of helping school children develop even a few motor skills that may generalize and, thus, enhance motor development, with the additional benefit of increasing the child's independence. In this case, the child before "training" usually needed a handrail to use stairways. It also emphasizes the interrelationship of motor activities and the need to provide children with a variety of activities, even with minimal equipment, for maximal development.

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