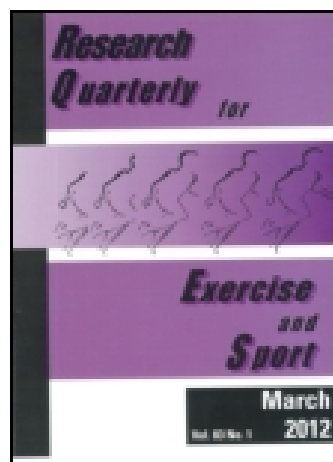




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Influence of a Motor Skill Intervention on Fundamental Motor Skill Development of Disadvantaged Preschool Children

Jacqueline D. Goodway and Crystal F. Branta

The influence of a 12-week (24, 45-min motor sessions) motor skill intervention on fundamental motor skill (FMS) development of disadvantaged preschoolers was examined. Pre- and postintervention measures of the object control (OC) and locomotor subscales of the Test of Gross Motor Development were obtained for both groups. Prior to the intervention, developmental delays in FMS were reported. Two separate 2 x 2 (Group x Pre-Postintervention) analyses of variance with repeated measures yielded a significant Group x Pre-Postintervention interaction for locomotor, $F(1, 57) = 134.23, p = .000, h^2 = .70$, and OC, $F(1, 57) = 161.55, p = .000, h^2 = .74$ skills. Compared to the Control group, the motor skill intervention group revealed significantly higher locomotor and OC scores following the intervention than prior to the intervention.

Key words: early childhood, locomotor, motor skill instruction, object control

Fundamental motor skills (FMS) are commonly considered the building blocks to more advanced movement skills and specific sport skills (Gabbard, 2000; Haywood & Getchell, 2001; Payne & Isaacs, 2002; Seefeldt, 1980) and are included in the national content standards in physical education (National Association for Sport and Physical Education, 1995). In his model of the progression of motor skill proficiency, Seefeldt (1980) proposed that children must learn a certain level of competency in FMS if they are to break through a hypothetical “proficiency barrier” and successfully engage in sport specific skills later in life. Seefeldt suggested that early childhood was the time to best develop FMS. Motor development text-

books (Gabbard, 2000; Haywood & Getchell, 2001; Payne & Isaacs, 2002) support this view, indicating the importance of early childhood for motor skill development. However, these skills do not naturally “emerge” during early childhood, rather, they result from many factors influencing the child’s motor skill development (Newell, 1984, 1986).

Newell (1984, 1986) suggested that motor skill development is based on the interaction between constraints from the task, the organism, and the environment. That is, FMS emerge within a dynamic system consisting of a specific task, performed by a learner with given characteristics, in a particular environment. In this dynamic systems theory perspective, factors (subsystems) within the organism (the learner) will influence motor skill development. For example, motivation, strength, and neurological development, are a few of these many factors. In addition, environmental considerations, such as the equipment used, previous experience, and instruction, may influence motor development. These two factors (organism and environment) are specific to the task being asked of the performer. Given this dynamic view of motor skill development, it may be hypothesized that certain populations of children will be influenced by constraints

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that retard the development of FMS in early childhood. Preschool children who are identified as disadvantaged may be one such group, as they present both environmental and biological (organismic) risk factors in the identification of their disadvantaged status.

Federal law protects young children who are disadvantaged. Federal legislation in the form of Public Law 105-117-Part C & H (1997) identifies and provides for disadvantaged individuals at risk of having substantial developmental delays, if early intervention services are not provided. Incorporated within this legislation is the notion that a child exposed to biological (organismic) or environmental influences (risk factors) may demonstrate a greater probability of developmental delay or educational failure. Given the possible influence of the biological (organismic) and environmental risk factors to which disadvantaged young children are exposed, it may be suggested that these young children will demonstrate developmental delays in FMS development.

A number of research studies (Connor-Kuntz & Dummer, 1996; Goodway & Rudisill, 1997; Hamilton, Goodway, & Haubenstricker, 1999) have found that disadvantaged children demonstrated developmental delays in FMS. Goodway and Rudisill (1997) and Hamilton et al. (1999) further suggested that these delays indicated the lack of environmental support in which the children were raised. Given these data, it is important to examine the role of intervention programs in remediating developmental delays with this disadvantaged population, specifically in the motor development area.

The effectiveness of early intervention programs, such as Head Start, in achieving positive educational and social outcomes for disadvantaged children is well documented (Casto & White, 1984; Guralnick, 1991; White & Casto, 1985; Zigler & Muenchow, 1992). White and Casto's (1985) meta-analysis of 162 studies revealed that effect sizes for early intervention programs averaged half a standard deviation. These authors concluded that more organized interventions or those with professional interveners reported greater gains in outcome measures than those with less structure and noncertified interveners. However, despite a substantial body of early intervention literature, limited evidence is available with respect to motor development outcomes for disadvantaged children.

Contemporary literature on the benefits of motor skill interventions for young children is limited (Connor-Kuntz & Dummer, 1996; Halverson & Robertson, 1979; Hamilton, et al., 1999; Kelly, Dagger, & Walkley, 1989; Miller, 1978; Valentini, 1997; Zittel & McCubbin, 1996). Halverson and Robertson (1979) documented the positive influence of instruction on typical young children's throwing performance. Kelly et al. (1989) reported that typical preschool children demonstrated qualitative performance gains in six fundamental motor skills from

pretest to posttest as a result of two 5-week instructional units consisting of direct instruction. In contrast, the control group, who engaged in well equipped free play, made no significant gains in motor skill development. A study by Connor-Kuntz and Dummer (1996) found significant pretest-posttest gains in FMS in typical preschool children, Head Start (disadvantaged) preschool children, and preschool children with disabilities, as a result of an 8-week intervention. Despite significant improvements, children in Head Start and Special Education were still below expected standard scores for their age at the posttest. Hamilton et al. (1999) found that prior to a motor intervention, disadvantaged preschool children demonstrated developmental delays in object control skills. Following an 8-week parent-assisted intervention, they found significant pre- to posttest gains in object control skills for the experimental group, as compared to a control group who did not demonstrate significant change in motor performance. Finally, Valentini (1997) found that a 12-week, student-centered instructional program resulted in significant gains in the FMS of developmentally delayed kindergarten children from pre- to postintervention. What was interesting about this study was that the control group did not change from pre- to postintervention, despite the fact both groups had received 30 min of daily physical education per day throughout the intervention period. In contrast to the above studies, Zittel & McCubbin (1996) used a single-subject design to examine the influence of an 8-week motor skill intervention on the motor skill acquisition of 4 developmentally delayed preschool children. These authors did not find significant change in motor skills in either the integrated or segregated condition, a finding attributed to limited time to practice and the nature of the developmental delays.

For students to learn motor skills, quality programs using effective instruction must be provided (Graham, Holt/Hale, & Parker, 2001; Rink, 1996). Quality motor skill interventions and programs should incorporate developmentally and instructionally appropriate practice (Council on Physical Education for Children [COPEC], 1992). Developmentally appropriate practice recognizes the varied individual capacities of children and accommodates those characteristics within the instructional environment. Instructionally appropriate practice incorporates what is currently known as best practice as a result of research and experience (COPEC, 1992). Practice that is appropriate to the learning goal, providing a variety of tasks for learner success, clearly communicating tasks and outcomes to students, providing appropriate feedback, and allowing students to develop at their own rate, are all considered indexes of effective instruction (Rink, 1996). In addition, good content development, such as conducting a task analy-

sis and arranging instructional tasks with a clear progression of scope and sequence, are also important to effective instruction (Rink, French, Werner, Lynn, & Mays, 1991). If a teacher provides such indexes of effective instruction, students should be able to meet the desired learning outcomes.

Overall, the literature suggests that young children who are disadvantaged demonstrate developmental delays in FMS and significant changes in motor skill development can result from as little as 8 weeks of instruction. Also, motor skill interventions using different instructional approaches (direct, parent-assisted, and student-centered) were able to bring about positive change in the FMS performance.

The purposes of this study were: (a) to obtain baseline data on FMS (locomotor and object control) development of preschool children who are disadvantaged and for whom limited data are available, (b) to determine the influence of a motor skill intervention on the locomotor and object control skills of the intervention and control children, and (c) to examine in which skills significant changes occurred in pre-postintervention FMS. It was hypothesized that preschool children who are disadvantaged would demonstrate developmental delays in their FMS prior to the motor skill intervention. It was also hypothesized that children receiving the motor skill intervention would demonstrate greater gains in locomotor and object control development than the Control group from pre- to postintervention and that the intervention group would show improvement in all skills.

Method

This study was conducted as part of educational reform efforts in a large midwestern urban school district with a high percentage of disadvantaged children. The school district is situated in an industrial city that has undergone urban decay and has a high percentage of unemployment, poverty, and crime (see Branta & Goodway, 1996, for a detailed description of the site).

Participants

Participants for the motor skill intervention (MSI) group ($n = 31$) and Control group ($n = 28$) were selected from children enrolled in an urban compensatory preschool program. The program serves predominantly African American, 4-year-old children who were identified as disadvantaged and at risk of becoming educationally disadvantaged or developmentally delayed if early intervention services were not provided. All participants in the MSI and Control groups were African American. Eligibility for the program was based on school readi-

ness test scores and the number of risk factors presented (see Table 1). Children were screened on an objective-referenced preschool readiness test (Office of Compensatory Programs, 1991a) which assessed: (a) cognitive objectives, such as counting and alphabet recognition; (b) affective objectives, such as self-esteem and emotional awareness, and; (c) psychomotor objectives, such as scissor cutting, manipulation skills, and standing on one leg. Risk factors (Office of Compensatory Programs, 1991b) were also used to identify children for the program as per State Board of Education guidelines. Potential risk factors are illustrated in Table 2. The children selected were those considered to be most in need of the program's early intervention services as indicated by a combination of the lowest preschool readiness test score and the greatest number of risk factors. Once identified, the children participated in the typical preschool program consisting of a half-day session (lasting 2.5 hr) 4 days per week. A certified early childhood teacher and a paraprofessional provided instruction in the preschool program in classes ranging from 14 to 16 children. The

Table 1. Demographic information for the participants and their families by group

Variable	Group	%	<i>M</i>	<i>SD</i>	Range
Age (years)	MSI		4.74	0.29	4.25–5.25
	C		4.74	0.33	4.00–5.17
Risk factors	MSI		5.29	1.29	2–10
	C		5.79	2.13	2–11
Preschool readiness test score (0–20)	MSI		6.03	4.05	0–19
	C		4.18	2.16	0–12
Developmentally immature	MSI	77.4			
	C	67.9			
Single parent family	MSI	87			
	C	61			
Maternal age (years)	MSI		27.83	5.18	21–40
	C		29.13	6.30	21–43
Receive welfare	MSI	71			
	C	89			
Unemployed	MSI	68			
	C	71			
Maternal education level (grade)	MSI		12.16	1.21	9–16
	C		11.57	1.14	9–13
Mothers with GED	MSI	90			
	C	64			
Paternal education level (grade)	MSI		11.74	1.83	5–16
	C		11.62	1.20	8–14

Note. *M* = mean; *SD* = standard deviation; MSI = motor skill intervention group; C = control group.

primary instructional emphasis was on cognitive (i.e., alphabet, colors, numbers) and social (i.e. listening, cooperating) objectives. Motor objectives were part of the curriculum, but only fine motor skills, such as scissor cutting and drawing, received substantial instructional time and formal instruction. No formal instruction was provided in gross motor skills. Gross motor activity consisted of playground recess activities, such as swinging, climbing, and playing with balls. These activities occurred randomly depending, in part, on the weather.

Informed Consent. Informed consent was obtained from the custodial caregiver(s) of each child participating in

the study. Verbal assent was obtained from each child by asking the child if she or he would like to participate in a "gym class." All children responded in a positive and excited manner to this question, indicating their assent to the investigator. All teachers of the participants also consented to the study. Prior to the investigation, human participants approval was obtained from the Institutional Review Board, school district, and schools.

Motor Skill Intervention Participants. Participants for the MSI group were drawn from two intact preschool classrooms in two urban elementary schools. Due to the study taking place in the naturalistic setting of elementary schools, it was not possible to assign participants to groups randomly. Table 1 provides demographic information on the participants. The MSI participants included 16 girls and 15 boys, with a mean age of 4 years and 9 months. MSI participants had poor readiness skills for school as evidenced by a score of 6.03 from a possible 20 on the objective-referenced test and averaged 5.29 risk factors. The typical student in the program demonstrated the following types of risk factors: being developmentally immature, from a low-income family, with a single, unemployed parent. Other common risk factors included prenatal drug abuse of a parent, low educational attainment of a parent, incarceration of a family member, loss of parent or sibling, and low birth weight. Ten of the 31 children were born prematurely ($M = 3.8$ weeks premature, $SD = 2.10$). The mean birth weight of all MSI children was 2.97 kg ($SD = .79$).

Control Participants. Participants for the Control group were drawn from two intact preschool classrooms from one urban elementary school and were considered a suitable Control group for the MSI group, because (a) the eligibility requirements for the preschool program were the same for all children, (b) the children in the Control group were selected from the same African American community with the same types of risk factors and family demographics, and (c) teachers and parents reported that children from the MSI and Control groups were drawn from the same community. The Control participants included 14 girls and 14 boys, with a mean age of 4 years and 9 months (see Table 1). Control group participants also had poor readiness skills for school, with a score of 4.18 from a possible 20 on the school readiness test and averaged 5.79 risk factors with similar risk characteristics to those of the MSI group. Seven of the 29 Control participants were born prematurely ($M = 3$ weeks premature, $SD = 2.76$). The mean birth weight of the Control group was 3.23 kg ($SD = .56$).

Instrumentation

The Test of Gross Motor Development (TGMD) was administered to both MSI and Control groups prior to and following the motor skill intervention. The 12-item

Table 2. Risk factors used to identify participants for the preschool program

Description of risk factors
1. Serious concern expressed by a parent, primary caregiver, or professional regarding a child's development, parenting style or parent-child interaction
2. Parent or primary caregiver with chronic or acute mental illness, developmental disability, or mental retardation
3. Parent or primary caregiver with drug or alcohol dependence
4. Parent or primary caregiver with a developmental history of loss or abuse
5. Family medical and genetic history characteristics
6. Parent or primary caregiver with severe chronic physical illness
7. Acute family crisis
8. Chronically disturbed family interaction
9. Parent-child or primary caregiver-child separation
10. Adolescent mother
11. Parent has four or more preschool children
12. Family income up to 200% of federal poverty guidelines
13. Presence of one of the following: parent education is less than ninth grade; neither parent is employed; or single parent
14. Physical or social isolation and/or lack of adequate social support
15. Lack of stable residence, homelessness, or dangerous living conditions
16. Family has inadequate health care or no health insurance
18. Limited prenatal care
19. Maternal prenatal substance abuse
20. Severe prenatal complications
21. Severe perinatal complications
22. Asphyxia
23. Very low birth weight
24. Small for gestational age
25. Bronchopulmonary dysplasia
26. Excessive irritability, crying, or tremulousness on the part of the infant
27. A typical or recurrent accidents involving the child
28. Chronic otitis media (inflammation or infection of the middle ear)

TGMD (Ulrich, 1985) provided information on the performance of seven locomotor and five object control skills for children ages 3–10 years. Subscale locomotor raw scores ranged from 0 to 26 points (run, jump, hop, slide, worth 4 points each, and gallop, leap, skip, worth 3 points each). Subscale object control raw scores ranged from 0 to 19 points (throw, catch, kick, strike, worth 4 points each, and bounce, worth 3 points each). Percentile ranks were calculated from both subscale raw scores. As per the Ulrich (1985) standardized protocol, all children performed three trials of each task, and the presence or absence of the criterion elements of form was evaluated. A child who demonstrated a criterion element of form for two of the three trials would receive a score of 1 for that element. Test administration took approximately 15–25 min per child and was conducted individually in an available space. The caregiver of each child completed a demographic questionnaire, which included information on sociodemographic status, caregiver educational attainment, caregiver employment, maternal age at birth of child, and current marital status (see Table 1).

Procedures

This study used a quasiexperimental, pre-postintervention design with the MSI and Control groups. It was not possible to randomize participants to the groups due to the nature of the educational environment. Thus, intact classes were assigned to groups. Lack of student randomization to groups is acknowledged as a weakness of the investigation's design; however, there were no significant differences in preintervention scores despite the lack of randomization. Parametric statistics used as box plots of the dependent variables indicated a normal distribution. Additionally, using a dynamic systems theoretical orientation, it may be suggested that each student has unique organismic and environmental characteristics. Thus, intervention effects will be different for each student, supporting use of the student as the unit of analysis.

One week prior to the intervention and 1 week following the intervention all participants in the MSI and Control groups were evaluated using the TGMD. The MSI group received the motor skill intervention during the time allotted to the regular preschool program; the Control group received the regular preschool program. The primary investigator (the first author), a female Caucasian, was the test administrator in collecting all data.

Development and Implementation of the Motor Skill Intervention. A motor skill intervention was developed from a preschool physical education curriculum designed for all preschool students (Dummer, Connor-Kuntz, & Goodway, 1995). The intervention goals were developed

via formal and informal processes of program design that took place over one school year and involved teachers, paraprofessionals, and administrators. The goal of the intervention was to demonstrate improvement in FMS development. Eight skills were selected for instruction, and objectives were developed based on data about the age at which 60% of the children were able to perform at a specific developmental level for FMS (Seefeldt & Haubenstricker, 1982). The number of skills that were selected was based on the philosophy of exposing the children to a variety of introductory experiences in skills considered most critical to their ability to engage in games and sports. Students were taught the mature elements of form but, given their age, were not expected to master all elements of form (Seefeldt & Haubenstricker, 1982). Instructional time for skill development was allocated as follows: (a) hopping and galloping—50 min; (b) jumping—80 min; (c) ball bouncing—90 min; (d) striking—100 min; (e) kicking—110 min; and (f) catching and throwing—120 min.

The intervention consisted of 24 instructional sessions during a 12-week period. The children in the MSI group received the intervention during the time allocated to the typical preschool program. Each instructional session lasted 45 min and comprised (a) one 10-min period of sustained activity such as running games and moving to music; (b) three 10-min periods of skill instruction during which each group rotated to different skill stations; and (c) a 3-min closure of the lesson plan emphasizing key components of the skills learned that day. Two min were allowed for transition time. At each of the three skill stations, approximately 5–6 children worked with the instructor (primary investigator, teacher, or paraprofessional). Children rotated to all three skill stations during the lesson, receiving instruction from each instructor.

A direct instructional approach was used. Each station focused on teaching one FMS with a progression of 3–4 instructional activities. The 3–4 activities were selected from a developmental task analysis of the skill that reflected the children's current level of development. The instructor provided a clear task presentation and demonstrated each activity. Consistent key words were used to assist the children in remembering the critical elements of the skill. These key words were reinforced throughout the activities, along with positive-specific and positive-corrective feedback. Activities were individualized to challenge all children at their own level. For example, at a catching station the children might start by taping a balloon in the air and catching it, then toss a large bean bag vertically up and catch it, and then catch a tossed 20-cm foam ball from a close distance. All children had their own equipment. Examples of the key words used for catching are: hands and eyes ready, reach for the ball, pull to chest.

The primary investigator was the lead teacher for the intervention. Prior to the intervention, the teacher and paraprofessional received limited training in motor development, including such topics as principles of motor development, stages of fundamental motor skills, and feedback (Gabbard, 2000; Haywood & Getchell, 2001; Payne & Isaacs, 2002). Prior to each instructional session, the investigator, teacher, and paraprofessional went over the lesson plan for the day and discussed key instruction elements (key words, relevant feedback, etc.). At the end of the lesson, the investigator reviewed the activities with the teachers and made instructional decisions for the next lesson based on their feedback from that lesson.

The children in the MSI group attended on average 83% of all intervention sessions ($SD = 14.68$). The overall attendance ranged between 38.5 and 100%. Only 1 child attended 38.5% of the sessions, 2 children attended 54%, and 1 attended 67% of all sessions. The remaining 28 children attended 71% or more of all intervention sessions. The motor skill intervention was the only physical activity in which the children were engaged at school. Despite the importance of attendance in achieving program outcomes, no data were eliminated due to low intervention attendance. This decision was made, because the investigators wanted to maintain the ecological and social validity of this program's outcomes (Wolf, 1978). In an authentic educational setting, some preschool children who are disadvantaged do not attend school on a regular basis, and, thus, program outcomes may be diluted. However, it is important to know if group outcomes are found despite this concern. A Pearson product-moment correlation was conducted between the percentage of attendance and the MSI groups' postlocomotor ($r = .22$) and object control subscale ($r = .02$) scores. These weak correlations were not significantly correlated, supporting the notion that it was appropriate to keep all data in these analyses.

Control Condition. The participants in the Control group received the typical preschool program, which consisted of the following types of daily routines: free play in centers (e.g., manipulation, reading, art, etc.), circle time (numbers, story time, alphabet, etc.), directed play in centers, table work (writing, math, etc.), and snack time. In the typical program, organized physical activity did not take place, and unstructured physical activity (free play or recess with limited equipment) was left to the discretion of the classroom teacher. During the period in which the MSI group received the motor skill intervention, the investigator asked the Control teachers to record all bouts of physical activity. Seven bouts of 45 min of physical activity were recorded for the Control group. These sessions took place in the gymnasium due to inclement weather. Teachers indicated that 45 min of physical activities typically consisted of ap-

proximately 10 min of games (Simon Says, Red Light Green Light, Duck Duck Goose) and 30 min of free play with selected motor skill equipment (playground balls, tennis balls, jump ropes, scooters, bats). It is important to note that the physical activity sessions received by the Control group constituted part of the typical play component of the preschool program, and, as such, it was deemed unethical and inappropriate to ask the Control group to refrain from all activity during the study. During the free play activity sessions, the Control children were free to engage in any activity they chose without any structure imposed by the teacher. The primary investigator spent corresponding amounts of time (1 hr twice per week) with the Control and MSI groups during the 12-week intervention to minimize the influence of the experimenter effect. Time spent with the Control group varied including assisting with classroom centers (blocks, sand, science, etc.) or reading in the classroom.

Results

Baseline Measures of FMS Development

Figure 1 shows the pre- and postintervention subscale raw scores (locomotor and object control) for the MSI and Control groups. Two univariate analyses of variance (ANOVAs) demonstrated no significant differences between groups prior to the intervention on preintervention locomotor, $F(1, 59) = 3.71, p = .06$, and object control, $F(1, 59) = .02, p = .89$, raw scores. These raw scores were translated into percentile ranks that demonstrate developmental delays in FMS. Locomotor skills were 15% for the MSI group and 26% for the Control group. Object control skills were the 17% for the MSI group and 18% for the Control group.

Influence of the Motor Skill Intervention on FMS Development

Two separate 2×2 (Group $\times$ Pre-Postintervention) ANOVAs, with repeated measures on the last factor, were conducted using subscale raw scores to assess the influence of the motor skill intervention program on locomotor and object control development. The statistic of interest was the attainment of a significant Group $\times$ Time (pre-postintervention) interaction, which would indicate that one group performed significantly better than the other from pre- to postintervention. Thus, only the Group $\times$ Pre-Postintervention data are reported in the results. Effect size (η^2) was also calculated using this procedure.

Locomotor Skills. Figure 1 illustrates that the MSI group demonstrated improvements in locomotor

subscale scores across the intervention, from 10.32 to 20.03; as compared to the Control group who made little pre- to postintervention change (11.61 to 13.54). These raw scores translate into an improvement from 15 to 80% for the MSI group, whereas the Control group remained at 26%.

The ANOVA with repeated measures on subscale raw scores yielded a significant Group $\times$ Pre-Postintervention interaction for locomotor skill development, $F(1, 57) = 134.23, p < .001, \eta^2 = .70$, with a strong intervention effect size. Follow-up t tests were conducted to examine the differences among means. The MSI group improved significantly in locomotor skills from pre- to postintervention, $t(30) = -21.69, p < .001$ (2-tailed). The Control group also showed significant pre- to postintervention gains, $t(28) = -3.83, p = .001$ (2-tailed). However, the MSI group had significantly better postintervention locomotor scores than the Control group, $t(57) = 13.11, p < .001$ (2-tailed).

Object Control Skills. Figure 1 also illustrates the improvements demonstrated in object control subscale raw scores across the intervention. The MSI group improved from 3.07 to 12.77, whereas the Control group went from

3.14 to 7.29. These raw scores reflect an improvement from 17 to 80% for the MSI group. In contrast, the Control group demonstrated a slight improvement from 18 to 24%. An ANOVA with repeated measures on the subscale raw score revealed a significant Group $\times$ Pre-Postintervention interaction for object control development, $F(1, 57) = 161.55, p < .001, \eta^2 = .74$, with a strong intervention effect size. Follow-up t tests revealed the MSI group had significant changes in object control skills from pre- to postintervention, $t(30) = -20.49, p < .001$ (2-tailed). The Control group also revealed significant pre- to postintervention changes in object control scores, $t(28) = -3.40, p = .002$ (2-tailed). However, the MSI group had significantly higher postintervention object control scores than the Control group, $t(57) = 11.74, p < .001$ (2-tailed).

Pre-Postintervention Changes in Individual Skill Development

Table 3 shows pre- and postintervention scores for individual motor skills by group. Figure 2 shows the change scores (postintervention score minus the pre-

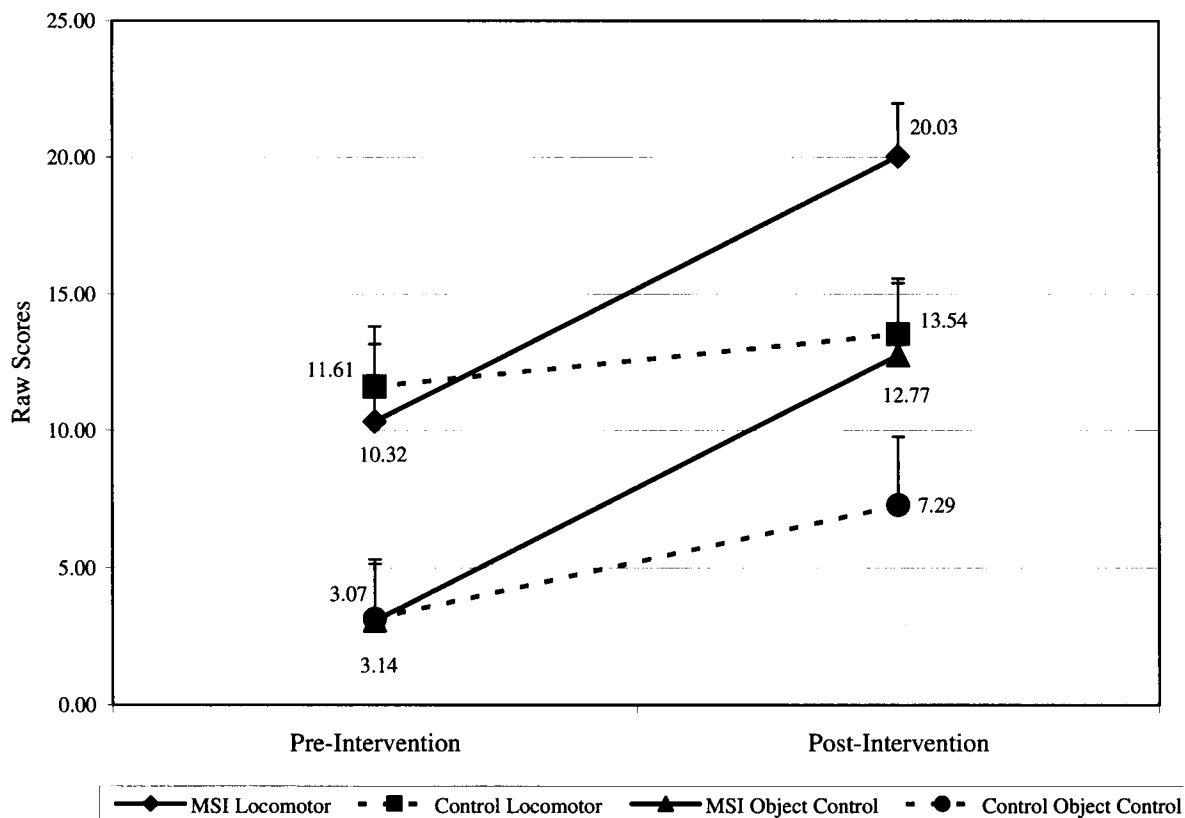


Figure 1. Pre- and postintervention locomotor and object control raw scores and standard deviations for the motor skill intervention and control groups. Points represent mean group scores; vertical lines represent standard deviations.

intervention score) by individual skill and group. As can be seen from Table 3 and Figure 2, the MSI group demonstrated an improvement in all skills, with 10 of the 12 skills improving by at least one criterion element of form.

Discussion

The purpose of this study was to obtain baseline data on the FMS of disadvantaged preschool children and

Table 3. Pre- and postintervention scores for individual fundamental motor Skills by group

Skill	Total points possible	Motor skill intervention group				Control group			
		Preintervention		Postintervention		Preintervention		Postintervention	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Run	4	1.45	.89	3.65	.66	1.57	.69	2.25	1.00
Gallop	4	2.55	.68	3.06	.25	2.39	.79	2.74	.60
Hop	4	0.87	.72	2.35	.55	1.25	.52	1.60	.50
Leap	3	1.35	.80	2.03	.55	1.64	.62	1.57	.57
Jump	4	1.00	.00	3.03	.31	0.96	.19	1.54	.74
Skip	3	0.52	.57	2.16	.97	0.64	.68	0.89	.63
Slide	4	2.58	.96	3.74	.51	3.14	.59	2.96	.79
Strike	4	0.77	.85	2.84	.73	1.00	.86	0.89	.79
Bounce	3	0.23	.62	2.58	.88	0.32	.72	1.18	.90
Catch	4	1.48	.85	2.51	.72	1.43	.74	1.50	.84
Kick	4	0.13	.34	1.45	.72	0.04	.19	0.04	.19
Throw	4	0.45	.51	2.39	.99	0.36	.56	0.86	.85

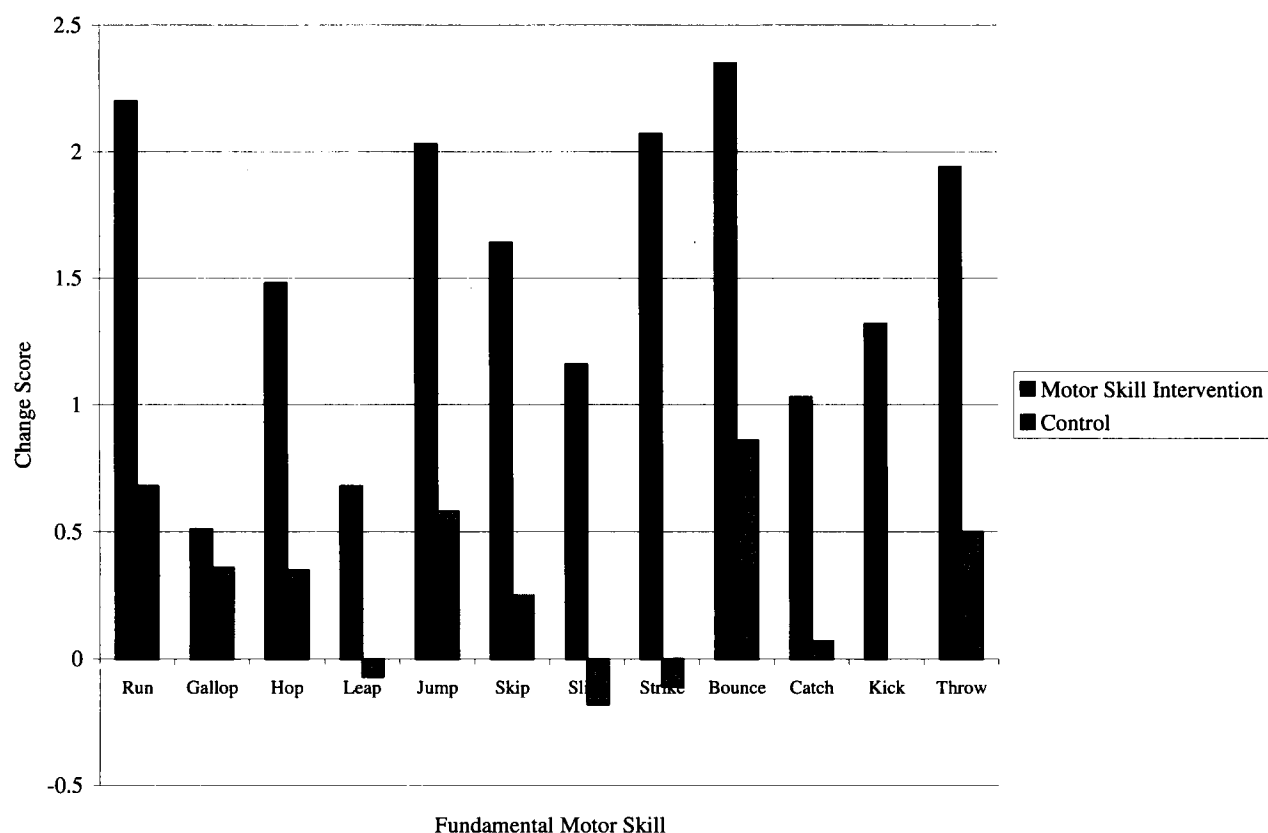


Figure 2. Change scores from pre- to postintervention for individual motor skills by group. Bars represent mean group change score for skill.

determine the influence of a 12-week motor skill intervention on FMS performance.

Baseline Data on the FMS of Disadvantaged Preschool Children

Baseline data obtained prior to the motor skill intervention documented that children in this study were delayed in their locomotor skills as compared to same-aged peers. All (100%) of the MSI participants and 85.7% of the Control participants performed at or below the 50th percentile in locomotor skills prior to the intervention. Object control skills for both groups were also developmentally delayed, with approximately 90% of MSI and Control participants at or below the 50th percentile. These data contribute to the emphasis identified by the Centers for Disease Control and Prevention (CDC) that suggests a need to provide more information on the physical activity of low income and minority populations (U.S. Department of Health and Human Services, 1990, 1995, 1996). The disadvantaged children in this study were both African American and low income, meeting two of the targeted populations by the CDC.

The developmental delays in FMS reported by this study reflect the findings in the literature (Connor-Kuntz & Dummer, 1996; Hamilton et al., 1999; Valentini, 1997). In a study of disadvantaged 3–5-year-old children, Hamilton et al. (1999) reported preintervention percentile ranks between 18 and 20% for object control skills. Valentini (1997) found that the developmentally delayed kindergarten children in her study demonstrated extremely low performance (5%) on locomotor skills, with object control skills at 25%. However, it is important to note that in contrast to the present study, Valentini's participants were identified for the study by their motor delay. Both of the above studies used the TGMD as the assessment means, and, as such, parallels can be drawn between these studies and the present findings.

The developmental delays found in the present study were not surprising given the children appeared to have limited experience in physical activity prior to the intervention. Anecdotal reports from the teachers, children, and parents indicated that the children had limited opportunities to play outside due to the unsafe nature of the neighborhood. In addition, it was clear from the testing procedures and the first few lessons that the children were unfamiliar with the motor skills emphasized in the program. Further research needs to examine factors (organismic or environmental) that might account for the developmental delays found in these participants. Such developmental delay in motor skills is not only of immediate concern but may pose a risk to future participation in physical activity. Future research should longitudinally track children who are disadvantaged to examine the long-term impact of such

motor delays on future physical activity patterns. Overall, these baseline data suggest the need to provide professional physical education services to disadvantaged preschool children. They also have implications for curricula design for urban schools and preservice and inservice teacher education.

The Influence of a Motor Skill Intervention on Motor Skill Development

The MSI group demonstrated significantly greater improvements in FMS from pre- to postintervention, as compared to the Control group. The MSI group demonstrated a mean increase from 15 to 80% for locomotor skills and 17 to 80% for object control skills over the 12-week motor skill intervention. These data reflect the high skill levels acquired by the children in the MSI group at postintervention as compared to Ulrich's (1985) normative sample of same-aged peers. The strong influence of the motor skill intervention was further evidenced by only 3% of MSI participants at or below 50% for locomotor skills compared to 93% of Control participants, on postintervention measures of locomotor scores. Additionally, 65% of MSI participants exhibited postintervention object control scores at or below 50%, as opposed to 89.3% of the Control participants.

The present study's findings were consistent with those described in the literature (Connor-Kuntz & Dummer, 1996; Hamilton et al., 1999; Kelly et al., 1989; Valentini, 1997), suggesting that significant motor development gains could be obtained as a result of a structured motor skill intervention. The improvements made in locomotor and object control skills were similar to those found by Hamilton et al. (1999) and Valentini (1997). The findings of the present study contrast those by Connor-Kuntz and Dummer's (1996), who reported that their disadvantaged and disabled children still demonstrated developmental delays at the end of the intervention period, despite significant improvement in skills.

The findings from this study indicate that the motor skill intervention provided to the children was successful. The intervention was developmentally appropriate in that tasks presented to the children ranged from simple to more complex, and all children were able to sequence through the tasks at their own rate. Additionally, instructionally appropriate practice was used. A variety of developmentally appropriate equipment was provided to each child (e.g., short, fat bats) and maximum opportunities for practice and success were identified in each lesson plan. Key words were provided to the children to promote the desired motor behavior. As the intervention progressed, the children could be heard using the key words to correct or remind each other or themselves to perform a particular motor behavior. Additionally, instructors provided positive-corrective feedback to the

children using the key words. These instructional approaches appeared to be successful in promoting the motor development of the MSI children.

Overall, the intervention yielded effect sizes of $\eta^2 = .70$ for locomotor skills and $\eta^2 = .74$ for object control skills. These effect sizes are strong and indicate that a large proportion of the variance in scores from pre- to postintervention can be attributed to the intervention, providing further evidence for the intervention success. The effect sizes in the present study are greater than those reported in a meta-analysis of the early intervention literature (Casto & Mastropieri, 1986; White & Casto, 1985). The structured nature of the present intervention and the use of professional interveners may have supported the strength of these effect sizes (White & Casto, 1985). Given the developmental delays with which these children started, it is heartening to see such positive developmental changes as a result of 12 weeks of instruction.

Children demonstrated large gains in both locomotor and object control skills as a result of 180 min of locomotor instruction and 540 min of object control instruction. Locomotor skill instruction consisted of 60 min of instruction each for the gallop, hop, and jump. However, it should be noted that the children in the MSI group were also exposed to locomotor skills during the 10-min sustained activity part of the lesson plan. It seems that the MSI children readily acquired many of the mature components of form from the instruction provided. It is interesting to note that although the Control group received seven bouts of physical activity as part of the preschool program play component, the Control group made barely any gain (0.4%) in their locomotor percentile scores. It may be that the lack of an organized approach to the play component of the Control group's experiences accounted for this finding. This finding parallels work by Miller (1978), who documented that children in a direct instruction group improved FMS performance to a greater extent than children in a well equipped play group. The run and jump showed the greatest amount of positive change, with an improvement in two of the four criterion elements of form. Hopping also showed a change score of close to 1.5 as a result of the instruction provided. Despite instruction, gallop did not improve as much as other skills. This finding may be attributed to ceiling effects from the high preintervention scores.

The significant gains made by the MSI group in object control skills were considered a direct result of 540 min of instruction, as children demonstrated lack of experience of object control skills prior to the intervention. All skills improved at least one criterion element of form from the instruction provided. Striking and bouncing improved the most, followed by throwing, kicking, and catching. Key words provided to the students

appeared to be particularly valuable as demonstrated by the children's frequent use of them in practice.

Educational Implications and Future Research

The findings from this study have exciting and significant educational implications. If disadvantaged preschool children can acquire such benefit from 12 weeks of motor skill intervention, then physical educators or preschool teachers with developmentally appropriate education should be able to engage children in the types and frequency of activity necessary to facilitate positive motor skill development. Future research should examine the effect of motor skill interventions with disadvantaged children from different ethnic groups across a variety of ages. Various types of physical activity curricula need to be evaluated to determine which types of programs are most effective with different populations of children. Ultimately, children need to be tracked longitudinally to examine the influence of such interventions on lifelong motor development and physical activity patterns.

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