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AUTHOR Bohren, Judy M.; Vlahov, Eric
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ABSTRACT

This study investigated the gross motor development of children at two day care centers, one with a movement-oriented physical education program and the other with an unstructured free play period. Also studied were the biological factors of age and sex. A total of 146 children were tested during a 3-year period. During the last two years, children at two other centers were tested as a control group. Subjects were given the Test of Gross Motor Development. A motor quotient indicating level of motor ability was derived from locomotor and object control subtests. Findings suggested that: (1) preschool-age children benefit from physical education regardless of teaching styles or curriculum used; (2) the movement-oriented approach produces better results on a motor development test and is an appropriate method of teaching preschool-age children; and (3) there are sex-specific differences in motor skill development at a very early age in both object control and locomotor skills. (RH)

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COMPARISON OF MOTOR DEVELOPMENT IN PRESCHOOL CHILDREN

Judy M. Bohren and Eric Vlahov

The University of Tampa

Tampa, Florida

USA

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Gross motor development is the skillful use of the total body in large muscle activities that require timing and spatial coordination of movement of a number of body parts at the same time (Williams 1983). As children develop their gross motor patterns, they pass through four stages of development. In stage one, the neonatal period, children develop reflexes and reactions. In stage two, the preschool and early elementary years, they progress to develop fundamental gross motor skills. In stage three, the middle and upper elementary period, children develop the skills to participate in leadup games and in stage four, upper elementary school through adulthood, they develop and may or may not master individual and leisure sports and dance skills (Gallahue 1982).

Individuals pass through these four stages at different speeds depending on both environmental and biological factors (Roberton 1982). Parents, childcare workers and early childhood specialists should be concerned with the environmental factors; teaching styles, informal play activities, playground areas and equipment that is especially designed for children (Rarick 1982).

This is a study of the preschool years (ages 3 through 6) of stage two, comparing the environmental factor of instructional styles and the biological factors of age (in six month intervals) and sex. We compared the gross motor development of children at two day-care centers; one with a movement-oriented physical education program, the other with an unstructured free play period. In the second and third years we did a similar comparison of a center offering a movement-oriented program with one that took a more traditional approach to physical education.

In the traditional approach, children are taught specific movement skills through formal practice and organized games. But in the movement-oriented approach the process is as important as the product. The teacher guides the children through different kinds of movement activities such as challenging the children to find as many ways as

they can to balance on three body parts. The movement education teacher stresses creativity and self-discovery (Chapman 1974). The main difference between the two styles is in who makes most decisions - the teacher or the child. In movement education the child decides when and how to move. In the traditional approach the teacher tells the child how to move (Goldberger 1983).

DESCRIPTION:

We tested 146 children from two day-care centers in Tampa, Florida, during May and June of 1986. Day-care center one offered a movement-oriented physical education program and day-care center two offered only free-play time for the children. We retested once a year for two more years. The two day-care centers were similar in size, parental socio-economic status and academic curriculum. During 1987 and 1988 we tested children from two additional centers to serve as a control group. In the second year both day-care centers altered their programs. Center one employed a physical education teacher who took a more traditional approach while center two employed a physical education teacher who implemented a movement-oriented program.

The Test of Gross Motor Development (TGMD) (Ulrich, 1985) was administered to all children in both schools. The testing teacher gave the children simple directions and observed which performance criteria they met. We measured two subtest scores. locomotor (LSS), including run, jump, hop, leap, gallop, skip and slide; and object control(OSS), including two-handed strike, stationary bounce, catch, kick and overhand throw. From the two subtests we derived a total Motor Quotient (MQ) number which is norm-based and indicates level of motor ability: 100 is the mean and an interval of 10 represents a standard deviation. (See Table 1)

The performance criteria that we were looking for can best be demonstrated in these videos.

TABLE 1

T.G.M.D.

	1986	1987	1988
Day care center 1			
LSS	13.2955	11.3077	11.2143
OSS	13.3977	12.9135	12.4694
MQ	119.8750	112.6058	111.0510
Day care center 2			
LSS	10.6176	11.2805	14.0706
OSS	11.8618	12.2683	14.4000
MQ	107.1176	111.0488	125.4118

When a child runs we look to see if there is a brief period where both feet are off the ground. The arms move in opposition to the legs with elbows bent. The foot placement is near or on a line with the nonsupport leg bent at approximately 90 degrees.

When a child hops, the foot of the nonsupport leg is bent and carried in back of the body. The nonsupport leg swings in a pendular motion to produce force. The arms are bent at the elbows and swing forward on the take-off.

When jumping, the preparatory movement includes flexion of both knees and the arms are extended behind the body. During the flight phase, the arms extend forward and upward to a full extension above the head. The arms are brought down during the two-footed landing.

When galloping the front foot steps forward with the trailing foot stepping to a position adjacent to or behind the forward foot. There is a brief period when both feet are off the ground.The arms are bent at about waist level.

When skipping there is a rhythmical repetition of the step-hop on alternating feet. The nonsupport foot is carried near the surface during the hop. The arms move in opposition to the legs.

When sliding the body is turned sideways. There is a step sideways followed by a slide of the trailing foot to a point next to the lead foot. There is a short period when both feet are off the ground.

When performing a two handed strike, the dominant hand grips the bat above the nondominant hand. The nondominant side of the body faces the tosser with the feet parallel. Hips and spine rotate during the swing and the weight is transferred by stepping with the front foot.

When bouncing a ball, the ball is contacted with one hand at about hip height. The fingers push the ball and the ball contacts the floor in front of the foot on the dominant side.

When catching a ball, the elbows are flexed and the hands are in front of the body during the preparation phase. The arms are extended in preparation for ball contact. The ball is caught by the hands and the elbows bend to absorb the force.

When kicking, there is a rapid approach to the ball. The trunk is inclined backward during ball contact. There is a forward swing of the arm opposite the kicking leg and a follow-through by hopping on the nonkicking foot.

When throwing a ball there is a downward arc of the throwing arm to initiate the windup. The hips and shoulders rotate to a point where the nondominant side of the body faces an imaginary target. The weight is transferred by stepping with the foot opposite the throwing hand. After the release, the arm follows-through diagonally across the body.

RESULTS

We subjected the test results of the two schools to an analysis of variance, (ANOVA). To be considered significantly different, we used the .01 level of probability. The mean motor quotients were 119.87 and 107.12. This motor quotient was derived from the standard scores of the locomotor sub-test (13.30 and 11.66 respectively) (See graphs 1 and 2). The day-care center that included regular physical education as part of it's curriculum scored significantly higher on the locomotor sub-test, the object control sub-test and the total motor quotient. When we shared the results of these test scores with the proprietors of the two day-care centers, the person in charge of the curriculum of the day-care center offering only free play decided to hire a physical education specialist and initiate a physical education curriculum. At about this time the teacher who had developed the movement curriculum left that school and was replaced by a teacher with a much more traditional approach to physical education. The new teacher shifted the school to a program with more emphasis on traditional units such as track and field or tumbling.

TABLE 2

Analysis of Variance Tests
on TGMD Raw Scores and Sub-tests

		Mean Scores	S.D.	F-ratio	Prob.
Total Motor Scores	Boys	26.387	8.835	15.882*	.000+
	Girls	23.825	7.568		
Locomotor Subtest Scores	Boys	15.653	5.332	5.125*	.024
	Girls	16.547	4.781		
Object Control Subtest Scores	Boys	10.754	4.310	123.392*	.000+
	Girls	7.256	3.733		

*Significant at the .05 level.

TABLE 3

Analysis of Variance Tests
on TGMD Raw Scores
by Age Group (6-month intervals)

Age (months)	N	Boys Mean Girls Mean	S.D.	F-ratio	F prob.
36-41	4	13.500	10.724	.435	.539
	3	18.000	5.196		
42-47	39	19.410	7.010	1.474	.229
	32	17.500	6.054		
48-53	70	21.457	7.308	.078	.781
	61	21.098	7.389		
54-59	73	25.699	7.314	6.315*	.013
	87	22.931	6.608		
60-65	89	28.966	8.101	4.407*	.037
	68	26.412	6.772		
66-71	59	30.153	7.182	4.102*	.045
	48	27.458	6.401		
72-77	14	37.857	5.067	2.304	.146
	7	34.571	3.690		
78 +	9	38.222	3.701	.358	.563
	3	36.667	4.619		

*Significant at the .05 level.

The study continued for two more years. During the second year the ANOVA of the data revealed very little difference between the mean motor quotients of the children attending the two day-care centers. The scores for the two schools were very similar: 112.60 for school 1 (the school that originally offered physical education) and 114.04 for school 2 (the school that originally offered free play). These scores resulted in no significant difference (see graph 3). Males at both schools still performed better on object control portion of the test and females still performed better than males on the locomotor portion of the test.

By the third year the mean motor quotient scores of school 2 (125.41) were significantly higher on all portions of the tes than were the mean motor quotient scores of school 1 (111.05). The two day care centers had for all practical purposes changed places (See graph 3). The day-care center that had originally offered free play now had a well planned physical education curriculum and some of the children had now received physical education instruction each day for two years. At both schools, (See graph 3) boys were still scoring significantly higher than girls on object control skills and girls were still scoring higher than boys on locomotor skill (See graph 4 and 5).

We did an initial investigator of the raw scores of boys and girls from all four day-care centers and found , significant differences between the total and sub-test scores of the TGMD (See Table 2) On the total raw scores the boys and girls were significantly different . The boys' mean score of 26.387 was significantly higher than the girls' mean score of 23.825. The f-ratio of 5.882 was significant at the .05 level. The object control scores show the boys with a mean score of 10.754 significantly higher than the girls with a mean score of 7.256. The f-ratio of 123.393 was significant at the .05 level. The locomotor scores show the girls with a mean score of 16.547 scoring significantly higher than the boys with a mean score of 15.653. The F-ratio of 5.125 was significant at the .05 level.

TABLE 4

Analysis of Variance Tests
on Locomotor Raw Scores
by Age Group (6-month intervals)

Age (months)	N	Boys Mean Girls Mean	S.D.	F-ratio	F prob.
36-41	4	7.500	6.351	1.489	.277
	3	12.667	4.042		
42-47	39	11.718	4.359	.251	.618
	32	12.219	3.974		
48-53	70	12.914	4.409	5.389*	.022
	61	14.853	5.147		
54-59	73	15.397	4.054	2.759	.099
	87	16.506	4.326		
60-65	89	17.303	5.122	1.465	.228
	68	18.202	3.889		
66-71	59	17.254	4.619	1.770	.186
	48	18.375	3.955		
72-77	14	22.643	3.875	.0019	.965
	7	22.714	2.564		
78 +	9	22.000	4.637	.1071	.750
	3	21.000	4.359		

*Significant at the .05 level.

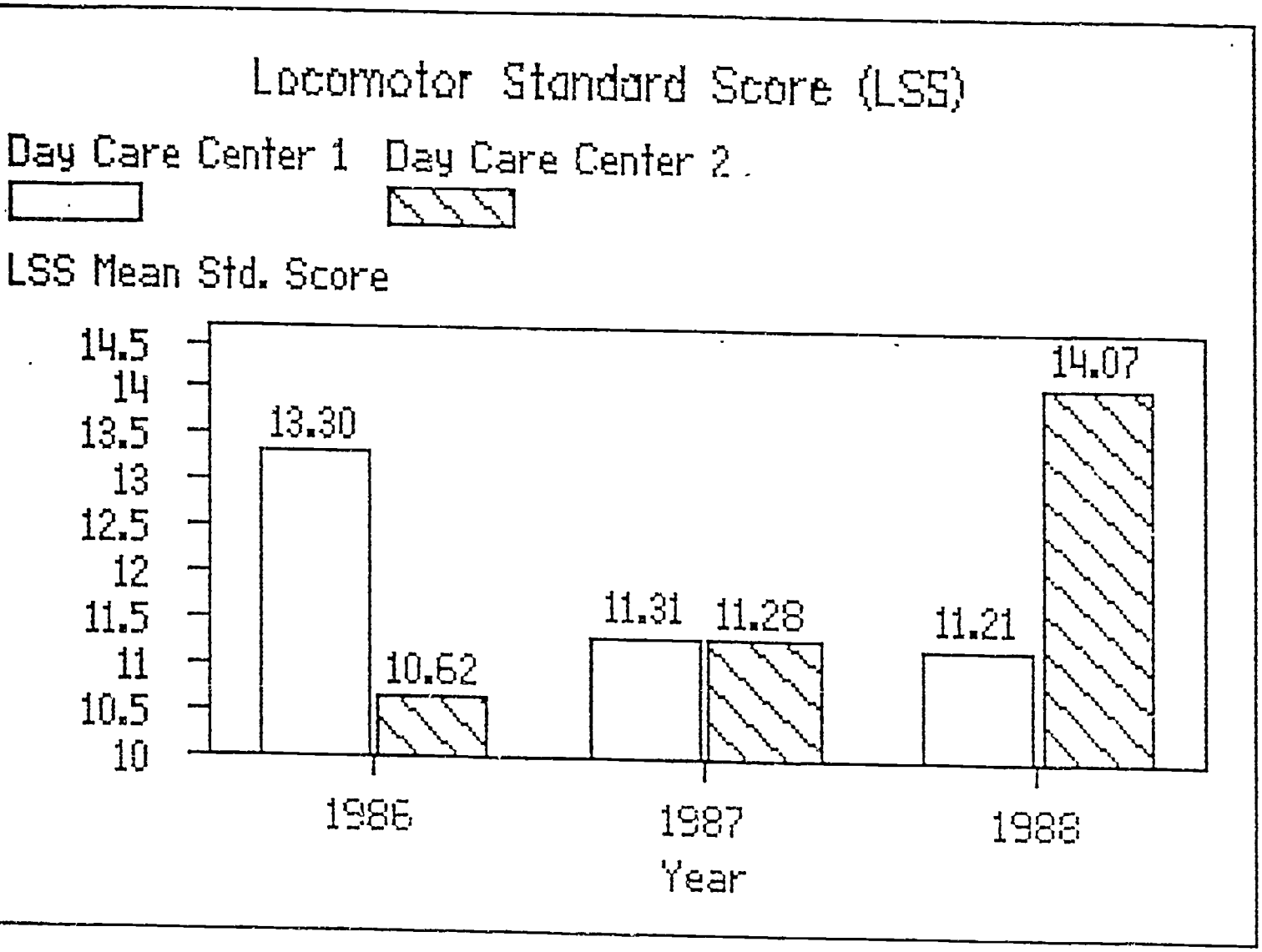
TABLE 5

Analysis of Variance Tests
on Object Control Raw Scores
by Age Group (6-month intervals)

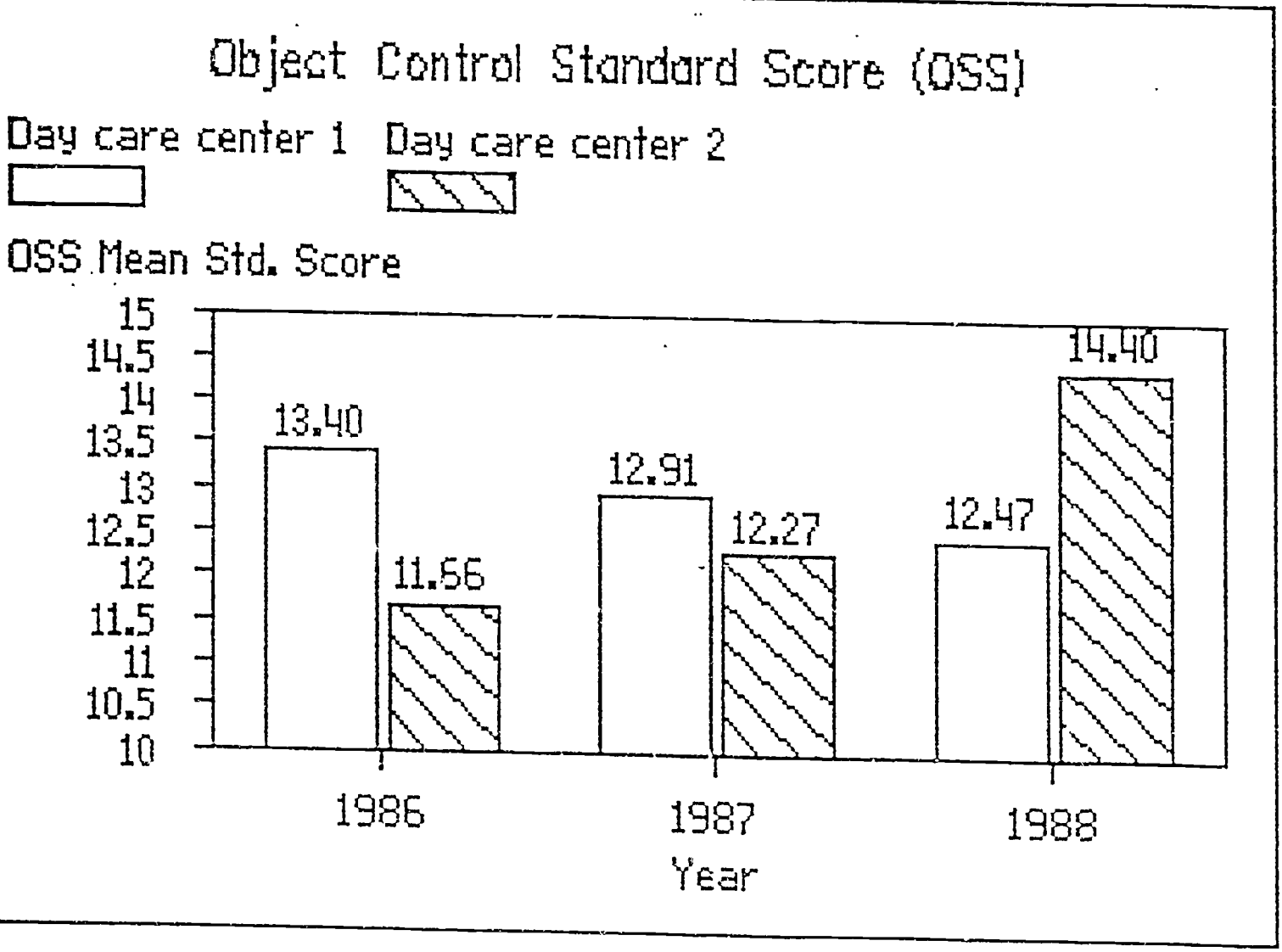
Age (months)	N	Boys Mean Girls Mean	S.D.	F-ratio	F Prob.
36-41	4 3	6.000 5.333	4.546 4.726	.036	.858
42-47	39 32	7.692 5.281	3.636 2.656	9.782*	.003
48-53	70 61	8.543 6.246	3.999 3.370	12.431*	.001
54-59	73 87	10.425 6 450	3.848 3.128	51.688*	.000+
60-65	89 68	11.652 8.206	3.949 3.854	29.968*	.000+
66-71	59 48	12.881 8.875	3.489 3.813	32.104*	.000-
72-77	14 7	15.214 11.857	2.455 2.116	9.498*	.006
78 +	9 3	16.222 15.667	1.922 .577	.230	.642

Significant at the .05 level.

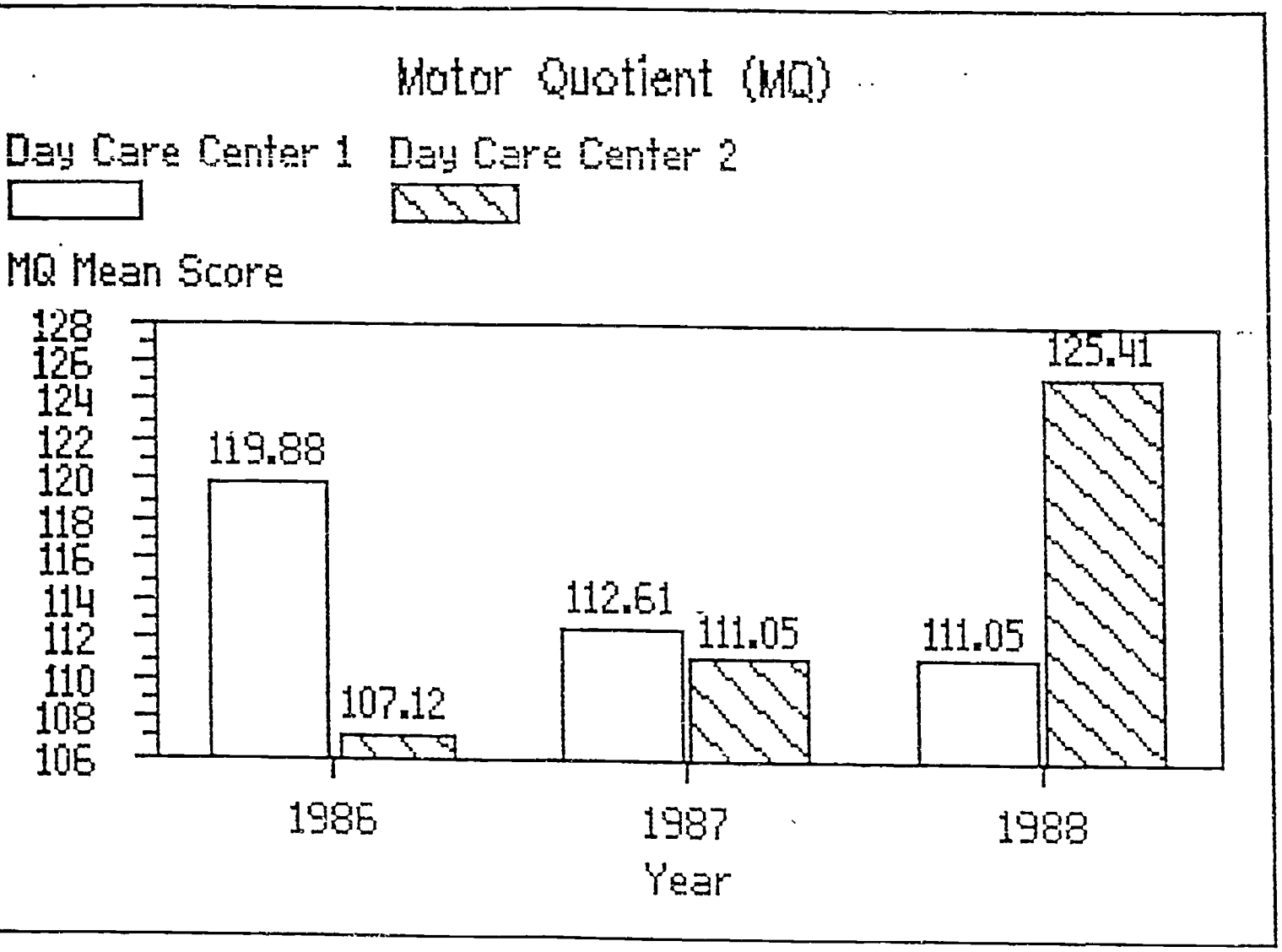
Graph 1


Locomotor Standard Score (LSS)
Day Care Center 1
Day Care Center 2
LSS Mean Std. Score
14.5
14
13.5
13
12.5
12
11.5
11
10.5
10
13.30
10.62
11.31
11.28
11.21
14.07
1986
1987
1988
Year

Graph 2


Object Control Standard Score (OSS)
Day care center 1
Day care center 2
OSS Mean Std. Score
15
14.5
14
13.5
13
12.5
12
11.5
11
10.5
10
13.40
11.66
12.91
12.27
12.47
14.40
1986
1987
1988
Year

Graph 3


Motor Quotient (MQ)
Day Care Center 1
Day Care Center 2
MQ Mean Score
128
126
124
122
120
118
116
114
112
110
108
106
119.88
107.12
112.61
111.05
111.05
125.41
1986
1987
1988
Year

When we analyzed the boys and girls by age groups (6 month intervals), several significant results were found. With the analysis of raw scores of the total TGMD (See table 3), the 36-41, 42-47 and 48-53 month-old boys and girls did not differ significantly from each other. We did find a significant difference at 54-59 months ($F = 6.315$) with the boy's mean score of 25.699 were higher than the girl's mean score of 22.931. Boy's mean score were significantly higher for the 60-65 and 66-71 month-old comparisons. We did not find a significant difference between 72-77 and 78+ month-old groups although the boy's mean scores were higher.

The comparison of the locomotor raw scores (See Table 4) showed that the girls' mean score (14.853) for 48-53 month-old (4-4 1/2 year old) was significantly higher than the boys (12.914). The scores were not significantly different between girls and boys at other age groups, although I would like you to note that the girls' scores were consistently higher than boys' scores.

The boys' mean score on the object control subtest (Table 5) were significantly higher for all age groups except the 36-41 month-old and 78+ month old groups. The scores favored the boys at those two age groups. At 42-47 months boys scored significantly higher on object control than girls and the difference increased through 54-59 month old. There was also significance at 60-65 and 66-7

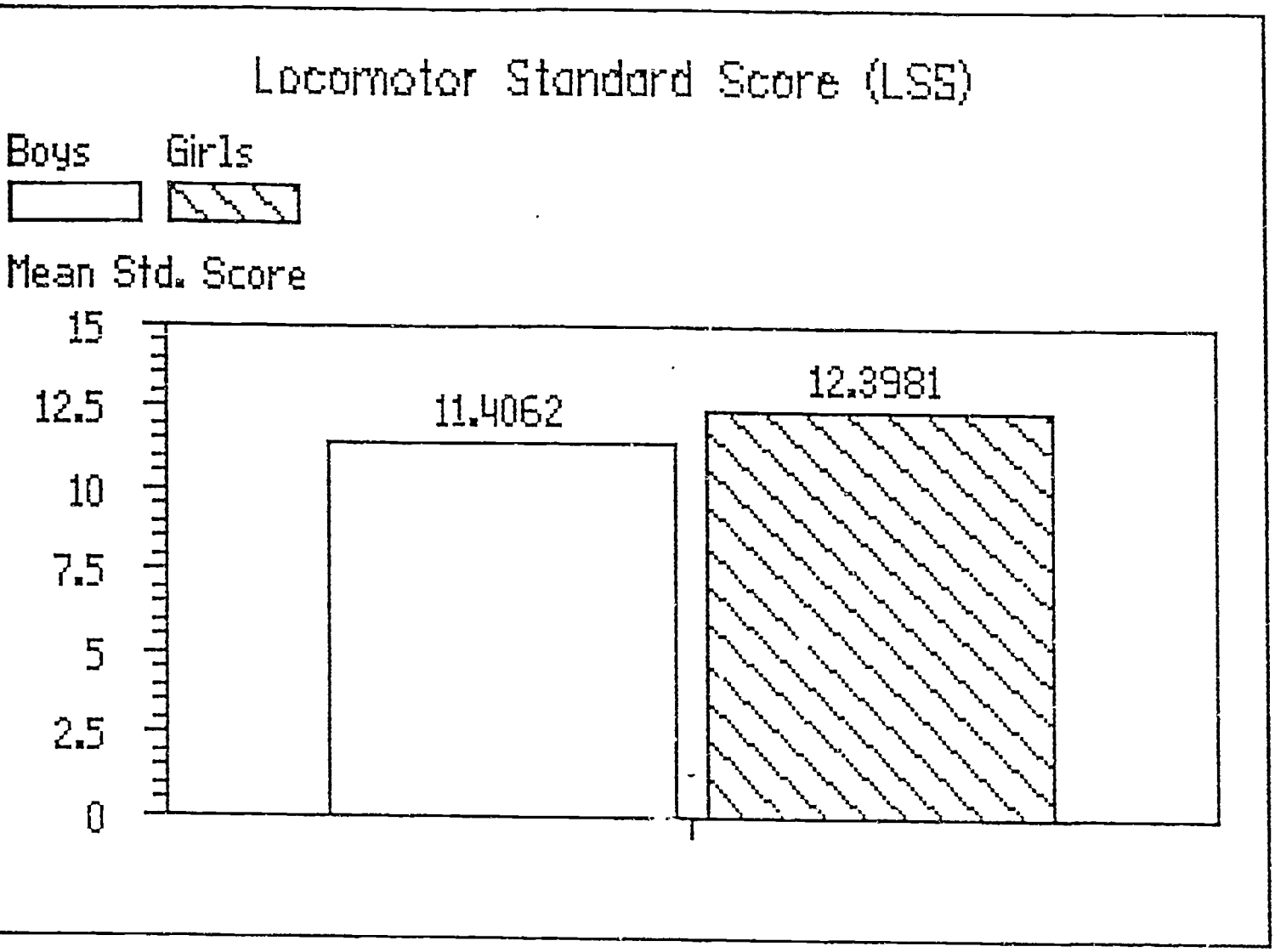
We can draw several interesting observations from the results of this three year study:

1) Preschool age children do seem to benefit from some form of physical education instruction regardless of the teaching styles or the curriculum.

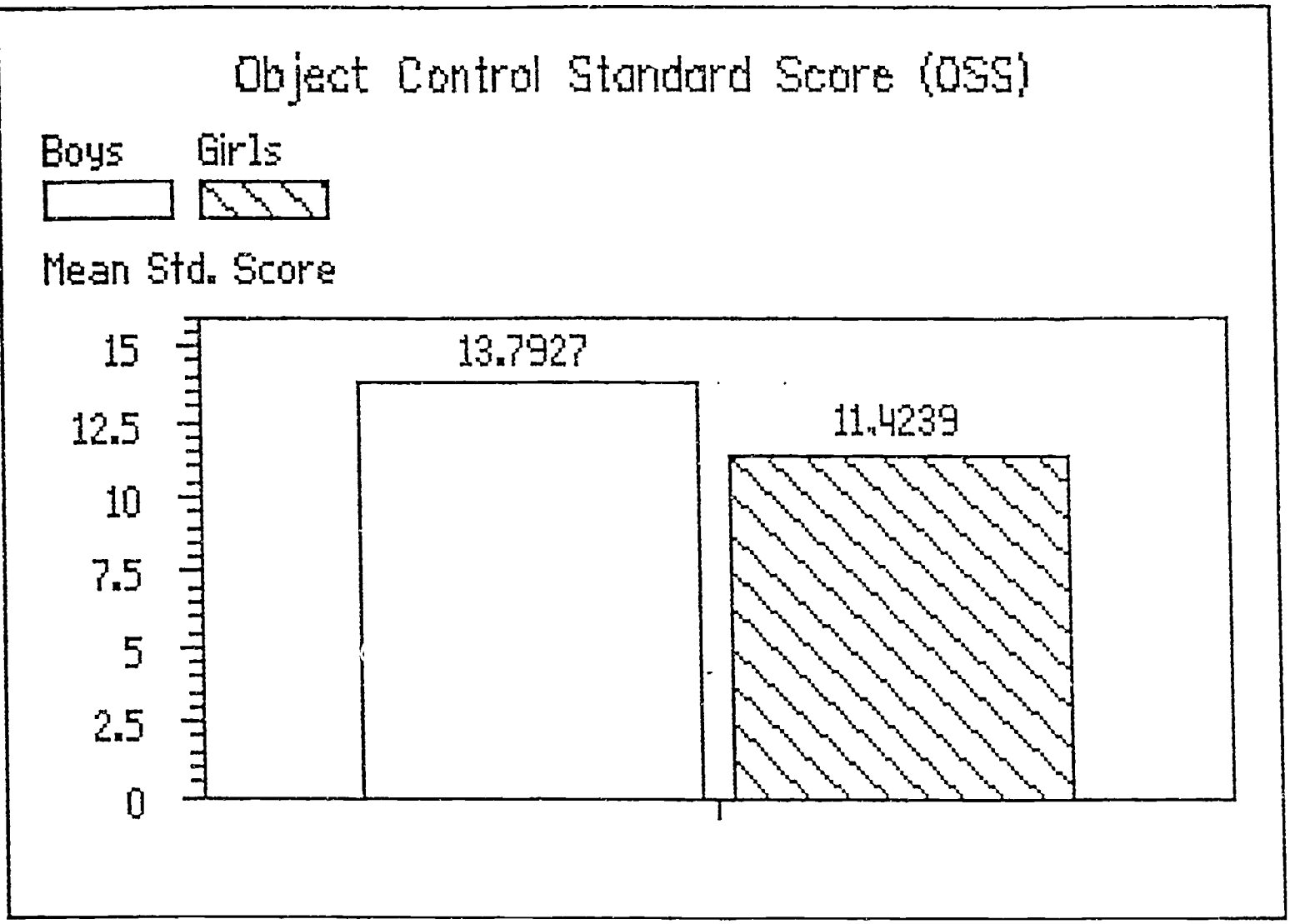
2) The movement-oriented approach seems to produce greater results on a motor development test and does seem to be an appropriate method of teaching preschool age children.

3) There seems to be sex-specific differences as to motor skill development at a very early age as to both object control skills and locomotor skills.

Graph 4


Locomotor Standard Score (LSS)
Boys
Girls
Mean Std. Score
15
12.5
10
7.5
5
2.5
0
11.4062
12.3981

Graph 5


Object Control Standard Score (OSS)
Boys
Girls
Mean Std. Score
15
12.5
10
7.5
5
2.5
0
13.7927
11.4239

As more and more children spend a greater portion of their early childhood years in day-care centers, we as early childhood specialists need to ask the question, "Is adequate attention being given to the movement component of the total curriculum of day-care centers, preschools and kindergartens?" That old adage, "Movement is the work of a child," certainly seems to be true.

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