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Young Children's Block Construction Activities: Findings From 3 Years of Observation

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The purpose of this study was to explore the development of the complexity of block constructions of preschool children and to determine the effects of various factors on the children's block play. Sixty-five children were observed a total of 421 times, over the course of 3 years. Hierarchical linear modeling was used to determine the effects of disability, gender, and time the child was involved with block construction activity on the developmental complexity of block constructions. Results indicate that (a) the complexity of children's block constructions increase with chronological age, (b) time the child was involved with block construction activity has a positive effect on block construction complexity, and (c) gender did not influence block construction complexity. Implications of findings are discussed in relation to increasing understanding of children's development and to authentic assessment approaches.

Block play is a fundamental activity of young children in the early childhood years. Playing with blocks provides opportunities for integrated learning across multiple areas of development. Peer interaction and communication skills are used as children plan, negotiate, solve problems, and cooperate during block play. Block play provides opportunities for children to learn and practice gross and fine motor skills as they carry blocks and build block constructions. Representational play is supported as children take on pretend roles when they play with toy figures and vehicles along with blocks. Furthermore, block play is a means to express creativity and develop feelings of competence (see discussions in Bailey & Wolery, 1992; Miller, 1996).

Block play also might, in part, lay the foundation for subsequent academic competence. Piaget (1967) and Reifel (1984a) suggested that, through block play, children have the opportunity to learn mathematical and geometric concepts (e.g., size, seriation), to create topological knowledge (how features of the environment relate to one another), and to learn to match and group. These abilities might provide the early experiences that support later mathematical learning.

Empirical studies have, in fact, related construction play abilities (including block play) and mathematics-related learning in children who are developing typically. Pasnak, McCutchen, Holt, and Campbell (1991) found that the ability level of preschool children to classify, seriate, and conserve in their construction play related positively to performance on standardized achievement tests in kindergarten. Pasnak, Madden, Martin, Malabonga, and Holt (1966) found that the same group of children included in the Pasnak et al. (1991) study scored statistically significantly higher than a control group did in mathematical abilities in first grade. In addition, Stannard (1999) found a statistically significant relationship between children's developmental level of block play in the preschool years and standardized mathematical test scores, average mathematics grade, and number of mathematics-related honors classes at grade 7.

As proposed by Pickett (1998), Stroud (1995), and Vygotsky (1976), block play also might support the development of literacy and other academic skills. That is, as children build block constructions that represent structures within their world of experience, the play serves as an introduction to symbolism and provides the opportunity for pretend play. Visual discrimination, an important reading skill, might be enhanced by block play. The handling of blocks might contribute to the preparation for writing, as fine-motor strength and coordination are developed. In addition, block play creates an environment to encourage children to communicate orally, a skill that contributes to the literacy process. Furthermore, literacy-related materials and activities might be provided in block areas, further enhancing opportunities to support emergent literacy skills.

Because of the potential positive impact block play might have on the learning and development of young children, several researchers have studied children's block constructions and presented developmentally sequential scales as a result of their research. Over 65 years ago, Bailey (1933) conducted a study to standardize a scale that could be used as a measuring device to evaluate the block play of young children. Her scale (standardized on 44 children ranging in age from 26 months to 69 months) showed that children tended to progress from stacking blocks vertically, to constructing enclosures with blocks, to building elaborate constructions including a variety of stacks and enclosures combined to represent a structure to the child (e.g., a house). Guanella (1934) further documented the increasing complexity of block structures as children develop. Based on observations of 66 children (1 to 6 years old), she described a set of stages, beginning with nonstructural use of blocks in late infancy. Children then progressed to piles or rows of blocks, to bidimensional use of blocks (combining piles or rows), to tridimensional use of blocks (enclosing space), and then to representational play with block constructions.

In recent years, researchers have used these scales or adaptations of the scales to further document the developmental progression of block play and to establish approximate age norms for various block construction abilities. These studies (Johnson, 1984; Reifel, 1982, 1984a, 1984b; Vereeken, 1961) have shown that, by the age of 3 years, children typically are able to create rows and stacks of blocks. After age 3, children begin to combine the rows and stacks to create surfaces and begin to construct enclosures that have interior space. Most children typical in development can build enclosures, differentiate objects within a construction, clarify indoor and outdoor space, and coordinate landmarks (such as trees) with buildings (such as houses) by age 4. As they continue to develop, they begin to combine the rows, piles, and enclosures creatively, being able to coordinate interior space with interior objects by age 7. Thus, as children grow older, their block constructions become more complex.

Research focusing on children's block play also indicated gender differences. That is, boys preferred playing with blocks over other play activities (Farwell, 1930; Margolin & Leton, 1961; VanAlstyne, 1932), and girls tended to choose non-block play activities when given a choice of block play or non-block play (Margolin & Leton, 1961). Once engaged in block play, however, boys and girls tended to play in a similar fashion, with no gender differences noted in their choice of block type (Moyer & von Haller Gilmer, 1956). Studies researching the influence of gender on the developmental level of block play, however, have not been conducted.

Experience with blocks also seemed to influence children's behavior in block play, as increased experience has been shown to be related to more complex block constructions (Guanella, 1934; Johnson, 1984). Furthermore, the attention span of 3- to 5-year-old children tended to increase with age, with 3-year-olds having a mean attention span of 22.3 minutes; 4-year-olds, a mean attention span of

25.3 minutes; and 5-year-olds, a mean attention span of 28.8 minutes (Moyer & von Haller Gilmer, 1956). Nevertheless, the influence of the time the child was involved with block construction in relation to the complexity of block constructions has not been researched.

In addition, none of the studies mentioned above included children with disabilities. Thus, little is known about the block play of children whose development is atypical, despite the potential impact of experiences with blocks on social, emotional, motor, and cognitive development in the early childhood years and its potential influence on later academic functioning. Furthermore, none of these studies involved longitudinal analysis of children's block construction abilities as they change overtime. Such longitudinal developmental research that involves multiple data points on the same children over time is essential to understanding the course of development of children (Freidman & Haywood, 1994; Rogosa, Brandt, & Zimowski, 1982).

Therefore, the purpose of this study was to explore the development of the complexity of block constructions of children with and without disabilities and to determine the effects of disability and other variables on the developmental sophistication of block constructions over time. Specific research questions were:

1. Are there statistically significant differences between growth rates on block construction scale scores for children with and without disabilities?
2. Are there statistically significant differences between estimated block construction scale scores for children with and without disabilities at age 60 months?
3. Are differences between children's block construction scale scores and growth rates accountable by gender or the time the child was involved with block construction activity?

METHOD

Participants

A total of 65 children participated in the study, 30 of whom were receiving special education services from the local school district. Seventeen children received services under the label of physically impaired. Two of these children had Down syndrome, one had Rubenstein–Taybi syndrome, one had been born prematurely, one had experienced near drowning, one was identified as having Pervasive Developmental Disorder, and one child had cerebral palsy. Two of the other 10 children with physical impairments had multiple disabilities (including visual disabilities), and 8 experienced developmental delays co-occurring with their physical disability. One child was identified as having a hearing impairment, 8 as having speech-language delays, 3 as having developmental delays, and 1 as having autism.

Demographic characteristics of the participating children are presented in Table 1. The *Batelle Developmental Inventory* (Newborg, Stock, Wnek, Guidubaldi, & Svinicki, 1984) was administered within a week of each child's initial observation for this study. Children with disabilities or developmental delays had statistically significantly lower overall age equivalents on the *Batelle Developmental Inventory* (effect size: Cohen's $d = .93$; Cohen's d is a standardized difference score, reflecting the percentage of a pooled standard deviation). All children had to perform at a minimum of 6 months on the subdomain Muscle Control and 12 months on the subdomain Fine Muscle of the Motor Domain of the *Batelle Developmental Inventory*. In this way, all participants were able to sit without support for 5 seconds, extend a toy to a person and release it from a grasp, and use a neat pincer grasp to pick up a raisin, thus assuring the ability to manipulate blocks. In addition, the special education teachers confirmed the appropriateness of the block construction scale for each participant with disabilities or development delays.

Depending on their length of attendance at the preschool study site and the age at which they began participation in the study, the children participated in the research over a period ranging from 1 to 3 years, beginning and completing participation at various points throughout the 3 consecutive calendar years of the study. Four children with disabilities or de-

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Table 1.
Demographic Information of Participants

Child Characteristics	Children With Disabilities (n = 30)	Children Without Disabilities (n = 35)
Gender, n (%)		
Boys	14 (47)	17 (47)
Girls	16 (53)	18 (53)
Age		
Mean age in months (*SD*)*	42.47 (10.48)	39.03 (13.30)
Mean age equivalents on BDI (*SD*)	26.43 (11.72)	39.22 (15.64)
Ethnicity, n (%)		
Caucasian	19 (63)	30 (86)
African-American	11 (37)	4 (11)
Other	0 (0)	1 (3)

*Age at first observation.

velopmental delays participated for all 3 years, 13 participated for 2 years, and 13 participated for 1 year. Seven children without disabilities or developmental delays participated for 3 years, 11 participated for 2 years, and 17 participated for 1 year. Information regarding the number of observations at varying age levels is presented in Table 2. Children without disabilities or developmental delays were observed a total of 223 times; children with disabilities or developmental delay, a total of 198 times.

Setting and Materials

The study took place at an inclusive community-based program accredited by the National Association for the Education of Young Children. The program has provided service to 145 children ages 6 weeks through kindergarten for 27 years. Children are divided into infant, toddler, preschool, and kindergarten programs. Services for children in special education programs are provided through collaborative agreements with community agencies, including the local school system.

Table 2.
Number of Observations of Block Construction Play by Age and Disability Status

	Children Without Disabilities or Developmental Delays	Children With Disabilities or Developmental Delays
Age in months		
16–26	22	4
27–36	24	14
37–46	53	52
47–56	59	56
57–66	53	47
67–75	12	25
Total	223	198
Mean number of observations per child (*SD*)	6.74 (9.49)	6.07 (9.23)

Data were collected in the block center (i.e., activity area) of the preschool. This center is approximately 9.1 m by 15.2 m and is separated from other centers by shelves filled with over 3000 blocks, miniature props (e.g., vehicles, people, animals), and books about construction. Room dividers in the block area hold laminated posters of different constructions. For example, one poster has pictures of bridges, another of Egyptian buildings using columns, another of square buildings, and so forth. The blocks are arranged on the shelves according to their shape (e.g., triangles, cylinders, arches) and are arranged in descending order according to size from left to right. Books with pictures of skyscrapers, buildings, bridges, and so on, are available to the children. During play, pieces of different colored plywood (approximately 0.9 m by 1.2 m) of different shapes (e.g., triangles, rectangles, etc.) are spaced on the floor approximately 0.9 m apart.

Children participated in block play during the program's morning center time once a week in a consistent playgroup of 10 children composed of children with and without disabilities or developmental delays. One adult was in the center with the children. The block play lasted approximately 1.5 hours.

During the first 10 minutes, the teacher conducted an introduction to the block play, which varied from block experience to block experience. The teacher either (a) chose a block shape, discussed its geometric properties, related it to other block shapes, showed pictures of constructions that use that shape, assisted the children to locate that shape throughout the classroom, or asked children to locate on the shelves a similar block; (b) read a book about the construction process or a type of construction; or (c) led gross motor activities centered around the plywood markers by encouraging the children to jump *on* the markers, stand *beside* them, and so forth. This part of the children's block's experience ended with the adult asking the children to find a space in which to play, and suggested they could use all the blocks they wanted to build whatever they choose.

Children had the remaining 80 minutes of the 90-minute scheduled block center time to build. When children completed their block construction and communicated the completion to the teacher, they were encouraged to add props that could support symbolic play and to invite friends to play with them.

Procedures

Data were collected over the course of 3 calendar years by research assistants who were master's degree students in Early Childhood Special Education (ECSE) or in Early Childhood Education. Prior to the collection of data for this study, the research assistants spent 2 weeks at the beginning of each calendar year participating in block center activities and photographing and videotaping children's block play and constructions as though data were being collected, to desensitize children to their presence.

After this period of desensitization, children's block play was videotaped and the children's block constructions were photographed four times per year, spaced approximately 3 months apart. The children participated in block center activities as part of their routine at the preschool. When data were gathered, all the children in the block center worked independently on their block constructions, and adults in the block center did not initiate interactions with the children, but responded to children's initiations. The children participating in the study were videotaped, and a photograph was taken of each participating child's final block construction. In addition, the research assistants noted the time the child was engaged in building. The research assistants also asked the children the open-ended question, "Can you tell me about your block construction?" and recorded children's responses. The questions were asked and responses recorded to assist in coding, especially when children reached a score of 11 or above (see Table 3).

Dependent Variables

To assess the complexity of children's block constructions, the photograph of each participant's final block construction was scored according to a 19-point scale. The scale is pre-

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Table 3.
Block Construction Scoring Scale

Score	Description of Block Use or Construction
NONCONSTRUCTION USE OF BLOCKS	
1	*No constructions* Child investigates physical properties of blocks by engaging in noise-making, transportation, motion, and bodily contact manipulations. Child attempts to engage in social interactions using blocks.
LINEAR CONSTRUCTIONS	
2	*Vertical linear arrangement* Child piles or stacks block on top of each other.
3	*Horizontal linear arrangement* Child places blocks side by side or end to end in a row.
BIDIMENSIONAL/AREAL CONSTRUCTIONS	
4	*Vertical areal arrangement* Child constructs adjoining piles of blocks or superimposes
5	*Horizontal areal arrangement* Child combines rows of blocks in no horizontal area
TRIDIMENSIONAL CONSTRUCTIONS	
6	*Enclosed vertical space* Child places two blocks parallel and spans the space between them with a block; forms an arch or bridge.
7	*Enclosed horizontal space* Child makes square-like shapes out of four or more blocks.
8	*Solid tridimensional use of blocks* Child makes a flooring out of blocks and superimposes one or more additional layers of blocks.
9	*Enclosed tridimensional space* Child roofs horizontal enclosure and creates a tridimensional enclosed space.
10	*Elaborations/combinations of many construction forms* Child uses various combinations of linear, bidimensional/areal, and tridimensional constructions.
REPRESENTATIONAL PLAY	
11	*Naming begins* Child names individual blocks in constructions as "things;" block constructions/block shapes may or may not resemble the "thing" they are supposed to represent.
12	*One construction, one name* Child names an entire block construction as a "thing;" one construction represents one "thing."
13	*Block "forms" are named* Child names block "forms" in a construction as representing "things." For example, a particular block in a structure representing a hospital might be labeled "the door."
14	*Separated objects are named* Child builds constructions that include separated objects; separated objects are named. For example, a single block that is separated from a house structure (built from many blocks) might be labeled a "tree."
15	*Interior space represented* Child builds constructions that have interior space represented; interior space is not totally formed.
16	*Interior objects placed in the exterior* Child builds constructions with enclosures that represent interior and exterior space; interior objects are placed outside the construction.
17	*Representation of interior and exterior space* Child builds constructions with enclosures that represent interior and exterior space; inside and outside objects are separated appropriately.
18	*Constructions built to "scale"* Child builds constructions with block "forms" separated; some sense of scale in the construction.
19	*Complex configurations* Child builds a complex configuration that includes interior space, landmarks, routes, and a sense of scale.

Note. From "Block play: Creating effective learning experiences for young children," by P. Phelps and M. F. Hanline, 1999, *Teaching Exceptional Children, 32*(2), 64–69. Copyright 1999 by the Council for Exceptional Children. Reprinted with permission.

sented in Table 3. It is based on the work of Guanella (1934) and Reifel (1982, 1984b). The coding system shows a developmental progression of children's use of blocks from nonconstruction use of blocks (Stage 1) to linear constructions (Stages 2 and 3) to bidimensional constructions (Stages 4 and 5) to tridimensional constructions (Stages 6–10) and to representational play with blocks (Stages 11–19). The scale reflects a child's growing understanding of spatial relationships, topological and geometrical knowledge, as well as representational play skills.

In addition, the research assistants recorded the time the child was involved with block construction activity. This time began when the teacher stated to the children that they may begin building and ended when the children indicated that they had completed their construction. These data were recorded using a stopwatch. The research assistants started the stopwatch when the teacher ended the introduction activity and stopped the stopwatch when the child indicated to the teacher that he or she had completed the construction. The child's gender (boy or girl) and the developmental status (with or without a disability) also were used in analysis.

Interoberver Agreement

The third author who was blind to when the photographs were taken and to the child whose construction was being scored, completed the coding of the photographs of the blocks constructions. A teacher with a bachelor's degree in Early Childhood Education and employed at the preschool recoded a random sample of 25% of the observations. She also was blind as to when the photograph was taken and to whose block construction was photographed.

To obtain interobserver agreement, a doctoral student in ECSE observed a random sample of 25% of the block play videotapes and computed the time the child was involved with block construction. These times were compared to those of the research assistants' written records.

Interobserver agreement for both the block construction scale score and time the child was involved with block construction activity was calculated by dividing the number of agreements by the number of agreements plus the number of disagreements and multiplying by 100. The primary and secondary coders were considered to be in agreement on the block construction score, when they gave the exact same score on the block construction scale. Similarly, the primary and secondary coders were considered to be in agreement on the time the child was involved with the block construction when they coded the same amount of time (to the minute). Kappa was computed for both observations and ranged from .83 to 1.00 (M = .95) for the block construction score and from .85 to 1.00 (M = .96) for the time the child was involved with the block construction activity.

Data Analysis

Our research questions sought to compare children with and without disabilities on their levels of block construction development and their rate of development in block construction. These questions led us to choose growth curve analysis for the data. Growth curve analysis is a special case of hierarchical linear modeling (Bryk & Raudenbush, 1992; Burchinal, et al., 1994), in which analysis is conducted at several levels of data aggregation. In hierarchical linear modeling growth curve analysis, two analyses are conducted—one at the level of repeated observations of individual children and the second at the level of children's characteristics (such as disability status or gender) predicting their rate of growth and development (i.e., block construction scale score). These two analyses are reported as Level 1 and Level 2 analyses, respectively.

Hierarchical linear modeling, which is a relatively new statistical technique, has several advantages over previous repeated measures techniques. Hierarchical linear modeling does not require equal time intervals between observations or equal numbers of observations per subject. In addition, hierarchical linear modeling relaxes the independence of observation assumptions required in ANOVA repeated measures designs (Tate, 1998).

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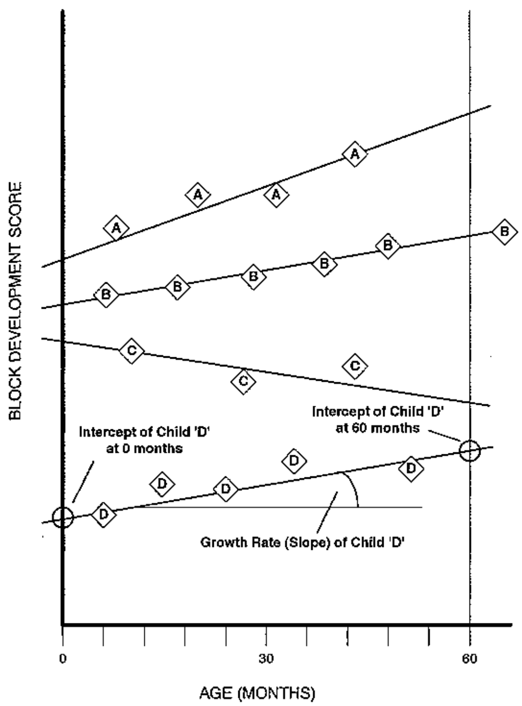

Figure 1.
Level 1 growth curve analysis (4 hypothetical participants).

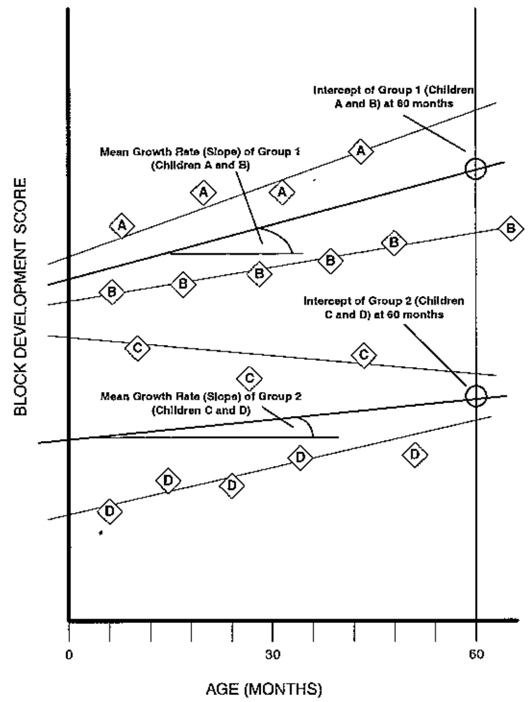

Figure 2.
Level 2 growth curve analysis (4 hypothetical participants in 2 categories).

In Level 1 analysis, two parameters are estimated *for each child.* Using ordinary least squares regression analysis, each child's developmental block scale score is regressed on his or her chronological age. The unstandardized regression coefficient (*b*) for each child can be interpreted as the *growth rate* for that child, i.e., the increase (or decrease) in block score per month (see Figure 1).

The second parameter, the intercept for each child, is handled differently in hierarchical linear modeling than in typical regression analysis. The typical treatment of the intercept in regression analysis is to estimate the point at which the regression line crosses the *y*-axis, i.e., the score on the dependent variable when *x*, the independent variable, is equal to zero. In the case of growth in block scale scores over age, however, the intercept when $x = 0$ would be interpreted as the estimated block score when a child is zero years old. Not only would this be a nonsensical construct, it is also an extrapolation beyond the range of the data collected. Instead, in growth curve analysis, the intercept is typically estimated (i.e., centered) at a substantively meaningful level of the independent variable. In this analysis, we shift the intercept to the *x*-value at 60 months, thus providing an estimate of each child's development block score at 5 years of age (see Figure 1).

In Level 2 analysis, these two parameters, the regression coefficient (growth rate) and intercept (estimated score at 60 months) are themselves used as dependent variables that can be functions of other independent variables. Such an analysis is often referred to as using "slopes as outcomes." Thus, the correlates of growth rates among children, or of their scores at a given age, can be investigated. In this study, we are able to determine the differences in growth rates between children with and without disabilities, and between estimated block scores at 60 months between children with and without disabilities (see Figure 2). Hierarchical linear modeling is designed to test the differences between mean growth rates and score levels of these two groups. In addition, other independent variables (such as gender and time the child was involved with block construction activity) might be included in the model that predicts slopes and intercepts.

In summary, the Level 1 Model estimated in this study is:

$$Y_{ti} = \pi_{0i} + \pi_{1i} a_{ti} + e_{1I}, \quad (1)$$

where Y_{ti} = block construction scale score for each child at age a; π_{0i} = intercept at age 60 months for each child; π_{1i} = slope for each child; and e_{1i} = error term for each child, whereas the Level 2 Model are:

$$\pi_{1i} = \beta_{10} + \beta_{11}(\text{disability})_{1i} + \beta_{12}(\text{time involved with block construction activity})_{2i} + \beta_{13}(\text{gender})_{3i} + r_{1i}, \quad (2)$$

where π_{1i} = each child's growth rate (slope determined from the Level 1 Model); β_{10} = the constant term; β_{11} = the effect of disability status on growth rate; β_{12} = the effect of time involved with block construction activity on growth rate; β_{13} = the effect of gender on growth rate; and r_{1i} = error term, and

$$\pi_{0i} = \beta_{00} + \beta_{01}(\text{disability})_{1i} + \beta_{02}(\text{time involved with block construction activity})_{2i} + \beta_{03}(\text{gender})_{3i} + r_{0i}, \quad (3)$$

where π_{0i} = each child's projected block score at age 60 months (intercept determined from the Level 1 Model); β_{00} = the constant term; β_{01} = the effect of disability status on score (age 60 months); β_{02} = the effect of time involved with block construction activity on score (age 60 months); β_{03} = the effect of Gender on score (age 60 months); and r_{0i} = error term.

Hierarchical linear modeling growth curve analysis typically proceeds in three steps. First, using a combination of theory and visual data inspection, the form of the growth curve for individuals is specified. Here it is determined whether to use linear or nonlinear growth curve models. Second, in the Level 1 analysis, slopes and intercepts are computed for each individual according to the specified curve, and the array of slopes and intercepts is inspected to determine whether there is sufficient variability among individuals to warrant further attention. Third, in the Level 2 analysis, predictors of the individual slopes and intercepts are analyzed for their explanatory power (see Tate, 1998).

A graduate student in ECSE entered the data into the statistical program *HLM 5: Hierarchical Linear and Nonlinear Modeling* (Raudenbush, Bryk, & Congdon, 1999). The first author of this article checked the accuracy of all data entry points independently and found the data to be 100% accurate.

RESULTS

Specification of Growth Curve

There were theoretical reasons to attempt to model either a linear growth curve or a quadratic growth curve (see Burchinal, Bailey & Snyder, 1994). The former fits a straight line of constant growth over the time frame. The latter fits either a curve that starts off rather flat, and then accelerates in slope; or a curve with a sharp slope at the beginning of the time frame, then gradually leveling off. In addition, a visual inspection of scatterplots led us to try both functional forms of the Level 1 equation. Nonlinear growth analysis, however, requires more observations per individual than a linear form does. When the linear form was run using hierarchical linear modeling, all 65 cases were retained in the analysis. When the quadratic growth model was applied in the analysis, the program only retained 33 cases because of the many cases with small numbers of observations per child. In addition, reliability estimates were artificially inflated. Tate (1998) recommended that fitting a quadratic growth curve requires at least one more observation per individual than the parameters being estimated. Thus, we chose to retain the linear growth model in the Level 1 analysis.

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analysis, however, requires
per individual than a linear
the linear form was run us-
ear modeling, all 65 cases
he analysis. When the qua-
el was applied in the anal-
only retained 33 cases be-
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er child. In addition, reli-
ere artificially inflated. Tate
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el in the Level 1 analysis.
nalysis, the average slope

Table 4.
HLM Analyses: Influence of Disability Status on Individual Block Development Score Growth Rates (Slopes) and Levels at Age 60 Months (Intercept) (n = 65)

	Unstandardized Regression Coefficient	*t* Ratio	*p* Value
Intercept			
Intercept 2	11.27	26.49	<.001
Disability	−5.30	−6.43	<.001
Slope			
Intercept 2	0.27	18.61	<.001
Disability	−0.11	−3.42	.001

for all subjects indicated a growth rate of .25 point in the block scale score per month (*SD* = .24). The average block development score at age 60 months (adjusted intercept) was a score of 8.90 points (*SD* = 4.78). The standard deviation of each parameter was substantial, thus demonstrating that there was considerable variability in growth rates and scores, warranting further analysis.

Research Question 1: Are there statistically significant differences between growth rates on block construction scale scores for children with and without disabilities?

In a Level 2 analysis, individual slopes and intercepts were regressed on the child's disability status. As reported in Table 4, the impact of disability status on individual children's block development growth rate was −0.11, and was statistically significant ($p < .001$). Thus, children with disabilities gained about a tenth of a block scale score less on the block construction scale per month than did children without disabilities. In other words, the average growth on block play development for children with disabilities was an increase of .16 of a score on the block scale per month, and for children without disabilities, it was .27 points per month. Over 12 months, the difference in growth rate between

Table 5.
HLM Analyses: Influence of Disability, Gender, and Time the Child Was Involved With Block Construction Activity on Individual Block Development Score Growth Rates (Slopes) and Levels at Age 60 Months (Intercept) (n = 65)

	Unstandardized Regression Coefficient	*t* Ratio	*p* Value
Intercept			
Intercept 2	6.93	4.34	<.001
Disabililty	−4.99	−6.80	<.000
Gender	0.024	0.84	<.402
Time	0.23	3.89	<.000
Slope			
Intercept 2	0.12	2.13	.033
Disability	−0.10	−3.51	.001
Gender	0.02	0.84	.402
Time	0.01	3.07	.003

children with and without disabilities was over one scale point.

Research Question 2: Are there statistically significant differences between estimated block construction scale scores for children with and without disabilities at age 60 months?

As reported in Table 5, the impact of disability status on the estimated block construction scale score at 60 months was −4.99, and statistically significant ($p < .001$). Thus, children with disabilities score about 5 points lower than children without disabilities do at age 60 months. To see whether these differences can be accounted for either by differences in gender or time spent engaged in block building, a Level 2 equation was specified with three independent variables predicting individual slopes and intercepts.

Research Question 3: Are differences between children's block construction scale scores and growth rates accountable by gender or by time engaged in block building?

As reported in Table 5, the impact of gender was not statistically significant either for growth rate in block construction scale scores, or on predicted block construction scale score at 60 months. Boys and girls showed growth at about the same rate and had comparable scores at age 5.

We also investigated whether time the child was involved with block construction activity could account for differences between children with and without disabilities. The impact of time the child was involved with block construction activity was positive and statistically significant ($p < .001$) both on growth rates and estimated scores at 60 months. Nevertheless, the differences between children with and without disabilities persisted, even when controlling for time the child was involved with block construction activity. Gender did not have a statistically significant effect either on slope or intercept. Thus, even when controlling for presumed differences between attention spans between children with and without disabilities, the effects of disability status persisted.

DISCUSSION

The purpose of this study was to explore the block play of young children with and without disabilities. Emphasis was placed on assessing the changes that occurred in the complexity of the children's block constructions as the children's chronological age increased and on the influence of variables that past research indicated might effect block play. Specifically, the effects of disability, gender, and time the child was involved with block construction activity were evaluated. A developmentally sequential scale assessing the complexity of children's block constructions, previously applied only to children without disabilities, was used as the dependent variable.

The results of the study indicate that the complexity of the block constructions of both children with and without disabilities increased as the children became older, but the children with disabilities built statistically significantly less complex structures than children did of the same chronological age who were developing typically. In addition, children with disabilities progressed through the different stages of block construction at a statistically significantly slower rate than children without disabilities did. These findings parallel those of other research related to the play behavior and development of children with disabilities. That is, children with disabilities generally tended to develop play skills in the same sequence as children without disabilities, but at a slower rate (as reviewed in Elgas & Lynch, 1998; Frost, Wortham, & Reifel, 2001). It is important to note, however, that, although children tend to progress through the stages sequentially, they might on occasion use blocks in a manner that does not reflect their capability. That is, children who are able to construct an enclosed tridimensional space might choose to stack vertically on a particular day. Also, some children built at one stage for an extended period of time, and then began building several stages above that level.

In addition to supporting the developmental relationship between the complexity of block constructions and the chronological age of the child, findings also showed that time the child was involved with block construction activity has a positive effect on block construction complexity. This relationship is as expected, as more complex constructions require more time to build.

Findings also indicate no differences between girls and boys with or without disabilities in the complexity of their block constructions or in their growth rate through the block construction stages. Although previous studies have indicated gender differences in choosing to play with blocks (Farwell, 1930; Margolin & Leton, 1961; VanAlstyne, 1932), this did not seem to influence the block play of children included in this study. In fact, at the preschool in which this study took place, boys and girls had equal opportunity to play with blocks.

We noticed in our observations that if children have the opportunity to build the most developmentally advanced block construction, they must have adequate time to complete their constructions and have an adequate number of blocks. We allowed as much time as ilities progressed through the of block construction at a sta- cantly slower rate than chil- sabilities did. These findings f other research related to the and development of children . That is, children with dis- lly tended to develop play ne sequence as children with- but at a slower rate (as re- & Lynch, 1998; Frost, Wor- 2001). It is important to note, lthough children tend to pro- he stages sequentially, they on use blocks in a manner that their capability. That is, chil- ble to construct an enclosed pace might choose to stack articular day. Also, some chil- stage for an extended period n began building several stag- vel.

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the child desired (within the scheduled 90-minute block center time) and provided approximately 200 unit blocks per child in the block center. We further noted that children's constructions tended to be more complex if other play materials (e.g., miniature vehicles, animals, or people) were provided *after* the block construction was completed. In this way, the child focused on the construction first, and the representational play later.

The block construction scale used in this study is sensitive to changes in children's development over time. As such, it lends itself for use in authentic approaches to assessments. Authentic approaches to assessment are appropriate for use in ECSE programs because, in part, they gather information about what children do and how they do it in the natural environment over time (Pucket & Black, 1994). For example, the use of portfolio assessment, as a method of authentic assessment, has been advocated for use with young children with disabilities because it minimizes the need for standardized assessment instruments, such as intelligence tests, which are often not valid or reliable for children with disabilities. In addition, authentic assessment procedures provide multiple measures of child development, are implemented as an ongoing process, take place in a natural setting, might be free of cultural or gender bias, take advantage of a variety of the child's natural response modes, and help integrate instruction and assessment (McLean & Crais, 1996; Meisels & Steele, 1991; Wolery, 1996).

Nonetheless, information collected in a child's portfolio must not be evaluated in the absence of some standard of evaluating an individual child's progress (Hanline & Fox, 1994; Southern Early Childhood Association, 1994). The results of this study indicate that the block construction scale might be used as a method of evaluating the progress of young children in their block play. In fact, teachers requested that the block construction scale be posted on the wall in the block center. In this way, they had a guide from which to evaluate child progress, as well as a guide to what construction play behavior they should encourage and support next.

There are several limitations that should be noted in this analysis. First, we were unable to examine nonlinear growth curve functions within individuals, because of the limited number of observations on approximately half the cases. Nevertheless, the effect of disability status on block play development appears to be robust: If a quadratic or cubic form proves to be a better fit than the linear form, it is likely that the effect of disability status would prove even greater than we found in this analysis. Despite the limited power resulting from fewer observations, we still found statistically significant differences between children with and without disabilities, as well as time engaged in block building. Second, the data set we used did not have *type of disability* specified. Considering the wide range of growth rates and intercepts among children classified as disabled, there may well be variance within this group that could be further explained through classifying the type or severity of their disabilities. In addition, the large number of children with motor delays or physical disabilities might account for the significant differences between the children with and without disabilities. This variable was not controlled for in the analysis.

Furthermore, a precise analysis of the actual amount of time the children were on task or engaged in actual block construction during the time they engaged in block construction activity was not measured. For example, a child who indicated completion of their block construction in 23 minutes might have built the construction in 10 minutes. The remaining 13 minutes might have been spent talking with peers or banging blocks. A more detailed analysis of children's engagement and children's time on task in block play might well reveal differences other than those measured by time the child was involved with block construction.

Continued research investigating the block play of young children with disabilities is needed to further substantiate the developmental sequence of their block play and constructions, and to explore the effects of block play in the early childhood years on subsequent academic functioning. In addition, the relationship between block play and other aspects of play and areas of development, programmatic factors (e.g., physical environment, grouping of children) affecting the sophistication of block play, and methods of promoting more sophisticated block play should be studied to enrich our understanding of how to promote the successful development of all children (Rosenbaum, 1998).

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