Purpose. This study examined how performance components and variables in intervention influenced fine motor and functional outcomes in preschool children.

Method. In a sample of 44 preschool-aged children with fine motor delays who received occupational therapy services, eight fine motor and functional performance assessments were administered at the beginning and end of the academic year. Data on the format and intervention activities of each occupational therapy session were recorded for 8 months.

Results. The children received a mean of 23 sessions, in both individual and group format. Most of the sessions (81%) used fine motor activities; 29% addressed peer interaction, and 16% addressed play skills. Visual motor outcomes were influenced by the number of intervention sessions and percent of sessions with play goals. Fine motor outcomes were most influenced by the therapists' emphasis on play and peer interaction goals; functional outcomes were influenced by number of sessions and percent of sessions that specifically addressed self-care goals.

Conclusion. The influence of play on therapy outcomes suggests that a focus on play in intervention activities can enhance fine motor and visual motor performance.


Occupational therapists often provide services to preschool children with fine motor delays. These services have become an integral part of most preschool environments where children with disabilities are served. In intervention to improve preschoolers' fine motor skills, the occupational therapist often selects activities based on neurodevelopmental and sensory integration approaches (Couch, Deitz, & Kanny, 1998; Lawlor & Henderson, 1989; Swart, Kanny, Massagli, & Engel, 1997). Results of pediatric practice surveys indicate that occupational therapists emphasize a child's sensory motor performance components as a primary intervention to improve functional performance (e.g., self-care) (Swart et al., 1997). However, the literature provides almost no empirical data relating performance components or intervention activities to functional outcomes. As a result, we have minimal evaluation data supporting an intervention focus on performance components, or the use of specific activities or intervention approaches to enhance fine motor performance.

Relationship of Performance Components to Function

Many authors have theorized about the relationships between performance components and function (Case-
intervention activities that influence functional performance, contextual variables affect performance. Contextual variables include the objects and space available to the child and adult or peer support of performance. Occupational therapy intervention is one important support to the child's development of fine motor skills (Boehme, 1988; Exner, 1996; Swart et al., 1997).

**Intervention for Fine Motor Problems in Preschool Children**

**Preparatory Activities with Emphasis on a Sensory Integration Approach**

Specific frames of reference guide the therapist's activity selection and overall approach in intervention. In the initial part of an intervention session, preparatory activities may be implemented to improve the child's arousal, attentional focus, postural tone, and readiness for action. This initial phase may be guided by a sensory integration approach (Koomar & Bundy, 1991). For example, the therapist may provide vestibular and proprioceptive input to promote postural stability and behavioral organization as foundational elements to the child's performance. Specifically vestibular and proprioceptive input can enhance muscle tone and promote trunk stability related to the child's ability to use his or her hands in space (Danella & Vogtle, 1992; Exner, 1996; Parham & Mailloux, 1996). A sensory integration approach may also include activation or inhibition of the tactile system to increase the child's tolerance and perception of a variety of materials (Case-Smith & Berry, 1998; Exner, 1995; Miller & Heaphy, 1998). The hand's discrimination of an object's tactile qualities (i.e., haptic perception) is believed to be important to the expression of manipulation skill and may be an emphasis of this phase of intervention. Although clinical experience suggests that preparatory sensory activities enhance the child's performance, empirical evidence of this relationship is minimal.

**Graded Motor Practice**

A neurodevelopmental or motor learning approach often emphasizes graded movement experiences. In graded movement practice, the occupational therapist selects developmentally appropriate and challenging activities and provides sufficient support to the child so that he or she succeeds in the activities (Boehme, 1988; Exner, 1995). For example, the therapist plans a step-by-step sequence of motor activities to elicit isolated and controlled hand and arm movements, thereby improving manipulation skills, such as writing or cutting with scissors (Benbow, 1995; Exner, 1995). Neurodevelopmental approaches emphasize techniques to enhance the quality of movement, use the sequence of normal development to grade the activities presented, and include sensory (e.g., proprioceptive, tactile, kinesthetic) or cognitive (e.g., verbal) reinforcement of motor patterns (Benbow, 1995; Case-Smith, 1996; Exner, 1996; Exner & Henderson, 1995). Specific performance components are often the focus of intervention activities with the goal of improving related functional performance (Boehme, 1988). For example, activities to improve thumb stability can help the child develop precision grasp and in-hand manipulation for activities such as buttoning (Myers, 1992). Activities to improve isolated control of fingers can promote the child's play by increasing his or her ability to handle small objects such as Lego™ blocks, game, or doll pieces. Therapy activities focused directly on fine motor goals provide the child with developmental movement experiences that challenge the child's skills. When children succeed in challenging motor activities, they are reinforced for their efforts.

Play and playful activities implemented in therapy sessions tend to elicit more participation, improve motivation, and increase learning (Bundy, 1991; Parham & Primeau, 1997). Whereas motor learning and sensory integration may be the focus of therapy and may determine the selection of activities, play is often the context for therapy (Mailloux & Burke, 1997).

**Use of Play and Peer Interaction in Intervention**

Object and social play interactions have been defined as both the mode and the method of intervention with children (Rast, 1986). Play can also be a goal of intervention (Parham & Primeau, 1997; Reilly, 1974). As an intervention mode, play activities maintain the child's attention, interest, and energy for the task (Blanche, 1997; Rast, 1986). A playful environment reinforces the child's efforts in therapy. As a means to therapeutic ends, it engages the child and motivates him or her to attempt the activity and to sustain the effort (Pierce, 1997). When playing, the child also experiences joy or pleasure, and therefore associates positive affect with the activity at hand. Pleasurable

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experiences are ones that the child eagerly repeats and even initiates on another occasion; therefore, the skills associated with play are generalized and are likely to be practiced with peers and in other environments. Because play includes affective, social emotional (e.g., with peers), and cognitive (e.g., imagination) components, as well as motor components, it provides opportunities for the child to integrate new skills into his or her repertoire of daily behaviors (Bundy, 1991; Blanche, 1997; Pierce, 1997). In addition to these variables that define in broad terms occupational therapy activities, intervention format and frequency likely affect child outcomes.

Intensity and Frequency of Services

Several studies have investigated how intensity of services is associated with differential gains in function (Jenkins & Sells, 1984; Law et al., 1997; Parette, Hendricks, & Rock, 1991). The question of whether more therapy produces better outcomes has not been completely answered (Hanft & Feinberg, 1997). With inconclusive evidence about the benefit of greater frequency of services, additional data on the relative effects of this variable are needed. Therefore, this study was conducted to examine how performance components and variables in occupational therapy intervention influence fine motor and functional outcomes in preschool children. Two related research questions were investigated.

1. To evaluate the theoretical model that links (a) performance components, (b) skills, and (c) functional performance (Coster & Haley, 1992; Dunn, Brown, & McGuigan, 1994; Case-Smith, 1995): Do the performance components of visual perception, eye–hand coordination, and in-hand manipulation strongly correlate with fine motor skills and functional performance?

2. To explore the influence of intervention variables on performance outcomes: Does (a) frequency of occupational therapy services, and (b) frequency of specific intervention activities during occupational therapy sessions predict children’s fine motor and functional performance outcomes?

Methods

Research Design

This multisite evaluative study examined fine motor and related functional performance before and after 8 months of occupational therapy services in preschool settings using a sample of children with fine motor delays. A descriptive rather than experimental design was used, in which the occupational therapy intervention was measured but not manipulated. By quantifying the intervention frequency and types of activities, outcome data could be correlated with the intervention variables. A research team of seven occupational therapists, with 14.2 years (range: 5–20 years) of pediatric experience, performed the evaluations at the beginning and end of the academic year. Other collaborating therapists provided the intervention and recorded the type and amount of service provided during the 8 months.

Sample

A sample of children from 4 to 6 years of age who had fine motor delays and who attended preschool at least half time was used for this study. They were recruited by the research team from their local school districts. Participants were volunteers who met the following criteria. Exclusion criteria for participants were: (a) medical or educational diagnosis indicating central nervous system dysfunction (e.g., mental retardation, cerebral palsy, autism, traumatic brain injury), (b) severe sensory loss (i.e., visual or auditory impairment), and (c) serious health problems (requiring ongoing medical care). Inclusion criteria for the participants with fine motor delays included: (a) scored 1.5 standard deviations or more below the mean on the Peabody Developmental Motor Scales–Fine Motor (PDMS–FM) (Folio & Fewell, 1983), (b) received weekly direct occupational therapy services, and (c) had at least one fine motor goal on his or her Individualized Education Program (IEP). Of the 48 children with fine motor delays who entered the study, 44 completed the end-of-the-year testing; two moved, one developed health problems, and one was unavailable at the end of the year. Table 1 presents demographic data about the participants.

Instruments

Functional performance and fine motor components of performance were measured at the beginning and end of the academic year, an interval of 8 months. For two of the...
standardized tests, only parts were administered to limit the amount of testing and the number of variables in the statistical analysis. The assessments and portions of assessments selected specifically measured targeted variables of the performance components—skills—functional performance model. Assessments were completed by the research team members in one to two observational testing sessions. Interviews of the parents were completed within 2 weeks of the observational testing.

**Fine Motor Performance Components**

*In-hand manipulation.* In-hand manipulation was assessed in translation and rotation tasks with the five small pegs and a nine-hole pegboard. In the Rotation Test, the participant prehended a 1-inch peg from the pegboard and rotated it 180° in his or her fingertips, then returned it to its peg hole (see Case-Smith, 1994, 1995 for additional information regarding testing procedures). Each participant individually rotated the pegs with each hand, producing two timed scores. The number of drops and times the peg was stabilized on another surface were also recorded and summed. Using the means of these scores, a composite score based on the time (in seconds) and the number of drops was computed. In the Translation Test, the participant picked up two, three, four, and then five pegs from the pegboard, moving them into the palm and then back into the finger tips to return to the pegboard. The seconds required to complete each task and the number of drops were recorded and means calculated. A composite score of time and number of drops were used in the data analysis.

*Eye–hand coordination.* The Motor Accuracy test of the Sensory Integration and Praxis Tests (Ayres, 1989) was used to measure eye–hand coordination. In the testing task, the participant traced a long curved line, crossing the midline, with each hand. Accuracy was measured by using a map reader, and accuracy scores were adjusted for the time (in seconds) that was required to trace the line. The mean adjusted raw scores for both hands were computed for the data analysis.

*Visual perception.* Two subtests of the Developmental Test of Visual Perception (DTVP) (Hammill, Pearson, & Vosser, 1993) were used to measure visual perception. Position-in-space measures the ability to recognize when forms have the same spatial orientation. Figure Ground requires identification of a figure hidden by lines or embedded within other lines and figures. This test is norm referenced, and high test–retest and interrater reliability are reported by the test authors (Hammill et al., 1993). Raw scores were used in the analysis because the children fell in the lowest categories of scaled and percentile scores, reducing sensitivity to score changes.

**Measures of Skill**

*Fine Motor.* The PDMS–FM (Folio & Fewell, 1983) were administered to measure overall fine motor performance. This norm-referenced standardized test measures hand use, eye–hand coordination, and manual dexterity using typical preschool activities (e.g., cutting, building with blocks, lacing). Items are rated on a 3-point scale. Test–retest reliability for the PDMS–FM is good \((n = 38; \ r = 0.80)\) and interrater reliability is excellent \((n = 35, \ r = 0.94)\) (Folio & Fewell, 1983). Summed raw scores were used, because many of the participants fell into the lowest percentile group, where changes in scores were not reflected as changes in percentile.

*Visual Motor.* Two subtests of the DTVP (Hammill et al., 1993) were used to measure visual motor skills. Both tests involve copying designs presented visually. In Spatial Relations, the child copies lines drawn on a grid made of dots, requiring analysis of forms and patterns. The test measures the ability to reproduce visually presented patterns. In Copying, the child copies forms of increasing complexity, which measures the ability to recognize the features of a design and to draw it from a model. Raw scores were used in the analysis.

The Draw-A-Person test was administered to measure integration of visual motor skills (Short-DeGraff & Holan, 1992; Vane, 1967). Each participant was given a blank piece of paper and asked to draw a figure of himself or herself. Points were given for inclusion of facial features and various body parts. This simple scoring system did not account for the quality of the drawing because all lines that were intentionally drawn to represent body parts received credit. This scoring method has high interrater reliability \((n = 32; \ r = .93)\) and concurrent validity with the Goodenough-Harris Draw-A-Person test \((n = 32; \ r = .64)\) (Short-DeGraff & Holan, 1992).

*Functional Performance*

The functional scales of the Pediatric Evaluation of Disability Inventory (PEDI) (Haley et al., 1992) were administered by interviewing participants’ parents. The interviews required between 30 and 40 min, using the standardized procedures for clarifying items and scoring. Two scales were used in the analysis; the Mobility Scale was not used because all of the participants were ambulatory and scored at the scale’s ceiling. The Self-Care Scale includes items that rate the child’s independence in feeding, dressing, bathing, fastening, and toileting. Many of these skills require some level of manipulation. The Social Function Scale measures the child’s communication skills, self-identification skills, safety, participation in peer play and household chores, and ability to problem solve. Of particular interest were the child’s play and problem-solving skills. Haley et al. used both traditional analysis of their normative data and Rasch analysis to assist in interpreting test scores. Scaled scores based on the Rasch analysis that indicates item difficulty were used in the data analysis.
Intervention

Direct intervention was provided to the 44 participants by the 22 collaborating occupational therapy practitioners who were recruited by the research team members. The 17 occupational therapists and 5 certified occupational therapy assistants had a mean of 12 years experience (7–23), with 9 (4–17) years in the public schools. The collaborating therapists used the form weekly to record the amount of time with the child, provision of consultation, use of group or individual format, and child’s level of participation. Using a list of 20 possible intervention activities in four goal categories (sensory integration, motor/manipulation, self-care, and play/peer interaction), each therapist also recorded specific intervention activities included in the session. The data form was developed by the research team and was piloted by two team members. Evaluation of face validity by the collaborating therapists using a written questionnaire indicated that the form had adequate and sufficient categories to record their intervention activities (see Case-Smith et al., 1998).

Data Analysis

To create a reasonable number of variables for the analysis, the intervention activities recorded on the data forms were collapsed into 9 categories of related activities. Intervention activity data were only combined within the goal categories, and research team members concurred that collapsing the targeted activities did not result in lost information. Frequencies and percentages for the collapsed categories of goals and activities were computed to summarize the child’s intervention over the year. Mean scores also were computed for intervention time and format. These scores and pretest and posttest scores for the 44 students were entered into a statistical computer program.

To validate the relationships among performance components, skill, and functional measures, Pearson correlation coefficients using year-end test scores for all participants were computed, followed by multiple regression analyses using the PEDI scores as the outcome variables.

To evaluate the influence of occupational therapy intervention variables on the fine motor outcomes, several steps of data analysis were completed. First, to establish whether participants made gains during the year, mean scores for the assessments at the beginning and end of the year were computed and paired t tests were calculated. Then because each t test was significant, effect sizes (d values) were calculated, adjusting for the correlation coefficient between pretest and posttest scores. To determine the influence of intervention variables on outcomes, backward linear regression equations were computed for each outcome variable. The number of sessions, the pretest scores, and the percentages for the collapsed categories of intervention activities were entered in each equation.

Table 2

Percent of Sessions That Included Specific Intervention Activities

<table>
<thead>
<tr>
<th>Intervention Activities</th>
<th>M (%)</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vestibular/proprrioceptive input</td>
<td>31.70</td>
<td>25.97</td>
<td>0–95</td>
</tr>
<tr>
<td>Tactile input/motor planning</td>
<td>40.36</td>
<td>25.33</td>
<td>0–83</td>
</tr>
<tr>
<td>Visual perception</td>
<td>58.57</td>
<td>26.61</td>
<td>4–100</td>
</tr>
<tr>
<td>Visual motor integration</td>
<td>80.98</td>
<td>16.69</td>
<td>5–100</td>
</tr>
<tr>
<td>In-hand manipulation</td>
<td>64.98</td>
<td>15.74</td>
<td>24–100</td>
</tr>
<tr>
<td>Bilateral manipulation</td>
<td>51.02</td>
<td>22.73</td>
<td>3–92</td>
</tr>
<tr>
<td>Self-care (dressing)</td>
<td>13.02</td>
<td>14.66</td>
<td>0–61</td>
</tr>
<tr>
<td>Peer interaction</td>
<td>28.78</td>
<td>30.36</td>
<td>0–87</td>
</tr>
<tr>
<td>Play</td>
<td>15.95</td>
<td>25.12</td>
<td>0–87</td>
</tr>
</tbody>
</table>

Results

Description of Intervention

Occupational therapy intervention activities provided in the preschools are presented in Table 2. The frequency of intervention goals and activities were quite varied despite similarities in the participants (i.e., all had mild to moderate fine motor delays). Some of the variation can be attributed to regional differences in services delivery models. The participants from New York received about 50% more intervention sessions than the participants in Ohio.

The 44 participants received a mean of 23.1 (SD = 6.01; range of 12–43) sessions over the course of the year. Total time for intervention ranged from 408 to 1824 minutes, with a mean of 825 minutes. The therapists consulted with teachers in 16.1% of their sessions, provided group intervention in 52.3% and individual in 61.5% of the sessions (individual and group formats were combined in some sessions). Percentage of consultation and intervention session formats seemed to vary by therapist more than by region. However, regional differences in consultation percent were found. Consultation was highest in rural Illinois, Texas, Florida, and Cleveland, where 87% to 100% of the children received some consultation during the year.

The high percentage of visual motor and manipulation activities was anticipated given that the participants were selected because they had fine motor IEP goals. Infrequent use of sensory integration activities was expected because only two of the children had identified sensory integration problems; these activities were used in about a quarter of the sessions. The wide variance in application of sensory integration suggests that this approach was not used by some therapists and was extensively used by others. The variance in sensory integration activities may reflect that therapists with expertise in that approach frequently use activities that provide sensory input.

The participants made statistically significant gains in all eight measures over the course of the academic year. Table 3 presents beginning and end-of-the-year scores. Effect sizes are listed with pretest and posttest scores, and mean effect size for the eight measures was 1.81.
The correlations between performance component and skill measures are listed in Table 4. The coefficients were moderate to high, suggesting a substantive relationship between the performance components and the fine motor skills examined. These results suggest that relationships are strongest at the bottom two levels of the performance components–skills–functional performance model.

Weaker correlations were expected between the component and skill measures and functional performance (i.e., PEDI scores). However, all coefficients, except visual perception and self-care function, were statistically significant, suggesting that the parents’ reports of their children’s self-care and social function correlate with the fine motor and visual motor skills measured (see Table 5). When regression equations were computed using the PEDI scores as outcome measures, specific skill measures predicted the functional performance outcomes. PEDI Self-Care scores were predicted by DTVP Visual Motor scores ($\beta = .450$, $p = .005$). Social Function was predicted by the PDMS–FM scores ($\beta = .412$; $p = .001$).

### Outcome Measures Predicted by Occupational Therapy Intervention

To measure the effects of specific intervention activities in occupational therapy on fine motor outcomes, the percentage of sessions that included each category of intervention activities and the number of sessions were entered as independent variables in regression equations, with each of the fine motor skill and functional performance tests as the outcome variable. In each regression equation, the pretest score of the outcome variables was entered. By accounting for the participants’ performance at the beginning of the year, the remaining variance in the year-end scores may be attributed to maturation and intervention. Backward linear regression equations were computed to determine what intervention variables, if any, would predict the fine motor outcomes.

Of the nine collapsed variables defining the intervention activities, seven were entered into each equation. The variables included four intervention activities that were focused on performance component and skill levels (tactile input/motor planning, in-hand manipulation, visual motor integration, bilateral coordination) and three that were focused on functional performance (self-care, play, peer interaction). Vestibular input and visual perceptual activities were excluded from the regression analysis because the literature indicates that these variables are less related to fine motor skill acquisition than the seven selected (Fisher, 1991; Peshoski, 1995; Shumway Cook & Woollacott, 1995). The unique contributions of these intervention activities provided by the occupational therapists to the participants’ fine motor outcomes are presented in Table 6.

Of the descriptive variables, only play activities and peer interaction were predictive of the fine motor/visual motor outcomes. The number of sessions was also predictive of DTVP Visual Motor Skills. The PEDI Self-Care Scale scores were predicted by inclusion of self-care (i.e., dressing) activities in the occupational therapy sessions. The participants’ social function was predicted by the number of therapy sessions and by the percentage of sessions that included self-care and bilateral coordination activities.

### Table 3
Pretest and Posttest Scores for the Performance Components

<table>
<thead>
<tr>
<th>Category of Student</th>
<th>n</th>
<th>Beginning of Year $M$ (SD)</th>
<th>End of Year $M$ (SD)</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-hand manipulation</td>
<td>43</td>
<td>26.3 (7.7)</td>
<td>19.7 (5.5)*</td>
<td>2.01</td>
</tr>
<tr>
<td>Motor Accuracy</td>
<td>42</td>
<td>115.4 (15.7)</td>
<td>130.6 (13.3)*</td>
<td>1.99</td>
</tr>
<tr>
<td>DTVP–Visual Perception</td>
<td>42</td>
<td>5.4 (3.5)</td>
<td>8.7 (3.1)*</td>
<td>2.13</td>
</tr>
<tr>
<td>Draw-A-Person</td>
<td>43</td>
<td>3.32 (2.4)</td>
<td>6.7 (2.1)*</td>
<td>2.03</td>
</tr>
<tr>
<td>Peabody Fine Motor Scales</td>
<td>41</td>
<td>182.9 (12.1)</td>
<td>200.8 (12.6)*</td>
<td>1.87</td>
</tr>
<tr>
<td>DTVP–Visual Motor Integration</td>
<td>43</td>
<td>4.7 (5.8)</td>
<td>10.3 (8.0)*</td>
<td>1.83</td>
</tr>
<tr>
<td>PEDI Self-Care Function</td>
<td>36</td>
<td>67.5 (6.6)</td>
<td>76.1 (9.1)*</td>
<td>1.77</td>
</tr>
<tr>
<td>PEDI Social Function</td>
<td>36</td>
<td>63.83 (1.58)</td>
<td>69.47 (1.47)*</td>
<td>0.82</td>
</tr>
</tbody>
</table>

*Significant difference between pretest and posttest scores based on Tukey post hoc analysis.

Note. DTVP = Developmental Test of Visual Perception; PEDI = Pediatric Evaluation of Disability Inventory.

### Table 4
Correlations Between Performance Components and Skill Measures ($n = 44$)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DTVP–Visual Perception</td>
<td>.731 (.000)</td>
<td>.530 (.000)</td>
<td>.554 (.000)</td>
</tr>
<tr>
<td>Motor Accuracy</td>
<td>.634 (.000)</td>
<td>.609 (.000)</td>
<td>.702 (.000)</td>
</tr>
<tr>
<td>In-Hand Manipulation</td>
<td>-.633 (.000)</td>
<td>-.599 (.000)</td>
<td>-.649 (.000)</td>
</tr>
</tbody>
</table>

Note. DTVP = Developmental Test of Visual Perception.

### Table 5
Correlations of Functional Performance With Skills and Performance Components ($n = 44$)

<table>
<thead>
<tr>
<th>Performance Component Measures</th>
<th>Self-Care Social Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTVP–Visual Perception</td>
<td>.232 (.075)</td>
</tr>
<tr>
<td>Motor Accuracy</td>
<td>.450 (.000)</td>
</tr>
<tr>
<td>In-hand manipulation (composite of rotation and translation scores)</td>
<td>-.336 (.009)</td>
</tr>
<tr>
<td>Skill Measures</td>
<td></td>
</tr>
<tr>
<td>DTVP–Visual Motor Skills</td>
<td>.481 (.000)</td>
</tr>
<tr>
<td>Draw-A-Person</td>
<td>.482 (.001)</td>
</tr>
<tr>
<td>Peabody Fine Motor Scale</td>
<td>.473 (.000)</td>
</tr>
</tbody>
</table>

Note. DTVP = Developmental Test of Visual Perception.
Table 6
Intervention Variables That Predict Fine Motor and Functional Performance Outcomes

<table>
<thead>
<tr>
<th>Outcome Variable</th>
<th>Intervention Predictor Variable</th>
<th>β</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual Motor Skills</td>
<td>% of sessions with play activities</td>
<td>0.207</td>
<td>0.015</td>
</tr>
<tr>
<td></td>
<td># of sessions</td>
<td>0.170</td>
<td>0.043</td>
</tr>
<tr>
<td>Peabody Fine Motor Scale</td>
<td>% of sessions with peer interaction activities</td>
<td>0.399</td>
<td>0.013</td>
</tr>
<tr>
<td>Draw-A-Person</td>
<td>% of sessions with self-care activities</td>
<td>0.292</td>
<td>0.034</td>
</tr>
<tr>
<td>Self-Care Function</td>
<td>% of sessions with self-care activities</td>
<td>0.266</td>
<td>0.035</td>
</tr>
<tr>
<td>Social Function</td>
<td># of sessions with self-care activities</td>
<td>0.225</td>
<td>0.044</td>
</tr>
<tr>
<td></td>
<td>% of sessions with self-care activities</td>
<td>0.324</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>% of sessions with bilateral coordination activities</td>
<td>0.215</td>
<td>0.071</td>
</tr>
</tbody>
</table>

*In each analysis, the posttest score was the dependent variable after controlling for the pretest score.

Discussion
Relationships Between Performance Components and Child's Function

The motor components measured accounted for a large portion of the variance in skills and functional performance. As predicted, performance components (including visual perception and motor accuracy) had a strong relationship to fine motor and visual motor skills. These correlations support the findings of others that visual perceptual and eye-hand skills are measured in the Draw-A-Person test (Short-DeGraff & Holan, 1992) and that eye-hand coordination is measured in the PDMS–FM (Folio &Fewell, 1983). The strong correlation coefficients between performance components and skill measures are similar to those found in Case-Smith (1996).

As expected, the correlation between observed measures of performance components and skill and parent reports of functional performance were low to moderate. Although most of the correlation coefficients were significant, the lower relationships reflect that roles and function are influenced by variables other than standard measures of performance components and skills. Roles and function are strongly influenced by the environment and the opportunities provided to the child (e.g., to demonstrate independence in dressing or bathing) as well as skill. The moderate correlation coefficients of motor accuracy and visual motor skill to self-care function suggest the importance of those skills to the child’s abilities in self-feeding, hygiene, and dressing. The correlation between fine motor skill and social function is more difficult to interpret. Several items on the PEDI Social Function Scale require fine motor skills (e.g., those that measure play skills). An alternative interpretation is that the correlation coefficients reflect the influence of a third variable, for example, cognition or language. The PDMS–FM in particular has items that require receptive language and cognitive skill. Therefore, the shared variance between these measures may suggest that children with higher level motor skills have higher level cognitive and communication skills and, by extension, social function (Odom, McConnell, & McEvoy, 1992).

In general, the relationships expressed validate the performance components–skills–functional performance model used to evaluate the children and support the hierarchy of performance that links components to skills to function and roles. As in Case-Smith (1995, 1996), the relationships are strongest between performance components and skills and are more tenuous but significant when skills are related to the functional performance of the child as reported by the parent.

Influence of Intervention Variables

Intervention activities as recorded by the collaborating therapists were entered into regression equations to measure their influence on fine motor outcomes. It was expected that the child’s year-end fine motor skills would relate to the frequency that fine motor and manipulation activities were implemented in the sessions, to validate the belief that practice of skill relates to improved performance (Pehoski, 1995; Schmidt, 1982). However, the percentage of sessions with fine motor manipulation, as well as visual perception activities, did not significantly relate to fine motor outcomes. In addition, activities that provided sensory input (e.g., tactile) did not uniquely contribute to fine motor outcomes. Although the relationships between number of sessions and outcome measures were positive, frequency of intervention was predictive of only two outcomes. Participants who received more occupational therapy sessions improved more in visual motor skills and social function.

The most surprising finding was that the therapist’s use of play and peer interaction predicted the fine motor outcomes and that among the intervention variables, play and peer interaction were the only significant predictors. Almost half of the sessions used small groups and about 30% of the sessions included peer interaction goals. This finding suggests that occupational therapists do address social function and that positive effects may be derived from this intervention focus (Case-Smith, 1997; Davidson, 1996; Davidson & LaVesser, 1998). Their focus on development of children’s social function is inherent in their holistic approaches, but is not always reported (i.e., occupational therapy may not be listed as a service provided to meet psychosocial goals) (Case-Smith, 1997; Davidson & LaVesser, 1998).

The influence of play activities on fine motor outcomes can be interpreted a number of ways. Play may be an effective means to motivate and engage children so that they become more focused or make greater efforts to attempt fine motor activities (Pierce, 1997). Couch, Deitz, and Kanny (1998) found that 91% of the 202 occupational therapists they surveyed used play to motivate the child. A second interpretation is that the play activities gave the participants a comfortable, enjoyable context to practice...
their fine motor skills in other environments at other times. Because children play in all environments, use of play activities that enhance fine motor skills enabled the children to generalize their skills to other settings and other play opportunities (Parham & Primeau, 1997; Reilly, 1974). A third interpretation of this relationship suggests that the therapists who reported use of play were more skillful and creative in motivating children to achieve fine motor and functional performance goals. Occupational therapists who create a playful environment not only motivate children, but also generally provide the “just-right” challenges in which children can succeed and master the environment. When therapists succeed in engaging a child in play, the selected activities are more likely to be effective in improving performance (Gliner, 1985; Reilly, 1974). It is important to note that the therapists who reported using play also used sensory and motor activities suggesting that the performance component objectives were embedded in play or congruent with the play activities.

Limitations

Although the therapists reported which activities and goals they used in intervention, the recording forms did not provide space to explain the rationale or details of their activities. The amount of time of each activity was also not recorded. More precise measurement of the occupational therapy sessions is recommended for future study.

Summary

Fine motor and functional performance outcomes of preschool children after 8 months of regular occupational therapy intervention were correlated with performance components. An evaluation model that links fine motor performance components, skills, and functional performance was supported. As in previous studies, foundational components and skills are highly related, and skills are moderately related to roles and functional performance. Specific performance outcomes were predicted by the frequency of sessions and the percentage that specific activities were implemented. Occupational therapists’ use of play activities and peer interaction were important predictors of skill levels at the end of the year. These results support the importance of therapeutic use of play in intervention. ▲

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