CONCURRENT VALIDITY OF THE FINE MOTOR DOMAIN OF THE BATTELLE DEVELOPMENTAL INVENTORY WITH THE FINE MOTOR SCALE OF THE PEABODY DEVELOPMENTAL MOTOR SCALES

A Thesis

Presented in Partial Fulfillment of the Requirements for the degree Master of Science in the Graduate School of The Ohio State University

by

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THESIS ABSTRACT

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TITLE OF THESIS: Concurrent Validity of the Fine Motor Domain of the Battelle Developmental Inventory with the Fine Motor Scale of the Peabody Developmental Motor Scales

The purpose of this study was to investigate the relationships between scores on two preschool fine motor assessment tools. Strong correlations were obtained between scores on the Fine Motor Domain of the Battelle Developmental Inventory (BDI) and scores on the Fine Motor Scales of the Peabody Developmental Motor Scales (PDMS), and between scores on the BDI Perceptual Motor Subdomain and scores on the PDMS Eye-Hand Coordination Subtest. Scores on the BDI Fine Muscle Subdomain correlated moderately with scores on the PDMS Manual Dexterity Subtest. The PDMS Fine Motor Scale identified more preschoolers as eligible for special education preschool services.

Jane Case-Smith
Adviser's Signature

To Erin and Lisa

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

Background of the Problem

In recent years, the use of standardized assessment instruments has become more common among school-based occupational therapists evaluating the motor development of their young clients (Royeen, 1992). This was not always the case. Historically, developmental therapists have depended on the use of many therapist-written tests and unpublished checklists (Campbell, 1989). In a survey studying current practices in evaluating the motor behavior of children with disabilities, 67 occupational therapists and 59 physical therapists were part of 245 respondents who reported use of 256 different motor evaluations (Lewko, 1976). Ninety-one of these tests were published and 165 were unpublished. Sixteen respondents indicated they did not use formal tests, relying on their "experience" in evaluating motor behavior.

This widespread use of unpublished tests was due partly to the variety and severity of diagnoses of clients seen by developmental therapists at that time. Pediatric therapists were often employed by facilities for "crippled children" and public institutions for the mentally retarded. They served children with a variety of orthopedic and neurological impairments. Motor behavior of these children is very difficult to quantify. Appropriate published and/or standardized tests were unavailable. This resulted in the "adaptation syndrome":

> "As occupational therapists, we seem particularly prone to the 'adaptation syndrome'; we seem to believe that no evaluation tool, however well-designed, is really appropriate for our unique clinical setting and population. So we take evaluation tools and 'adapt' them to our needs, taking a few items from one test, a few from another, and putting them together in a new and 'improved' evaluation tool. Of course, we do not usually take the trouble to validate the new test, since few of us have the skills to do so. When fellow therapists admire our evaluation, we generously give them a copy and thus proliferate the vast array of unproven tests." (Punwar, 1976, p. 421).

As increasing numbers of children with disabilities began to be served by public schools according to the mandates of Public Law 94-142 of 1975, there was also a rapid increase in the number of occupational therapists employed by school systems (Gilfoyle & Hays, 1979; Royeen, 1986). In the schools, therapists were more accessible to larger populations and began to receive referrals for children with subtle disabilities (behaviors more within the norms) (American Occupational Therapy Association, 1989). The motor performance of these children was more easily quantifiable. New assessment instruments, appropriate for occupational and physical therapists serving the school population, were developed, standardized, and published in the late 1970's and early 1980's. The increased use of standardized pediatric assessment tools is reflected in a survey of occupational therapists employed in the school systems of five northwestern states (Crowe, 1989). Of the fourteen developmental evaluations judged by the 293 respondents to be most relevant in school-based practice, twelve were standardized instruments.

Pediatric occupational therapists are increasingly encouraged to use standardized instruments in evaluating the motor development of children (Campbell, 1989; Crowe, 1989; Royeen, 1992). Campbell emphasized several major advantages for increased use of standardized tests (Campbell, 1989). The use of standardized tests enables therapists to define motor performance with numbers, which facilitates communication both within the profession and with other professionals in the health and education fields. Cost-effectiveness of therapy services can also be enhanced by reducing lengthy documentation time; the use of test scores to describe motor performance is less time-consuming than descriptive anecdotal records. Other advantages are increased objectivity and contributions to research.

In describing best practice standards for pediatric occupational therapists, current literature emphasizes that the use of standardized tests makes up only one component of a comprehensive assessment process that should also include information obtained from history, other written reports, interview, and observation (Cook, 1991; Huber & King-Thomas, 1987; Royeen 1992; Stengel, 1991). As an integral part of the assessment process, therapists' use of standardized tests can accomplish several purposes. These include: screening, diagnosis, determination of eligibility for services, determining treatment objectives, measuring individual progress toward achieving objectives, and assessing outcomes of intervention programs (Benner, 1992; Case-Smith, 1993; Haley, Coster, & Ludlow, 1991; Huber & King-Thomas, 1987; Mott, Fewell, Lewis, Meisels, Shonkoff, & Simeonsson, 1986; Piper, 1993; Salvia & Ysseldyke, 1991; Stengel, 1991).

Screening refers to the process of identifying which children need further assessment (Benner, 1992). Developmental screening identifies the presence of deviations from normal growth and development which in turn identifies children who are at risk for a delay or disorder in one or more areas of development (Case-Smith, 1993; Huber & King-Thomas, 1987). Children are referred for further in-depth evaluation if screening results indicate a possible developmental problem. Standardization is one characteristic of a good developmental screening tool (Palisano, 1993).

Standardized assessment tools are also used by developmental therapists for diagnostic purposes. Diagnostic assessment is a more in-depth evaluation than screening and documents the presence or absence of abnormality (Benner, 1992; Huber & King-Thomas, 1987). Diagnosis classifies or clarifies the problem (Benner, 1992). In diagnostic assessment, standardized instruments are used to distinguish one aspect of a developmental problem from another (Huber & King-Thomas, 1987). This is necessary for determining the need for intervention services and for choosing an appropriate program if indicated.

Therapists also use standardized instruments to determine eligibility for services. Each state has its own criteria for determining eligibility for special education and related services (American Occupational Therapy Association, 1989). These standards may differ according to the child's age. In Ohio, as in other states, eligibility for services is determined by scores on standardized tests (Crowe, 1989; Ohio Revised Code 3301-31, 1991; Provost, Harris, Ross, & Michnal, 1988).

Two additional reasons that occupational therapists use standardized tests are in initially determining treatment objectives and later for measuring a child's progress toward achieving those objectives. Although standardized or norm-referenced tests may not provide sufficient information for planning treatment strategies, they are often used in conjunction with criterion-referenced tests in program planning (Case-Smith, 1993; Huber & King-Thomas, 1987). Frequently therapists then measure the child's progress by re-administration of the assessment tool(s). The use of standardized instruments to measure a child's progress increases the validity of the child's change (Case-Smith, 1993).

With the increasing emphasis on efficacy research, there is yet another purpose for therapists using standardized tests. Experts in pediatric rehabilitation and in early childhood special education recommend the use of standardized tools in researching efficacy in rehabilitation and intervention programs (Haley et al., 1993; Mott et al., 1986). The use of appropriate outcome measures is critical in justifying intervention services and in documenting program effectiveness.

Significance of the Problem

When Public Law 94-142 was amended in 1986 (and became PL 99-457), preschoolers became eligible to receive special education and related services. Similar to rules established in other states, the Ohio Department of Education requires standardized test scores for determining eligibility for preschool services. In order to qualify for occupational therapy or other special education services, a child must receive at least one score that is two standard deviations below the mean score of the normative sample on a standardized test. In the fine motor domain, the Battelle Developmental Inventory (BDI) and the Peabody Developmental Motor Scales (PDMS) are probably the most frequently used assessment tools for determining eligibility for special education preschool and related services in Ohio. Both are widely used across the United States (Benner, 1992; Cook, 1991; Crowe, 1989).

The BDI is a standardized instrument that measures the developmental abilities of child from birth to age eight (Newborg, Stock, Wnek, Guidubaldi, & Svinicki, 1988). It was first published in 1984. The BDI includes five developmental domains: personal-social, adaptive, motor, communication, and cognitive. It was designed to be used by teachers, special educators, speech pathologists, psychologists, adaptive physical education specialists, and educational diagnosticians. The BDI was recommended as one of the most appropriate instruments for assessing outcomes in early childhood special education programs (Mott et al., 1986). It was also selected for use in a major efficacy study by the Early Intervention Research Institute at Utah State University (McLean, McCormick, Bruder, & Burdg, 1987; Sexton, McLean, Boyd, Thompson, & McCormick, 1988).

The PDMS is a standardized test that assesses gross and fine motor abilities of children from birth through 83 months of age (Folio & Fewell, 1983). The authors recommended that the scales be administered by teachers, physical therapists, occupational therapists, physical education teachers, and adaptive physical education teachers. The PDMS was the most widely used pediatric assessment assessment among the school-based occupational therapists surveyed in the northwestern states (Crowe, 1989). It has been used by occupational therapists as a standard for comparison in establishing reliability and validity of newly developed assessment instruments (Case-Smith, 1992; Pollock, Law, & Jones, 1991). The PDMS was also used in studies measuring the effectiveness of intervention programming (Haley, Stephens, & Larsen, 1988; Jenkins, Fewell, & Harris, 1983; Jenkins, Odom, & Speltz, 1989; Jenkins & Sells, 1984).

In reviewing the literature, this researcher found that most of the literature relating to the BDI is found in journals focusing on special education and school psychology, whereas information on the PDMS is most frequently found in the physical and occupational therapy literature. Likewise, in practice, special educators and psychologists tend to use the BDI in evaluating the motor skills of preschoolers while occupational therapists appear to prefer the PDMS.

An issue of concern to occupational therapists is how children's performance on the fine motor subtests of the BDI compares to performance on the fine motor subtests of the PDMS. This issue of concurrent validity is an important consideration for therapists in their selection of an appropriate assessment tool. Chapter II (Review of the Literature) will present information on the concurrent validity of both the BDI and PDMS as reported by the tests' authors and other researchers. While numerous concurrent validity studies have been conducted on both the BDI and PDMS, the correlation of scores between the two assessment instruments has not been reported.

Objectives

The objective of this correlational study is to examine the concurrent validity of the Battelle Developmental Inventory by examining the relationships of scores on the Fine Motor Domain of the BDI and scores on the Fine Motor Scale of the PDMS. The purpose of gaining this information is to contribute to the body of knowledge about both the BDI and PDMS in order to enable occupational therapists and other early childhood special education professionals to make informed choices in choosing appropriate assessment instruments and in interpreting test results.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

A brief discussion of the various purposes for occupational therapists' use of standardized tests was presented in Chapter I. This chapter will provide a review of the current literature on the BDI and the PDMS. An overview of each test will be presented, along with a section on instrument development and studies on the concurrent validity of each instrument. The chapter will also include a discussion of concurrent validity.

Developmental Motor Assessment

Crowe's survey (1989) provided information about which standardized tests were used by school-based occupational therapists for developmental motor assessment. Analysis of the survey data produced a list of fourteen tests that were used frequently or occasionally by nearly half of the 293 respondents, all of whom were employed in northwestern states. Palisano (1993) and Case-Smith (1993) presented information on a variety of standardized motor assessments for infants. Other authors have discussed standardized tests that can be used to assess motor development in children with special needs, ranging from infancy through school-age (Cook, 1991; King-Thomas & Hacker, 1987; Stengel, 1991).

The Bayley Scales of Infant Development, Second Edition (Bayley, 1993) is an example of an instrument that is frequently used by developmental therapists in assessing motor development in infants and toddlers. The Bruininks-Oseretsky Test of Motor Proficiency (Bruininks, 1978) is commonly used with the school-aged population. The PDMS (Folio & Fewell, 1983) and the BDI (Newborg et al., 1988) are used to identify delays in children from birth through early childhood. Both of these instruments are widely used with the preschool population.

Battelle Developmental Inventory

The BDI is a standardized, individually administered assessment instrument that measures the developmental abilities of children from birth to eight years of age (Newborg et al., 1988). The five developmental domains included in the BDI are: personal-social, adaptive, motor, communication, and cognitive. The entire battery consists of 341 items which are divided among the five domains and their subdomains. A shortened version of the BDI, the 96-item

Battelle Developmental Inventory Screening Test (BDIST), is also included in the test kit and can be used to identify developmental skill areas in which a child may benefit from further assessment.

The authors presented the purposes of the BDI in the examiner's manual. First, the BDI may be used to identify delays in any of the developmental domains. Eligibility for special services can be determined by using BDI norms. Second, the BDI can be used to identify relative strengths and weaknesses of typically developing children. Third, use of the BDI in developing and monitoring individual education plans (IEPs) is facilitated by the BDI's behaviorally specified and developmentally sequenced items which cover a comprehensive range of developmental skill areas. Fourth, the authors also intended that the BDI be used to measure the effectiveness of various educational programs on the progress demonstrated by groups of children with developmental delays.

The authors stated that the entire BDI battery may be administered in one to two hours. Because of test organization and the availability of scores for individual subdomains and total domains, the tests can be used to assess specific skill areas independently. Use of a 3-point (0,1,2) scoring system makes it possible to score emerging as well as fully-developed skills. Instructions for modifying standardized administration of test items are included in order to make the test more adaptable for assessment of children with various handicapping conditions. The authors also designed the test to use multiple types of administration procedures (i.e., structured format, observations, and interview) in order to "allow a more complete and ecological evaluation of a child's functional abilities" (Newborg et al., 1988, p. 1).

Standardization

The normative sample for the BDI consisted of 800 children, ages birth through 95 months. Stratified quota sampling procedures were used to select subjects for the normative sample in order to ensure that the sample was representative of the U.S. population. About 50 subjects were included in each age group from 0 to 23 months. Approximately 100 children were included in each age group from 24 months to 95 months. At each age level the sample was stratified by geographical region and subregion, race, and sex. A representative number of children with disabilities was included in the normative sample. Test-site selection controlled for urban/rural distribution and socioeconomic status.

Norms are presented as percentile ranks, which are derived from an individual child's raw score. Percentile ranks can then be converted to z scores, T scores, deviation quotients (DQ), or normalized curve equivalents (NCE). Age equivalent scores may also be derived from the raw scores.

Reliability

The authors reported that test-retest reliability was estimated by retesting 183 children within four weeks of their initial testing. The authors reported that these children were equally distributed across the age groups. Test-retest reliability coefficients are generally .90 or higher.

Interrater reliability was also calculated on a sample of children equally distributed across all age groups. Test administration to a group of 148 children was scored by second raters, and produced interrater reliability coefficients of .95 or higher (Harrington, 1985; McLinden, 1989; Sheehan & Snyder, 1989-1990).

Further research on the reliability of the BDI is reported by McLean, McCormick, Bruder, and Burdg (1987). With a sample of 40 children younger than 30 months with identified disabilities, interrater reliability on the BDI was .93 agreement on all items. Internal consistency for all five domains ranged from .89 to .96. This is in close agreement with the ".90 range and above" reported by Harrington (1985).

Using a sample of 78 children with severe disabilities, Snyder, Lawson, Thompson, Stricklin, and Sexton (1993) also found high internal reliability for subdomain items. They concurred with Sheehan and Snyder (1989-90) who recommended that internal consistency estimates for the BDI should be calculated and presented. This is in contrast to the test authors' opinion that "estimating reliability using internal consistency was deemed inappropriate" based on their assertion that items within domains or subdomains do not all measure the same skill or trait (Newborg et al., 1988, p. 53).

Content and Construct Validity

In the examiner's manual, Newborg et al. indicated that the test development process ensured the content validity of the BDI. Test development process began with collecting over 4000 items from various published and unpublished tests and included verification by content experts.

The authors presented correlations between BDI component scores and results of a factor analysis of pilot data as evidence for the construct validity of the BDI. The generally high, positive intercorrelations between all domain scores, subdomain scores, and total scores for the nonhandicapped norming sample are presented as support for the premise that children who perform well in one domain or subdomain will also perform well in other domains or subdomains ("common rate of development" prediction). The results of a factor analytic study of the pilot data suggested factors, consistent with the five BDI developmental domains, emerge for children between 2 and 5 years of age. Further evidence of construct validity for the BDI is demonstrated by its ability to discriminate between children with and without disabilities; the BDI norming sample had better performance on the BDI than the 160 children with disabilities in the comparison group (Newborg et al., 1988).

Gender and Ethnic Validity

Test authors provided evidence that the BDI is equally valid for both sexes and for Caucasian, African American, and Spanish-origin ethnic groups. Scores did not differ based on these attributes using t-test analysis of the standardization data by age group.

Criterion-Related Validity

Numerous studies have investigated the criterion-related validity of the BDI (Boyd, Welge, Sexton, & Miller, 1989; Feldman, Haley & Coryell, 1990; Guidubaldi & Perry, 1984; Johnson, Cook, & Kullman, 1992; McLean, McCormick & Baird, 1991; McLean, McCormick, Baird & Mayfield, 1987; McLean, McCormick, Bruder, & Burdg, 1987; Mott, 1987; Newborg et al., 1988; Sexton et al., 1988; Smith, Bauer, & Lyon, 1987). A series of studies compared children's test performance on the 10 major BDI component scores and test performance on comparable instruments including: the Vineland Social

Maturity Scale, the Developmental Activities Screening Inventory, the Stanford-Binet Intelligence Scale, the Wechsler Intelligence Scale for Children-Revised, and the Peabody Picture Vocabulary Test (Newborg et al., 1988). With sample sizes for these correlational studies ranging from 10 to 37, the strongest correlations were noted between the BDI total score and the Vineland and Developmental Activities Screening Inventory (.94 and .91 respectively). The authors reported that the pattern of correlations supports the concurrent validity of the BDI. However, the small size and inadequate description of the sample, as well as questionable choice of criterion measures and relatively low correlations between the BDI and standardized intelligence tests, have all been noted by other authors (Molitor & Kramer, 1987; Sheehan & Snyder, 1989-1990; McLinden, 1989).

Guidubaldi and Perry (1984) found positive concurrent and predictive validity between the BDI and a variety of criterion measures. A random sample of 50 children, chosen from 124 children who comprised an entire grade level in a school district, were evaluated during both kindergarten and first grade with a comprehensive battery of assessments. Criterion measures included: the Draw-A-Person and the Peabody Picture Vocabulary Test for cognitive measures; the Kohn Social Competence Scale and the Sells and Roff Scale of Peer Relations for personal-social measures; the Bender Visual-Motor Gestalt Test and the visual subtest of the Metropolitan

Readiness Test for perceptual-motor measures; the vocabulary items of the Stanford-Binet Intelligence Scale and the auditory and language subtests of the Metropolitan Readiness Test for communication measures; the Vineland Social Maturity Scale for an adaptive behavior measure; the reading and mathematics sections of the Wide Range Achievement Test, and the total score from the Metropolitan Readiness Test for academic readiness measures. The authors reported significant relationships between each of the criterion measures and corresponding BDI domain subtests. In addition, they reported that the BDI demonstrated a higher value as a predictor of first grade achievement in reading and mathematics than did other established assessments.

McLean, McCormick, Baird, and Mayfield (1987) investigated the concurrent validity of the BDIST with a sample of 65 children, 30 of whom had identified disabilities, between the ages of 7 months and 72 months. The Denver Developmental Screening Test-Revised (DDST-R) was selected as the comparison measure. Children who scored in the failed or questionable ranges on the BDIST were later administered the full BDI components. Results indicated that the BDIST overidentified subjects as needing follow-up testing, whereas the DDST-R underidentified children in need of follow-up testing. The authors recommend caution when interpreting BDIST results.

Smith et al. (1987) presented results of a study that compared scores from the BDI Cognitive Domain, the Kaufman Assessment Battery for Children, and the Stanford-Binet: Fourth Edition, all of which were administered to a sample of 30 children aged 3 years, 11 months to 6 years, 2 months. They found strong correlations among the global scales of the three instruments with less consistency across instruments noted for the subscales. The authors concluded that their results support the validity of all three measures with preschoolers.

Mott (1987) examined the concurrent validity of the Communication Domain of the BDI for children with speech and language disorders. Criterion measures included three tests that are commonly used to assess the speech and language function of young children: the Peabody Picture Vocabulary Test-Revised, the Preschool Language Scale-Revised, and the Arizona Articulation Proficiency Scale-Revised. Using a sample of 20 children identified as having speech/language disorders and ranging in age from 35 to 60 months, researchers administered all three of the language measures as well as the entire BDI battery to each child. The resulting correlations support the validity of the total communication domain as well as the expressive communication subdomain of the BDI for speech/language disordered children. The BDI receptive communication subdomain did not correlate with the other language measures. The author suggested that the BDI may be useful in assessing preschool speech and language disordered children and that it offers the advantage of providing a basis for comparing a child's speech/language function to his/her developmental level in other skill areas.

McLean, McCormick, Bruder, and Burdg (1987) investigated the concurrent validity of the BDI with a sample of 40 children with identified disabilities from birth to 30 months of age. Each child was administered the BDI, the Vineland Adaptive Behavior Scales: Survey Form Edition, and the Bayley Scales of Infant Development (BSID). The concurrent validity of the BDI in the cognitive and motor areas is supported by very strong correlations obtained between the BDI Cognitive Domain and the BSID Mental Development Index (MDI) and between the BDI Motor Domain and the BSID Psychomotor Index (PDI). Correlations between the BDI and the Vineland were also high, ranging from .72 to .95, with the highest correlation noted between the BDI Motor Domain and the Vineland Motor Subdomain.

Boyd et al. (1989) also examined the concurrent validity of the BDI by correlating BDI scores with performance on the BSID. Their research sample consisted of 30 children with known or suspected disabilities whose ages ranged from birth through thirty months. High correlations between the BDI Motor Domain and the BSID PDI (.95) and between the BDI Cognitive Domain and the BSID MDI (.89) support the concurrent validity of the BDI in the cognitive and motor areas. The BDI total score also correlated strongly with both the BSID MDI

(.91) and the BSID PDI (.88).

Sexton et al. (1988) pooled the data obtained in the two studies described above (McLean, McCormick, Bruder, & Burdg, 1987; Boyd et al., 1989) in order to improve the representativeness of the sample and thus broaden the generalizability of the results. The resulting combined sample included seventy infants, ranging from two weeks to thirty months of age, with known or suspected disabilities. Multivariate statistical analyses of the pooled data were employed in order to more fully and sensitively demonstrate relationships among test scores. The authors reported that results of their study "convincingly support the validity of the BDI" (p. 22).

Johnson et al. (1992) also compared the concurrent validity of the BDI with the Vineland Scales of Adaptive Behavior-Interview Form (VSAB) and the BSID with a sample of 67 children, ages 2 months to 60 months, all of whom exhibited identifiable motor delays. The majority of the correlations fell in the moderate range. The correlation between the Vineland Motor Domain and the BDI Motor Domain was .66 (n=52). The correlation between the BSID PDI and the BDI Motor Domain was .76 (n=48). While the authors reported correlations consistently lower than those reported in other studies, they explained that children with identified motor delays may score lower in other developmental domains due to the influence of impaired motor proficiency on performance in other domains.

Also, correlations may have been depressed due to lower scores received by children in this study, compared to children's scores in the similar study by McLean, McCormick, Bruder, and Burdg (1987).

The BDI has also been used as a criterion in measuring the concurrent validity of other developmental instruments. Feldman et al. (1990) examined the validity of the pilot version of the Pediatric Evaluation of Disability Inventory (PEDI) using the BDIST as the comparison measure. The sample included 20 children between the ages of 2 and 8 years with arthritic conditions and spina bifida and 20 nondisabled children matched for age and sex. The concurrent validity of the PEDI was supported with moderately high correlations of PEDI scores with BDIST scores. Another study, by McLean et al. (1991), compared results of the Griffiths' Mental Development Scales with the BSID and the BDI with a sample of 30 children between 3 weeks and 22 months of age with identified or suspected disabilities. A high correlation (.97) was found between the Griffiths' Locomotor Scale and the BDI Motor Domain.

In conclusion, numerous researchers have examined the correlation between children's performance on the BDI and performance on other developmental assessment instruments. These other instruments have included cognitive measures, speech-language measures, adaptive behavior measures, and motor development measures. Investigation of the correlation between performance on the BDI Motor Domain and performance on other measures of motor development has been limited to studies of infants and toddlers and studies using an interview tool for assessing motor development. A review of the literature reveals a lack of research on the concurrent validity of the BDI Motor Domain for children of preschool age.

Peabody Developmental Motor Scales

The PDMS is a standardized individually administered test that assesses both gross and fine motor abilities of children from birth through 83 months of age (Folio & Fewell, 1983). The two components of the test, the Gross Motor Scale and the Fine Motor Scale, are further divided into skill categories as follows: Gross Motor -- Reflexes, Balance, Non-locomotor, Locomotor, and Receipt and Propulsion of Objects; and Fine Motor -- Grasping, Hand Use, Eye-Hand Coordination, and Manual Dexterity. The entire instrument consists of 182 items which are divided among the components and skill categories according to age levels. The test kit also includes a set of activity cards which provide instructions for developing skills assessed by the PDMS.

The PDMS manual identifies the following purposes of the scales. The scales can identify children with delays in gross and fine motor skills and allow for comparison of abilities both within and between motor areas assessed (Folio & Fewell, 1983). The scales allow the examiner to identify motor skills to be targeted on an IEP and to measure performance across time in response to specific intervention (Folio & Fewell). The combined use of the scales and activity cards links assessment with programming in determining motor objectives for an IEP and in identifying effective strategies to promote development in targeted areas.

The manual reports that each scale can be administered in 20 to 30 minutes, with 40 to 60 minutes required for both scales. Valid use of the test includes administering and scoring only one area of motor competency (gross or fine). The use of a 3-point (0,1,2) scoring system allows examiners to identify emerging skills and to measure change in children with slowly progressing skills.

<u>Standardization</u>

The normative sample for the PDMS consisted of 617 children, ages birth through 83 months. Stratified quota sampling procedures were used to select a sample representative of the U. S. population. About 30 subjects were included in each age group from 0 to 23 months. Approximately 50 children were included in each age group from 24 to 83 months, with 25 children in both the 48-53 month and the 54-59 month ranges. The sample was stratified by geographical region, and for age and sex. Racial distribution was also stratified to represent the U.S. population. Communities selected for test-sites were chosen to reflect rural-urban characteristics and to represent a range of socioeconomic levels, although the majority of children were of middle socioeconomic status.

Norms are presented as percentile ranks, which are derived from the raw scores achieved by the children. Percentile ranks can be converted to T scores, z scores, and developmental motor quotients (DMQ). Age equivalent scores and scaled scores (recommended for describing performance and measuring progress in more involved children) can also be derived from the raw scores.

Reliability

Folio and Fewell (1983) reported that test-retest reliability was determined by retesting 38 children from the norming sample within one week of their initial testing. The authors reported that these children were approximately equally distributed across all ages. Test-retest reliability coefficients were .95 for the Gross Motor Scale and .80 for the Fine Motor Scale.

Interrater reliability was established with one examiner administering the scales to 36 children, approximately equally distributed across all ages, while a second examiner also scored the child's responses (Folio & Fewell, 1983). Interrater reliability was .97 for the Gross Motor Scale and .94 for the Fine Motor Scale.

Further research on the interrater reliability of the Fine Motor Scale of the PDMS is reported by Stokes, Deitz, and Crowe (1990). Their sample consisted of 32 four-and five-year old children, half of whom had identified delays and half of whom were considered typically developing. The resulting interrater reliability coefficient was .97 for children with delays and .77 for children without delays. The authors concluded that the interrater reliability of the PDMS Fine Motor Scale appeared adequate for determining eligibility for special education services.

Content and Construct Validity

In the examiner's manual, Folio and Fewell (1983) stated that "the content validity of the PDMS is based on established research into normal children's motor development and on other validated motor development tests" (p. 11). Content validity is also supported by comparing PDMS skill categories with Harrow's definitions and classifications of psychomotor skills. Data supporting the motor development theory are provided as evidence for construct validity of the PDMS. In accordance with motor development theory, skill scores on both the Gross Motor Scale and Fine Motor Scale improve with increasing age. Further evidence of construct validity of the PDMS was demonstrated by its ability to identify motor delays in children; the PDMS norming sample performed better on the scales than 104 children identified with developmental delay or motor development problems. Another analysis of the normative data provided additional support for construct validity of the PDMS. The generally high correlations between total scores and individual skill scores indicate that performance in each skill area is strongly related in children who are typically developing.

Gender and Ethnic Validity

The original standardization sample was used to analyze differences due to ethnic origin and sex. No differences existed between African American and Hispanic ethnic groups and the total norming sample for each age group. In addition, no difference was found when performance was examined by sex at any age level (Folio & Fewell, 1983).

Criterion Related Validity

In the manual, Folio and Fewell presented data correlating performance on the PDMS Gross Motor Scale and Fine Motor Scale with both the BSID and the West Haverstraw Test, a motor development test with strong conceptual similarities to the PDMS. The strongest correlations were between the PDMS Fine Motor Scale and the BSID Mental Scales (.78) and between the PDMS Fine Motor Scales and the West Haverstraw Fine Motor Test (.62). A moderate correlation was found between the PDMS Gross Motor Scale and the West Haverstraw Gross Motor Test (.55).

Palisano (1986) examined concurrent and predictive validity of the BSID Motor Scale and the PDMS with a sample of 23 full-term and 21 healthy premature infants who were administered both tests at 12, 15, and 18 months of age. Results of the study indicated that, for both groups, correlations between the BSID PDI and the PDMS Gross Motor Developmental Motor Quotient (DMQ) ranged from .78 to .96, while the correlation between the BSID PDI and the PDMS Fine Motor DMQ ranged from .20 to .57. Palisano also reported limited ability to predict 18-month BSID PDI and PDMS Gross Motor and Fine Motor scores from 12-month and 15-month scores, with the exception of fair to good predictive ability (.77) with 12-month and 15-month PDMS Fine Motor scores from the premature group.

Harris, Stewart, Berkey, Fewell, and Jenkins (1984) conducted a study to examine the relationship between the gross motor portion of the 1974 version of the PDMS, the Assessment of Sensorimotor Integration in Preschool Children, and the Tactile Sensitivity Checklist. Their sample consisted of 61 preschoolers, ages 3 through 5 years, 12 of whom were typically developing and 49 of whom had been identified with developmental delays. A moderately strong correlation was found between the PDMS Gross Motor score and the Assessment of Sensorimotor Integration in Preschool Children ($r=.59$).

Provost et al. (1988) investigated the relationship between scores on the PDMS and the Miller Assessment for Preschoolers (MAP) (Miller, 1982). The sample for this study consisted of 110 preschoolers, with ages ranging from 34 through 68 months, who were referred for diagnostic evaluations. The correlations between the PDMS Fine Motor and Gross Motor scores and the MAP Total score and MAP Foundation and Coordination indices were weak to moderate, suggesting that "the tests measure different aspects of sensorimotor functioning and that both tests should be used when assessing preschool children in order to identify all types of sensorimotor delays" (p. 50).

In conclusion, it is important to emphasize that the PDMS is well-recognized among occupational therapists and physical therapists for use in developmental motor assessment. The PDMS was the most commonly used test in Crowe's survey of school-based occupational therapists in the northwestern states (1989). Palisano states that among currently available developmental assessments it "provides the most in-depth assessment of motor development" (1993, p. 198). The PDMS is also presented in a number of pediatric occupational and physical therapy texts (Case-Smith, 1993; Cook, 1991; King-

Thomas & Hacker, 1987; Palisano, 1993; Stengel, 1991). Its usefulness to clinicians who assess motor development is further demonstrated by the previously mentioned research which has used the PDMS as a criterion measure in the development of new assessment instruments.

Concurrent Validity

As users of a variety of assessment instruments, occupational therapists are responsible for choosing the most appropriate assessment tool to meet the needs of a given situation. Knowledge of the psychometric qualities of a particular test is important for determining the usefulness of the test as well as for correct interpretation of test results (Rogers, 1987). One psychometric property of tests is validity. "Validity is the most important idea to consider when preparing or selecting an instrument for use" (Fraenkel & Wallen, 1990, p. 127). Validity is a concept, inferred from both research and judgement, that refers to the extent to which an instrument measures what it is supposed to measure (Dunn, 1989; Rogers, 1987; Salvia & Ysseldyke, 1991). The validity of a test "refers to the appropriateness, meaningfulness, and usefulness of the specific inferences made from test scores" (American Psychological Association, 1985, p. 9). Validity is an important consideration for developmental therapists who use assessment instruments for the purposes mentioned in Chapter I. "Evidence of validity is essential for determining the usefulness of a test for a particular situation" (Dunn, 1989, p. 150). Dunn (1989) further states that

> "validity is initially investigated as an instrument is being developed, and is confirmed through subsequent use. The process is a continuous one which consists of replication and cross-validation. It is accumulated knowledge that cannot be obtained from one study" (p. 167).

Three types of validity are considered in test development. Construct validity, the most abstract type of validity, refers to the extent to which a test measures a theoretical construct, trait, or characteristic (Anastasi, 1988). Content validity refers to the degree to which the test content reflects representative sampling of the behaviors it is intended to measure (Anastasi, 1988). Criterion-related validity refers to the relationship between performance on a particular instrument and performance on a criterion measure (Anastasi, 1988). Two types of criterion-related validity have been described in the literature: predictive and concurrent. Predictive criterion-related validity provides prediction of an individual's future score on a criterion measure while concurrent criterion-related validity involves the ability of a score to accurately estimate a person's current performance on a criterion measure (Fraenkel & Wallen, 1990; Rogers, 1987; Salvia & Ysseldyke, 1991).

Evidence of concurrent validity for an assessment tool answers the question: "Does knowledge of a person's test score allow the accurate estimation of that person's performance on a criterion measure?" (Salvia & Ysseldyke, 1991, p. 150). Selection of the criterion measure requires caution: it must be a valid measure itself in order to be useful in establishing the validity of another instrument (Fraenkel & Wallen, 1990; Rogers, 1987; Salvia & Ysseldyke, 1991). Test researchers measure concurrent validity by correlating scores on two or more measures given to subjects at approximately the same time, or after a stated interval (Anastasi, 1988; Dunn, 1989; Fraenkel & Wallen, 1990).

According to Anastasi (1988), concurrent validation is particularly relevant for tests used for diagnostic assessment, as opposed to tests used for predicting future status. It is also relevant to employ concurrent validation if a particular instrument may serve as a "simpler, quicker, or less expensive substitute" for the criterion measure (Anastasi, 1988, p. 146).

Summary

Both the BDI and the PDMS are popular assessment instruments among professionals serving preschoolers with special needs. The BDI has been received with enthusiasm by the special education community due to its adequate psychometric properties, its multifactored assessment capabilities, its adaptations for children with disabilities, and its usefulness in making eligibility decisions and in program planning (Mott, 1987; Mott et al., 1986). Motor development experts who assess motor development skills (i.e., occupational and physical therapists) tend to use the PDMS (Case-Smith, 1993; Cook, 1991; King-Thomas & Hacker, 1987; Palisano, 1993; Stengel, 1991). Test developers of each instrument have completed the norming/standardization process. Numerous studies have investigated the reliability and validity of both the BDI and the PDMS. However, there is a lack of published research on the fine motor sections of each test. The practical value of the PDMS to occupational therapists and physical therapists supports its use as a criterion measure in a study of the concurrent validity of the BDI Fine Motor Domain.

CHAPTER III

METHODOLOGY

Introduction

This chapter describes the research design and methodology. The research questions are presented. Sample selection, data collection, and data analysis are also described.

Research Design

This research is a correlational design. This study investigated the relationships between scores on the BDI Fine Motor Domain and scores on the PDMS Fine Motor Scale in children three through five years of age, with and without identified fine motor delays.

Research Questions

The following questions were investigated in this study using the combined sample of children with and without identified fine motor delays:

1) Are scores on the BDI Fine Motor Domain related to scores on the PDMS Fine Motor Scale?

2) Are scores on the Perceptual Motor Subdomain of the BDI Fine Motor Domain related to scores on the Eye-Hand Coordination Subtest of the PDMS Fine Motor Scale?

3) Are scores on the Fine Muscle Subdomain of the BDI Fine Motor Domain related to scores on the Manual Dexterity Subtest of the PDMS Fine Motor Scale?

4) Based on composite scores, do the two fine motor tests categorize the same children as eligible for services according to the rules of the Ohio Department of Education?

Sample

The sample consisted of forty children from three through five years of age. Twenty of the subjects were typically developing children who did not receive occupational therapy services. The criteria for this subsample were no significant medical history (eg, major trauma or illness that could affect motor development), no history of previous occupational or physical therapy, no visual nor hearing impairment, and report of the parent that the child had typical motor development or achieved motor skills on time. Twenty of the subjects had fine motor delays previously documented by various professionals who assess the developmental status of preschoolers. These subjects were all eligible for occupational therapy services through special education preschool programs. The criteria for this subsample were that each subject had fine motor delays as defined by a score of at least two standard deviations below the mean on a standardized fine motor assessment, or by a score of at least 1.5 standard deviations below the mean if there was a documented delay in another developmental domain. Exclusion criteria included diagnoses of visual or hearing impairment, muscular dystrophy, autism, upper extremity contractures, and deformities of arms and/or fingers. The subjects had not been tested using the BDI Fine Motor Domain nor the PDMS Fine Motor Scale in the six months previous to their participation in this study. The subjects were chosen from the preschool sample available to the researcher; it is a convenience sample.

Approval was obtained from the Biomedical Sciences Human Subjects Review Committee at the Ohio State University prior to data collection for this study (Appendix A). Verbal permission to contact kindergarten and preschool teachers and parents of potential subjects was obtained from one elementary school administrator and three administrators of special education preschool programs in Mansfield, Ohio. Acquaintances of the researcher who were parents of typically developing preschoolers were also requested to allow their children to participate in this study. Informed written consent and a child information form were obtained from a parent of each subject participating in this study (Appendix

B).

Instrumentation

Instruments used for this study were the BDI Fine Motor Domain and the PDMS Fine Motor Scales. An overview of each test was presented in Chapter II, including information regarding standardization, reliability, and validity of each instrument.

The BDI Fine Motor Domain consists of two subdomains: Fine Muscle and Perceptual Motor. Items included in the Fine Muscle Subdomain involve both unilateral and bilateral hand use in activities such as turning a knob to open a door, stringing beads, cutting and folding paper, turning pages of a book, using a key to open a padlock, and tying a knot with string. Items included in the Perceptual Motor Subdomain involve visual-motor skills such as cutting on a line, copying lines and shapes, and copying numbers and letters.

The PDMS Fine Motor Scale consists of four subtests: Grasping, Hand Use, Eye-Hand Coordination, and Manual Dexterity. Items included in the Grasping and Hand Use Subtests involve use of maturing prehension patterns in grasping and manipulating various objects such as large beads, a marker, and a small cap on a bottle. Most items in these subtest categories are included at the infant and toddler developmental levels and, as individual subtests, do not correspond to similar subdomains on the BDI. Scores on these subtests were not examined in this study. The PDMS Eye-Hand Coordination Subtest contains visual-motor items which closely resemble items on the BDI Perceptual Motor Subdomain such as cutting on a line, cutting out simple shapes, and copying lines, shapes and letters. The PDMS Eye-Hand Coordination Subtest also includes imitating patterns with wooden cubes. Items included on the PDMS Manual Dexterity Subtest are similar to those on the BDI Fine Muscle Subdomain and involve the use of one or both hands in various manipulative activities such as stringing beads, turning a key on a wind up toy, lacing a shoe, buttoning and unbuttoning, and timed grasp/release of small objects.

Both tests provide specific instructions for administering each item. For both instruments, some items are demonstrated and some are presented with verbal instruction only.

Each test manual also presents recommended sequences of item presentation. In the BDI, test items are grouped according to subdomains and listed by age level within each subdomain. The authors recommend that the subdomains be administered in the order in which they are listed in the protocol and that items at each age level should be administered in consecutive order within each subdomain (Newborg et al., 1988). In the PDMS scoring booklet, items are grouped by age level, not by subtest. According to test administration procedures presented in the manual, all items at one age level must be administered before administering any items at the next age level (Folio & Fewell, 1983). Within each age level, it is not necessary to administer test items in any particular order.

Data Collection

Data collection took place between November 1994 and February 1995. The entire sample of 40 preschoolers were tested individually by this researcher during one 30-40 minute session. The researcher is a pediatric occupational therapist who routinely evaluated the motor skills of young children in thirteen years of experience in working with preschool children. The researcher had also previously participated in data collection for research of another preschool instrument. In order to evaluate consistency and reliability of testing procedures, two experienced pediatric occupational therapists observed the researcher on two different occasions and then completed a procedural reliability checklist. One therapist observed as the researcher administered the tests to the fourth subject, who was a typically developing five year old. The other observed test administration with another five year old who had identified fine motor delays. Responses on the procedural reliability checklist indicated that the researcher effectively administered the fine motor tests according to generally accepted protocol for testing preschoolers and according to the standardized procedures recommended in each test manual. The completed procedural reliability checklists are included in Appendix C.

The twenty subjects with identified fine motor delays were all tested while they were at preschool. Twelve of the typically identified children were also tested while they were at preschool and three of them were tested while at kindergarten. These subjects were all tested in a separate room, free of distractions commonly found in a preschool or kindergarten classroom. These thirty-five children who were tested in their school environments were all seated in child-sized chairs at a child-sized table during test administration. Five of the typically developing children were tested in homes, either their own homes or the researcher's home. They were tested in quiet areas, either while sitting in child-sized chairs at a low table or while seated in a comfortable position at their own kitchen table.

The test items were presented according to the instructions in each manual and scored according to criteria presented in each manual. Because criteria for an item score of 1 on the PDMS Fine Motor Scale are not clearly delineated in the test manual, a scoring protocol was developed to provide consistency in scoring PDMS items for this study (Appendix D). Scores and identifying data for each subject were recorded on data sheets (Appendix E).

Materials for test items were presented one at a time to each subject. Materials not in use were kept within easy reach to the researcher's right side. Subjects sat to the researcher's left side. Each subject was administered both instruments in a single 30-40 minute session. Half of the subjects in each subsample were first administered the BDI, followed by the PDMS. The other half of the subjects were administered the tests in reverse order.

Data Analysis

T-tests were used to determine if the order of administration of the test instruments had a significant influence on test scores. In order to determine the relationships between composite scores and subtest scores on the two fine motor instruments, Pearson product moment correlations were computed between raw scores. To control the effect of age, partial Pearson product moment correlations were calculated using raw scores. McNemar's chi square analyses were used to determine if there was a significant difference in the number of subjects categorized by each test as eligible for special education preschool services.

CHAPTER IV

RESULTS

Introduction

This chapter presents the results derived from data collection and analysis. The first section presents data describing the research sample. Next, the effect of the sequence of test administration on final test scores is presented. The following sections present data describing the relationships between scores on the two fine motor tests and selected subtests. A comparison of the number of subjects identified by each test as eligible for special education preschool services is also included in this chapter.

Description of the Sample

The subjects were 40 children, ages three through five years, from Mansfield, Ohio. Twenty subjects had been previously identified as having fine motor delays. These subjects were enrolled in special education preschools in the Mansfield City School District, the Richland County Cooperative Preschool, and the Madison Local School District.

Besides the documented fine motor delays, additional diagnoses were reported by these subjects' parents when they completed the child information sheet (Appendix B). Four children were reported to have the following diagnoses: failure to thrive, cerebral palsy (left hemiparesis), neurofibromatosis and attention deficit hyperactivity disorder (ADHD), and sensory integration disorder and ADHD. Two subjects had histories of intrauterine exposure to cocaine and alcohol; one of these had seizures at birth. Both children with diagnoses of ADHD were receiving medication (one on Ritalin, one on both Ritalin and Clonodine) at the time of the study. Although an initial attempt was made to exclude children on medication from the sample, these children were included when it was decided that the medication would probably equally affect their performance on both tests as both tests were administered during the same session. Twenty subjects were considered to have typically developing motor skills according to parent report or according to parent and teacher report. Nineteen of the typically developing subjects attended various local preschools and kindergartens in the Mansfield area. One four year-old boy from this group was not yet enrolled in a preschool program. Table 1 provides descriptive data of the subjects in this study.

Table 1

Descriptive Data of the Subjects

	Total Sample (n=40)	Typically Developing (n=20)	Identified Fine Motor Delays (n=20)
Female	20	13	7
Male	20	7	13
Age range (months)	36-70	36-70	39-70
Mean Age (months)	56	57	56

Sequence of Test Administration

Half of the subjects were first administered the BDI, followed by the PDMS. The other half of the subjects were administered the tests in reverse order. T-tests were used to determine if the order of test administration had a significant influence on test scores. None of the t-values were significant at the p = .05 level. Therefore, it is reasonable to assume that there was no difference in scores based on the sequence of test administration.

Correlations Between Test Scores

In order to determine the relationships between composite scores and subtest scores of the BDI Fine Motor Domain and the PDMS Fine Motor Scale, Pearson product moment correlations were computed between raw scores. Percentile scores, z-scores, and DMQ scores were not used since 22 (55%) of the subjects of the combined sample (n=40) scored below the second percentile. Recognizing that raw test scores were likely to be highly related to age, partial Pearson product moment correlations that accounted for the effect of age were calculated. Table 2 presents correlation coefficients and partial correlation coefficients between composite scores and subtest scores for the combined sample. The range of z-scores, means, and standard deviations for the BDI, PDMS, and subtests are presented in Appendix F.

Table 2

Correlations Between Fine Motor Scores on PDMS and BDI (n=40)

Tests or subsections	Pearson r Correlation Coefficient	Partial Pearson (controlling for age)
Composite PDMS/ Composite BDI	.93*	.91**
PDMS Eye-Hand Coordination/ BDI Perceptual Motor	.91*	.88**
PDMS Manual Dexterity/ BDI Fine Muscle	.81*	.77**

*p=.01. **p=.000.

Identification as Eligible for Services

According to standards specified by the Ohio Department of Education, standardized test scores are used to determine eligibility for special education preschool services (Ohio Revised Code 3301-31, 1991). Determination of a delay must be documented by a score at least two standard deviations below the mean (-2.0 SD) in one developmental domain, or by a score at least 1.5 standard deviations below the mean (-1.5 SD) in two or more domains. Tables 3 and 4 present the number of subjects in the total sample who were identified as eligible for special education preschool services by scores of -1.5 SD and -2.0 SD on each test. The subjects who were scored as eligible for services on one instrument were not all identified as eligible for services on the other instrument. McNemar's chi square analyses were used to determine if there was a significant difference in the number of subjects categorized by each tests as eligible for special education preschool services. Results indicated a tendency for more individuals to be determined eligible for services by PDMS scores than by BDI at both -2.0 SD and -1.5 SD criterion levels. Results approached statistical significance at both criterion levels.

At the -1.5 SD criterion level, 28 children were categorized as eligible for services by either or both tests; scores on the PDMS Fine Motor Scale identified 23 children as qualifying for services, while 15 children were eligible according to BDI Fine Motor Domain scores. At this criterion level, 25 children did not qualify for special education preschool according to scores on the BDI Fine Motor Domain and 17 did not qualify with PDMS Fine Motor Scale scores. Of the 22 children who were identified as eligible for services at the -2.0 SD criterion level, 19 qualified for special education services on the basis of their scores on the PDMS Fine Motor Scale and 11 were categorized as eligible by the BDI Fine Motor Domain. At this same level, 21 children did not qualify for special education preschool according to scores on the PDMS Fine Motor Scale and 29 did not qualify with BDI Fine Motor Domain scores.

Table 3

Subjects (n=40) Identified as Eligible for Services With z-scores at or Below -1.5 SD

		PDMS composite scores	
		eligible	ineligible
BDI composite scores	eligible	10	5
	ineligible	13	12

McNemar's $\chi^2 = 2.72$ $p = 0.099$

Table 4

Subjects (n=40) Identified as Eligible for Services With z-scores at or Below -2.0 SD

		PDMS composite scores: eligible	PDMS composite scores: ineligible
BDI composite scores	eligible	8	3
	ineligible	11	18

McNemar's $\chi^2 = 3.50$ $p = 0.061$

Summary

Forty preschoolers (twenty with fine motor delays and twenty with typically developing motor skills) were administered two fine motor instruments, the PDMS Fine Motor Scale and the BDI Fine Motor Domain, in order to investigate the relationship between scores on the two instruments. Data analysis indicated that the sequence of test administration did not influence test scores. Partial Pearson product moment correlation coefficients were .91 between composite test scores and .88 and .77 between scores on comparable fine motor subsections. The PDMS Fine Motor Scale categorized more children as eligible for special education preschool services at both the -1.5 SD and -2.0 SD criterion levels.

CHAPTER V

DISCUSSION, RECOMMENDATIONS, AND CONCLUSION

Introduction

This chapter presents a discussion of the results of this research including implications for occupational therapists providing services to preschoolers with special needs. Limitations of the study are listed and recommendations for further research are suggested.

Discussion of Results

Correlations Between Test Scores

With the current widely-established need to document developmental delays with a standardized test score, preschool-based occupational therapists need information regarding how accurately different instruments detect a fine motor delay. The PDMS Fine Motor Scale and the BDI Fine Motor Domain are commonly used among occupational therapists for diagnostic assessment of preschoolers with special needs as well as for determination of eligibility for intervention services. Because of their wide use among professionals serving preschoolers with special needs and because of the similarities in the types of items presented on each test, it could be hypothesized that the instruments measure the same aspects of fine motor functioning and could be used interchangeably in assessing preschoolers with fine motor delays. Knowledge of concurrent validity, or correlation of scores on two or more measures, is important for determining the usefulness of one or both instruments (American Psychological Association, 1985; Dunn, 1989).

This study examined the relationships between scores of two widely used fine motor instruments, the Fine Motor Scale of the PDMS and the Fine Motor Domain of the BDI. Because correlations between raw scores would be inflated (stronger) due to the developmental tendency for raw scores to increase as age increases, partial correlations (controlling for age) may be considered more accurate. Therefore, in discussion of results of this research, partial correlation coefficients (accounting for the effects of age) are used. The strong correlation (.91) between composite raw scores for the combined sample indicated that the tests measure similar aspects of fine motor functioning. This supports the concurrent validity of the PDMS Fine Motor Scale with the BDI Fine Motor Domain.

Previous research has examined the relationships between various measures of motor development and scores on either the

PDMS or the Motor Domain of the BDI (Boyd et al., 1989; Case-Smith, 1992; Folio & Fewell, 1983; Guidubaldi & Perry, 1984; Johnson et al., 1992; McLean et al., 1991; McLean, McCormick, Bruder, & Burdg, 1987; Palisano, 1986; Provost et al., 1988; Newborg et al., 1988; Sexton et al., 1988; Taylor, Richards, & Moody, 1990). Most of the research used scores on the entire PDMS (i.e., including the Gross Motor Scale and the Fine Motor Scale) or on the complete BDI Motor Domain (i.e., including both the Gross Motor Domain and the Fine Motor Domain) in their studies. Seven studies investigated the fine motor section of either test in comparison to another measure of motor development (Case-Smith, 1992; Folio & Fewell, 1983; Guidubaldi & Perry, 1984; McLean et al., 1991; Palisano, 1986; Provost et al., 1988; Taylor et al., 1990). Studies examining the relationship between the fine motor sections of each test have not been published.

In comparing the findings of this study with previously published research cited above, there are several characteristics of this study which should be noted. First, in contrast to the sample of preschoolers in the present study, most of the previous studies used infants and toddlers as the research sample. The BSID were most often used as the criterion measure in these studies. McLean, McCormick, Bruder and Burdg (1987) obtained correlation coefficients of .92 between the scores on the BDI Motor Domain and the BSID PDI and .88 between scores on the BDI Motor Domain and the BSID

MDI with a sample of 40 children from birth to 30 months with identified handicapping conditions. Boyd et al. (1989) found strong correlations between scores on the BDI Motor Domain and the BSID PDI (r=.95) and between scores on the BDI Motor Domain and the BSID MDI (r=.82) with a sample of 30 children from birth to 30 months with known or suspected disabilities. Sexton et al. (1988) pooled the data from the two above-mentioned studies and obtained correlations of .95 between scores on the BDI Motor Domain and the BSID PDI and .90 between the BDI Motor and the BSID MDI. A study by Johnson et al. (1992) demonstrated correlations of .76 between scores on the BDI Motor Domain with each of the BSID indices with a sample of 48 children from two to sixty months, all of whom exhibited motor delays. The BSID have also been used as the criterion measure in studies examining the concurrent validity of the PDMS. Test authors Folio and Fewell (1983) found a weak correlation between the PDMS Fine Motor Scale and the BSID PDI (r=.36; n=43). A moderate correlation was found between the PDMS Fine Motor Scale and the BSID MDI (r=.78; n=42). A description of the sample was not provided. Palisano (1986) obtained weak correlations ranging from .20 to .57 between scores on the PDMS Fine Motor Scale and scores on the BSID PDI with a sample of 23 full term and 21 healthy premature infants who were administered both tests at 12, 15, and 18 months of age.

Two additional researchers used infants and toddlers in the research sample for examining the concurrent validity of newly developed instruments (Case-Smith, 1992; McLean et al., 1991). McLean et al. (1991) used the BDI as the criterion measure and found a strong correlation (r=.88) between the BDI Fine Motor Domain and the Hand/Eye Scale of the Griffiths' Mental Developmental Scales in a sample of 30 children between 3 weeks and 22 months of ages with identified or suspected disabilities. Case-Smith (1992) obtained a fair correlation (r=.67) when using the PDMS Fine Motor Scale as a criterion measure in examining the concurrent validity of the Posture and Fine Motor Assessment of Infants (PFMAI) using a sample of 25 full term infants who ranged in age from two through six months.

Several studies did include preschoolers in the research sample. The sample used by Johnson et al. (1992) included children up to 60 months of age; however, the mean age for children administered the BDI was 19.8 months. Provost et al. (1988) included 110 preschoolers from 34 through 68 months of age in a study investigating the relationship between the PDMS and the Miller Assessment for Preschoolers (MAP). They found a weak correlation (r=.48) between the PDMS Fine Motor Scale and the MAP. In another study, Taylor et al. (1990) used a sample of 80 preschoolers with a mean age of 39 months in examining the concurrent validity of the motor section of the Vineland Adaptive Behavior Scales (VABS) with the PDMS Fine

Motor Scale used as the criterion measure. A moderate correlation (r=.78) was found between subjects' scores on the PDMS Fine Motor Scale and scores derived from their mothers' responses on the VABS, which uses an interview format.

This study also differs from much of the previous related research in its inclusion of typically developing children in the research sample. Although studies by Case-Smith (1992) and Palisano (1986) included subjects with typical development in their research samples, other researchers have selected their samples from children with identified disabilities (Boyd et al., 1989; Johnson et al., 1992; McLean, McCormick, Bruder, & Brudg, 1987; Sexton et al., 1988) or suspected disabilities (McLean et al., 1991; Provost, 1988). Some researchers did not describe their samples (Folio & Fewell, 1988; Taylor et al., 1990). Inclusion of typically developing subjects results in a wider variation among subjects which could result in stronger correlations. Results of the research are generalizable to a broader group.

In summary, the strong correlation between scores obtained by the data analysis in this study lends support to the results reported by related studies cited earlier. In comparison to previous research, the present study differs in its selection of preschoolers for the research sample, in its inclusion of typically developing children in the sample, and in its use of two instruments specifically measuring fine motor skill development. Results of this study offer preliminary evidence for the concurrent validity of the BDI Fine Motor Domain with the PDMS Fine Motor Scale with preschoolers.

Correlations Between Subtest Scores

Correlations between the PDMS Eye-Hand Subtest and the BDI Perceptual Motor Subdomain (.88) as well as correlations between the PDMS Manual Dexterity Subtest and the BDI Fine Muscle Subdomain (.77) are supportive of the concurrent validity of selected subtests/subdomains. The comparison of this combination of subtests and subdomains was investigated because the grouping of similar type test items suggests that the PDMS Eye-Hand Subtest and the BDI Perceptual-Motor Subdomain assess visual-motor skills while the PDMS Manual Dexterity Subtest and the BDI Fine Muscle Subdomain assess manipulative skills. Correlations support the assumption that the paired subtests/subdomains measure similar aspects of fine motor functioning.

While both the PDMS Eye-Hand Coordination Subtest and the BDI Perceptual Motor Subdomain consist of items involving visual-motor skills, it is important to note the differences in the actual items presented on each subtest/subdomain between the 24-month and 84-month developmental levels, the range from which most items were administered in this study. In this range, the BDI Perceptual Motor Subdomain consisted of

13 items, 12 (92%) of which involved the use of a crayon or pencil to copy lines, shapes, numerals, letters, and words, and to draw a person. This subdomain also included one cutting item (8% of total subdomain items). In the same developmental range, the PDMS Eye-Hand Coordination Subtest included 23 items, 10 (43%) of which involved the use of a marker for imitating and copying lines, copying shapes and a word, and for tracing a line, connecting dots, and drawing a person. Four (17%) of the items required the use of scissors to cut paper. Six (26%) of the items required building various structures with one-inch cubes. The PDMS Eye-Hand Coordination Subtest includes a wider variety of tasks in which the eye guides hand movement and appears to be a more comprehensive measure of eye-hand coordination. The strong correlation between the two subsections suggests that despite the difference in number and type of items, these subtests/subdomains are measuring similar aspects of fine motor development.

The grouping of items on the PDMS Manual Dexterity Subtest and the BDI Fine Muscle Subdomain suggest that these subsections assess bilateral hand coordination and precise movement of hands and fingers during the unilateral tasks. Of the 10 items on the BDI Fine Muscle Subdomain, 7 (70%) require the use of both hands together for cutting, stringing beads, tying a knot, folding paper, and using a key with a padlock. Three (30%) items involve unilateral hand use to crumple paper, turn a door knob, and turn pages. The PDMS Manual Dexterity Subtest has a more equal distribution of its items between unilateral and bilateral tasks. Seven (54%) of the items require the use of both hands to string beads, button and unbutton, lace a shoe, unscrew a cap, activate a wind-up toy, and wind string onto a spool. Six (46%) of the items involve unilateral hand use in coloring within lines, and timed grasp/release activities. The correlation between scores on these subsections was not as strong as the correlation between the visual-motor subsections discussed above. The moderate correlation between scores on the PDMS Manual Dexterity Subtest and the BDI Fine Muscle Subdomain indicated that these subsections include items that measure similar, yet somewhat different aspects of manipulative skill development.

Eligibility for Services

Which available standardized evaluation an occupational therapist chooses for assessing a particular preschooler's fine motor skills may affect the child's eligibility for special education preschool services. This is especially true if the instruments measure different aspects of motor development. Therefore it is important to investigate how accurately various standardized evaluation categorize children as eligible for services.

Although NcNemar's chi square analyses indicated a tendency for the PDMS to identify more children as eligible for services, results were not statistically significant. However, the differences in the number of children identified by each test using either criterion is of clinical significance.

A variety of factors may influence the difference in numbers of children identified by each test as eligible for services. These include differences in methods of presentation of items on each test, the effect of cognitive delays on performance of some test items, and the subjective criteria in assigning scores of 1 point.

More children may have been identified as eligible for services by the PDMS Fine Motor Scale due to the different methods of instruction used in presenting items on each test. In the range of items most frequently administered in this study (i.e., 24-month to 84-month), items on both tests generally used either verbal instruction (without demonstration) or demonstration combined with verbal instruction in presenting individual items to the child. Some items on each test are scored by observation only during presentation of another item. Verbal instruction (without demonstration) is required more frequently in administration of items from the PDMS Fine Motor Scale than on items from the BDI Fine Motor Domain. Demonstration combined with verbal instruction is used more frequently on items from the BDI.

Table 5 presents the percentage of items presented by the various methods on each test. Items presented with verbal instruction only could be difficult for children with language delays. In this study, children with language delays may have failed items because of difficulty comprehending instructions and not because of a fine motor delay. In strictly adhering to administration procedures as outlined by test authors, if an item was to be administered by verbal instruction only, the researcher did not elaborate with demonstration even if it seemed that the child did not understand the instructions. Many of the subjects in this research sample had identified language delays which may have contributed to lower scores on the PDMS Fine Motor Scale and therefore increased the frequency with which the PDMS identified subjects as eligible for services.

Table 5

Method of Item Presentation for PDMS and BDI Items From 24-Month Level to 84-Month Level

(Percentage of total fine motor items)

	PDMS	BDI
Observation	5%	4%
Demonstration (with verbal instruction)	26%	39%
Verbal Instruction (without demonstration)	69%	57%

As noted by another researcher, cognitive delays may also contribute to lower scores on the PDMS Fine Motor Scale (Gebhard, 1994). Some items, such as Washing Hands and Turning Knob, are presented without demonstration and may seem out of context when presented among the paper-pencil and manipulative tasks that predominate on both tests. This may have confused children with cognitive and/or perceptual disabilities due to their difficulty generalizing skills (Gebhard, 1994). This could result in failure of items due to difficulties processing test instructions as opposed to delays in fine motor skills.

A third possible reason for increased frequency of lower scores on the PDMS Fine Motor Scale is the subjectivity involved in assigning a score of 1 point. Items on both fine motor instruments are scored on a scale of 0, 1, 2. The authors of the BDI give specific criteria for scoring each item (Newborg et al., 1988). The PDMS manual instructs examiners to score an item as 2 when the child's performance meets specific item criteria and directs examiners to make a judgement about how closely a child's performance resembles that of the item criteria in assigning a score of 1 point (Folio & Fewell, 1983). For this study, the researcher developed criteria for using scores of 1 point for the PDMS Fine Motor Scale in order to insure consistency in scoring the subjects' performance. It is possible that the criteria were too strict in comparison to the criteria used by test researchers during test standardization. This could have affected interrater reliability and could have contributed to more frequent low scores on the PDMS in this study. Similarly, the researcher may have scored some BDI items too leniently. Instructions for items 76 through 78, which were frequently administered in this study, do not provide precise criteria or examples for assigning 1 point in scoring the child's ability to copy words and numbers. It is possible that the researcher was more lenient in scoring subjects' performance on these items, which would contribute to depressed scores on the BDI Fine Motor Domain.

Implications for Practice

Occupational therapists frequently serve as members of assessment teams which function to evaluate the developmental status of preschoolers in order to determine eligibility for special education preschool services. Fine motor delays, like delays in other developmental domains, must often be documented by scores from standardized tests. Information on the relationships between scores on instruments which are designed for similar purposes can assist therapists in choosing which test to use for assessment purposes. Knowledge of the relationships between test scores is also important in interpreting assessment results.

Results of this study strongly support the concurrent validity of the PDMS Fine Motor Scale with the BDI Fine Motor Domain for preschoolers 3 to 5 years of age. The strong correlation between scores obtained in this study suggests that both tests measure similar aspects of fine motor functioning.

This study also demonstrated that children frequently obtain lower standard scores on the PDMS Fine Motor Scale. Subsequently, more children would be identified as eligible for special education preschool services based on PDMS scores than on BDI scores. Had these same 40 preschoolers been referred to a local collaborative preschool assessment team for determination of eligibility for preschool services, in many cases an individual child's eligibility could have been affected by the fine motor instrument he/she was administered.

For the purpose of the following discussion, one can assume that a child (i.e., subject in this study) could be considered eligible for special education preschool services with a qualifying standard score on either or both of the fine motor instruments administered in this study. Without a documented delay in another developmental domain, a child would need a score of -2.0 SD on a fine motor instrument in order to qualify for services on the basis of a fine motor delay (Ohio Revised Code 3301-31, 1991). In this study, at the -2.0 SD criterion level, 22 children were identified by one or both tests. Using BDI Fine Motor Domain scores alone, 50% of the children who would potentially benefit from a special education preschool program would have been determined ineligible for those services. Conversely, if the PDMS Fine Motor Scale was administered, 14% of the 22 children with fine motor delays would not receive services. In the presence of documented delay in another developmental domain, a standard score of -1.5 SD is sufficient to qualify a child as eligible for special education preschool services (Ohio Revised Code 3301-31, 1991). At this level, using findings from this study, 28 children qualified for services using both tests. Administration of the BDI Fine Motor Domain alone would have denied eligibility for 46% of the 28 children, while the PDMS Fine Motor Scale would have denied 18% the possible benefit of an educational program for preschoolers with special needs.

Provost et al. (1988) found similar discrepancies in the use of the PDMS and the Miller Assessment for Preschoolers (MAP) in determining eligibility for preschool services. They concluded that the two instruments measured different aspects of sensorimotor functioning and recommended that both tests be administered to preschoolers to adequately identify a sensorimotor delay.

Based upon the strong correlations obtained between composite test scores and the subtest/subdomain scores in this study, this researcher does not recommend administration of both fine motor instruments to determine a fine motor delay. The reality of clinical practice in special education preschool programs in Ohio is that occupational therapists and other professionals are not given the time necessary to administer both fine motor tests. However, several recommendations may be made concerning an occupational therapist's choice of a fine motor instrument for assessment of preschoolers.

First, it is recommended that the BDI Fine Motor Domain be administered when observations by the occupational therapist and information from the referral source indicate the existence of a significant fine motor delay. Because the BDI Fine Motor Domain has fewer items, the therapist can then quickly obtain the standard score required by state standards. This will allow more time for further informal observation of the child and for interpretation, discussion, and making recommendations to parents and educational personnel.

Secondly, administration of the PDMS Fine Motor Scale is recommended when referral information and/or the therapist's observations suggest that the child's fine motor skills are borderline or only mildly delayed. The greater number and variety of items included on the PDMS Fine Motor Scale will provide the therapist with a wider sample of fine motor skills and will result in a more informed judgement regarding the existence of a fine motor delay.

The use of the BDI Fine Motor Domain and the PDMS Fine Motor Scale in this research revealed several issues which may be of value to occupational therapists who practice in special education preschool programs. The invariant order of item presentation on the BDI Fine Motor Domain may make it difficult to elicit and maintain a child's attention and cooperation. This is especially true of the copying items at the 48- through 83-month developmental levels on the Perceptual Motor Subdomain. The child is given three trials for copying shapes, letters, numerals, and words. The repetition and lack of variety on this series of activities seemed rather demanding of active preschoolers. In addition, the use of verbal instruction alone in administration of test items may depress scores. It is possible for test results to indicate a fine motor delay when in fact the child has the fine motor skills but lacks the language/cognitive skills for processing verbal instructions. This was seen more frequently on the PDMS Fine Motor Scale, especially on Washing Hands, Unbuttoning, Tracing Line, Buttoning, Folding Paper, and Connecting Dots. The use of demonstration on these items provides the therapist with more accurate information regarding a child's fine motor skills. Finally, as suggested by Hinderer et al. (1989), it is advised that occupational therapists who work together in the same facility or in the same locality agree on more clearly defined criteria for assigning scores of 0 and 1 point on PDMS items. Likewise, coming to similar agreement on BDI items is recommended. If all occupational therapists who assess children for preschool special education and related services in a given district or county can establish more standardized procedures for using and assessment tool, there would be more agreement regarding the eligibility status of preschoolers with fine motor delays.

Occupational therapists should exercise caution in documenting fine motor delays with standardized scores alone. Clinical observation and clinical judgement remain important aspects of the functions of occupational therapists in diagnostic and intervention services with preschoolers.

Limitations of the Study

The limitations of this research have been identified as follows:

1) This study was limited to a convenience sample. Results may not be generalizable beyond this population.

2) Due to the inclusion of subjects with cognitive and language delays in this sample, results of this research may not be applicable to preschool populations with different characteristics.

3) The lack of clearly defined criteria for assigning scores of 0 and 1 may have resulted in scoring procedures different than those used in the standardization samples or those used by other researchers and therapists. Replication of this study by another researcher may produce different results.

Recommendations for Further Study

Suggestions for further research include:

1) A replication of this study with a greater number of subjects.

2) A study examining the effects of differences in language skill on fine motor test scores with a sample of preschoolers of comparable motor age with and without language delays.

3) A study examining the relationship between test scores on the Developmental Test of Visual-Motor Integration and one or both of the visual-motor subsections used in this research (i.e., PDMS Eye-Hand Coordination Subtest and/or BDI Perceptual Motor Subdomain).

4) A study examining the predictive validity of the BDI Fine Motor Domain and the PDMS Fine Motor Scale by administering both tests to children with and without identified delays as preschoolers, followed by readministration of both fine motor tests and other established measures of school achievement to the same subjects during kindergarten and first grade.

5) An investigation of the concurrent validity of the PDMS Gross Motor Scale with the BDI Gross Motor Domain.

Conclusion

The objective of this study was to examine the relationships of scores on the Fine Motor Domain and subdomains of the BDI and scores on the Fine Motor Subtest and selected subtests of the PDMS. Strong correlations were obtained between composite test scores of the BDI Fine Motor Domain and the PDMS Fine Motor Scale and between the BDI Perceptual Motor Subdomain and the PDMS Eye-Hand Coordination Subtest. Moderate correlations were obtained between the BDI Fine Muscle Subdomain and the PDMS Manual Dexterity Subtest. The strong correlations offer preliminary evidence of the concurrent validity of the BDI Fine Motor Domain with the PDMS Fine Motor Scale with preschoolers. The PDMS Fine Motor Scale identified more preschoolers as eligible for special education preschool services at both the -2.0 SD and -1.5 SD criterion levels.

APPENDIX A

HUMAN SUBJECTS APPROVAL

BIOMEDICAL SCIENCES
HUMAN SUBJECTS REVIEW COMMITTEE
THE OHIO STATE UNIVERSITY Meeting Date: September 19, 1994

RESEARCH PROTOCOL:

94H0326 CONCURRENT VALIDITY OF THE FIND MOTOR DOMAIN OF THE BATTELLE DEVELOPMENTAL INVENTORY IN PRESCHOOLERS, Jane Case-Smith, Cristine Sutter, Allied Medical Professions

presented for review by the Biomedical Sciences, Human Subjects Review Committee to ensure the proper protection of rights and welfare of the individuals involved with consideration of the methods used to obtain informed consent and the justification of risks in terms of potential benefits to be gained. The Committee action was:

Protocol was unanimously **APPROVED WITH THE FOLLOWING STIPULATION:**

1. Clarify whether children with delays will be tested in the same setting and if so, is there a risk that those who are delayed may be unfairly compared to normals.

2. Clarify how consent will be obtained.

3. Revise the consent form as follows and forward a copy to the Committee:

   a. In the description, include the child's name (e.g., "Administer two fine motor development tests for my child ___child's name___ ________.

Your approval is contingent upon your agreement to comply with the above stipulations. Please SIGN this form in the space(s) provided and RETURN WITH ANY ADDITIONAL INFORMATION REQUESTED TO THE HUMAN SUBJECTS REVIEW DESK, 300 RESEARCH FOUNDATION, 1960 KENNY ROAD, CAMPUS, within one week. Upon such compliance, the approval form will be mailed to you. In the case of a deferred protocol, please submit the requested information at your earliest convenience.

Date 10-9-94 Signature(s) Cristine Sutter

Jane Case-Smith

Principal Investigator(s)

HS-105 (2/91)
Stipulations/Comments

BIOMEDICAL SCIENCES REVIEW COMMITTEE
RESEARCH INVOLVING HUMAN SUBJECTS
THE OHIO STATE UNIVERSITY

_x_ Original Review
__ Continuing Review
__ Five-Year Review
__ Amendment

ACTION OF THE REVIEW COMMITTEE

With regard to the employment of human subjects in the proposed research:

94H0326 CONCURRENT VALIDITY OF THE FIND MOTOR DOMAIN OF THE BATTELLE DEVELOPMENTAL INVENTORY IN PRESCHOOLERS, Jane Case-Smith, Cristine Sutter, Allied Medical Professions

__ APPROVED

__ DISAPPROVED

_x_ APPROVED WITH STIPULATIONS*

__ WAIVER OF WRITTEN CONSENT GRANTED

*Stipulations stated by the Committee have been met by the investigator and, therefore, the protocol is **APPROVED>**

It is the responsibility of the principal investigator to retain a copy of **each** signed consent form for at least three (3) years beyond the termination of the subject's participation in the proposed activity. Should the principal investigator leave the University, signed consent forms are to be transferred to the Human Subjects Committee for the required retention period. This application has been approved for the period of one year. You are reminded that you must promptly report any problems to the Review Committee, and that no procedural changes may be made without prior review and approval. You are also reminded that the identity of the research participants must be kept confidential.

Date: September 19, 1994

Signed ______________________
Chairperson

HS-025H (Rev. 2/94)

APPENDIX B

CONSENT FORM

Dear Parent,

I am an occupational therapist with Mansfield City Schools. In order to complete my masters degree, I am doing a research project that involves gathering children's scores on two different tests of fine motor development. The scores on the two different tests will then be compared. Children will not be compared to each other. Children's names will not be used. Confidentiality will by protected by numbering all data, and the data will be analyzed only as a group.

I would like to spend some time with your child, at his/her preschool or daycare center, in order to administer the tests. Please read over the attached "CONSENT TO INVESTIGATIONAL TREATMENT OR PROCEDURE." There are two copies of this form. If you are willing to have me test your child, please sign on the appropriate line and have a witness sign on the line below. Please return one copy and keep the other for your records.

Also, please fill out the page entitled "CHILD INFORMATION SHEET," and return it with the consent form. I will need this information in order to complete the study of these two fine motor tests.

Thank you for your time and your consideration. If you have any questions, please feel free to contact me at 525-6375.

Sincerely,

Cristine Sutter
Occupational Therapist

THE OHIO STATE UNIVERSITY protocol no.________

CONSENT TO INVESTIGATIONAL TREATMENT OR PROCEDURE

I, ______________________________________, hereby authorize or direct Jane Case-Smith associates or assistants of her choosing, to perform the following treatment or procedure:

Administer two fine motor development tests for my child, (child's name)______________________________. Children will be observed during activities in which they use their hands and fingers. Test items will be scored based on observations.

The experimental (research) portion of the treatment or procedure is:

To compare scores on two different tests of fine motor development.

This is done as part of an investigation entitled:

Concurrent validity of the Fine Motor Domain of the Battelle Developmental Inventory in preschoolers.

1.) Purpose of the procedure or treatment:

To gather children's scores on two different tests of fine motor development.

2.) Possible appropriate alternative procedure or treatment (not to participate in the study is always an option):

None.

3.) Discomforts and risks reasonably to be expected:

None. Most children will think the various test items are "fun." Test items will include paper-pencil tasks and activities requiring the use of hands and fingers. Test items will be presented as "games." Children will be tested in their classroom/preschool/daycare environment, with the permission of their teachers.

4.) Possible benefits for subjects/society:

Benefit for subjects -- knowledge of each subject's fine motor development status may be helpful to parents and/or teachers. Benefit for society -- professionals in the field of early childhood special education will learn more about the two fine motor tests.

5.) Anticipated duration of subject's participation:
Estimated one visit, 45 minutes, per child.

I hereby acknowledge that Cristine Sutter has provided information about the procedure described above, about my rights as a subject, and she has answered all questions to my satisfaction. I understand that I may contact her at 525-6375 should I have additional questions. She has explained the risks described above and I understand them; she has also offered to explain all possible risks or complications.

I understand that, where appropriate, the U.S. Food and Drug Administration may inspect records pertaining to this study. I understand further that records obtained during my participation in this study that may contain my name or other personal identifiers may be made available to the sponsor of this study. Beyond this, I understand that my participation will remain confidential.

I understand that I am free to withdraw my consent and participation in this project an any time after notifying the project director without prejudicing future care. No guarantee has been given to me concerning this treatment or procedure.

I understand that in signing this form, beyond giving consent, I am not waiving any legal rights that I might otherwise have, and I am not releasing the investigator, the sponsor, the institution, or its agents from any legal liability for damages that they might otherwise have.

In the event of injury resulting from participation in this study, I also understand that immediate medical treatment is available at University Hospitals of the Ohio State University and that the costs of such treatment will be at my expense; financial compensation beyond that required by law is not available. Questions about this should be directed to the Office of Research Risks at 292-5958.

I have read and full understand the consent form. I sign it freely and voluntarily. A copy has been given to me.

Date:_________ Time: ________a.m./p.m.

Signed:____
(parent of subject)

Witness:____

I certify that I have personally completed all blanks in this form and explained them to the parent of the subject before requesting the parent to sign it.

Date:__________Signed:____________________________________
(authorized representative of project director)

CHILD INFORMATION SHEET

Name:____

Date of Birth:_________________

Please answer each statement by circling yes or no.

Has your child's motor development been typical, that is: has he/she achieved motor skills on time? yes no

Has your child ever had occupational therapy or physical therapy? yes no

Does your child have a visual impairment? yes no

Does your child have a hearing impairment? yes no

Is your child currently on medication? yes no

If so, what medication?_____________________________________

Does your child have a medical diagnosis? yes no

If so, what diagnosis?_______________________________________

Does your child have a significant medical history, such as surgeries, trauma, hospitalizations, etc.? yes no

If so, please briefly explain medical history:______________

____

____

____

Do you want information on your child's performance on the fine motor tests? yes no

APPENDIX C

PROCEDURAL RELIABILITY CHECKLIST

PROCEDURAL RELIABILITY CHECKLIST

Please circle "yes" or "no" in order to indicate how each statement applies to your observation of the examiner in the testing situation.

Setting:

--has a minimum of auditory and visual distraction

yes no

--has appropriate seating on child-sized chairs placed at child-sized table

yes no

--has adequate lighting and ventilation

yes no

Rapport:

--examiner develops a relaxed, comfortable relationship by communicating in a friendly and responsive manner

yes no

--examiner establishes and maintains eye contact

yes no

--examiner demonatrates interest in child's performance by giving general encouragement and praise for cooperation and effort, not specific responses

yes no

Attention and Motivation:

--administration of items is paced to child's level of interest and motivation

yes no

--examiner recognizes when child is unable to perform a given task according to the criterion and proceeds to next item without delay in order to avoid frustration and discouragement and to maintain child's interest and attention

yes no

Standard Procedures:

--examiner recognizes when child's performance on test item meets the given criteria in for scores of 1 and 2 points

yes no

--examiner adheres to standard procedures regarding verbal instructions, use of demonstrations, and number of trials allowed for test items

(yes) no

Adaptations for Children with Handicapping Conditions:

--if testing a child with a handicapping condition, examiner presents instructions to him/her according to suggested modifications as described by the tests' authors, in a manner that insures the child understands what is expected of him/her without invalidating the test

yes no (not applicable)

Comments: ______________________________

Date: 1/12/94

Signed: [signature], OTR/L

PROCEDURAL RELIABILITY CHECKLIST

Please circle "yes" or "no" in order to indicate how each statement applies to your observation of the examiner in the testing situation.

Setting:

--has a minimum of auditory and visual distraction
yes no

--has appropriate seating on child-sized chairs placed at child-sized table
yes no

--has adequate lighting and ventilation
yes no

Rapport:

--examiner develops a relaxed, comfortable relationship by communicating in a friendly and responsive manner
yes no

--examiner establishes and maintains eye contact
yes no

--examiner demonatrates interest in child's performance by giving general encouragement and praise for cooperation and effort, not specific responses
yes no

Attention and Motivation:

--administration of items is paced to child's level of interest and motivation
yes no

--examiner recognizes when child is unable to perform a given task according to the criterion and proceeds to next item without delay in order to avoid frustration and discouragement and to maintain child's interest and attention
yes no

Standard Procedures:

--examiner recognizes when child's performance on test item meets the given criteria in for scores of 1 and 2 points
yes no

--examiner adheres to standard procedures regarding verbal instructions, use of demonstrations, and number of trials allowed for test items

(yes) no

Adaptations for Children with Handicapping Conditions:

--if testing a child with a handicapping condition, examiner presents instructions to him/her according to suggested modifications as described by the tests' authors, in a manner that insures the child understands what is expected of him/her without invalidating the test

(yes) no not applicable

Comments: The examiner made necessary and appropriate adaptations for a mild left hemiplegic child. Her manner and comments helped the child through tasks which were difficult.

Date: January 27, 1995

Signed: [illegible signature], MA, OTR/L

APPENDIX D

PDMS SCORING CRITERIA

PDMS FINE MOTOR SCALE

Criteria for Scoring Items as 1 Point

24-29 months

71.) Turning Knob
1 = performs after demonstration

72.) Placing Rings
1 = places 5 rings with assistance or places 3 rings independently

73.) Removing Cap
1 = performs after demonstration

74.) Separating Beads
1 = separates 4 beads with assistance or separates 2 beads independently

75.) Imitating Stroke
1 = stroke is within 20 to 45 degrees of horizontal

76.) Building Train
1 = performs after second demonstration

30-35 months

77.) Building Tower
1 = performs on one of three trials

78.) Building Bridge
1 = performs after second demonstration

79.) Copying Circle
1 = draws circular stroke or circular scribble

80.) Washing Hands
1 = performs after demonstration

81.) Unbuttoning Buttons
1 = performs within 90 seconds, or within 75 seconds with demonstration

82.) Cutting Paper
1 = cuts halfway across page

36-41 months

83.) Showing Hand Preference
1 = uses same hand with writing tool on 3 of 5 items

84.) Removing Cap
1 = performs within 30 seconds after demonstration or within 40 seconds independently

85.) Stringing Beads
1 = strings 2 of 5 beads

86.) Winding Toy
1 = turns less than 90 degrees or turns 90 degrees after third demonstration

87.) Cutting Line
1 = cuts within 1/2" on half of line

88.) Copying Cross
1 = performs on one of two trials

42-47 months

89.) Tracing Line
1 = fewer than three deviations from line

90.) Holding Marker
1 = tripod grasp on 2 of 3 items or grasp is near tripod

91.) Copying Cross
1 = performs on one of three trials

92.) Copying Square
1 = performs on one of two trials, or has three closed corners on first trial

93.) Cutting Circle
1 = cuts within 1/4" of line on 1/3 of circle

94.) Lacing Shoe
1 = laces one of three holes

48-59 months

95.) Dropping Pellets
1 = performs within 40 seconds

96.) Buttoning Button
1 = performs within 30 seconds

97.) Building Gate
1 = performs after second demonstration

98.) Folding Paper
1 = performs after demonstration

99.) Cutting Square
1 = cuts within 1/4" of line on half of square

100.) Placing Clips
1 = places 1 of 3 paper clips, or places 2 of 3 after demonstration

60-71 months

101.) Connecting Dots
1 = deviates 3/8" or less

102.) Building Pyramid
1 = performs after second demonstration

103.) Touching Fingers
1 = performs within 10 seconds on first trial, or within 8 seconds on second trial

104.) Winding Spool
1 = performs within 30 seconds

105.) Coloring Within Lines
1 = crosses lines 4 times or less

106.) Placing Pennies
1 = performs within 40 seconds

72-83 months

107.) Copying Word
1 = forms 3 of 4 letters correctly

108.) Drawing Person
1 = at least 6 body parts

109.) Copying Diamond
1 = performs on 1 of 2 trials, or draws with 3 closed corners on first trial

110.) Touching Fingers
1 = performs within 7 seconds on first trial, or within 5 seconds on second trial

111.) Building Steps
1 = performs after second demonstration

112.) Placing Pennies
1 = performs within 30 seconds

APPENDIX E

DATA COLLECTION FORM

female (01)
male (02) ____________

subject # ____________

birthdate ____________ test date ____________

identified fine motor delays (01)
motor skills developing typically (02) ____________

first administered PDMS (01)
BDI (02) ____________

COMPOSITE SCORES

	PDMS	BDI
raw score	____________	____________
percentile	____________	____________
z-score	____________	____________
DMQ	____________	____________

SUBTEST/SUBDOMAIN SCORES

	PDMS: eye-hand coord.	BDI: percpt. mot.
raw score	____________	____________
percentile	____________	____________
z-score	____________	____________
DMQ	____________	____________

	PDMS: man. dext.	BDI: fine muscle
raw score	____________	____________
percentile	____________	____________
z-score	____________	____________
DMQ	____________	____________

ODE Eligibility Criteria yes(01) no(02)

	-1.5	-2.0
BDI: composite	____________	____________
fine muscle	____________	____________
percpt. mot.	____________	____________
PDMS: composite	____________	____________
eye-hand coord.	____________	____________
man. dext.	____________	____________

APPENDIX F

RANGE OF Z-SCORES, MEANS, AND STANDARD DEVIATIONS FOR BDI, PDMS, AND SUBSECTIONS

RANGE OF Z-SCORES, MEANS, AND STANDARD DEVIATIONS

FOR BDI, PDMS, AND SUBSECTIONS

Tests or Subsections	Range	$\overline{X}$	SD
Composite BDI	.71 to -2.33	-1.17	.87
BDI Perceptual Motor	.68 to -2.33	-1.21	.85
BDI Fine Muscle	.64 to -2.33	-.82	.91
Composite PDMS	1.04 to -2.33	-1.47	1.00
PDMS Eye-Hand Coordination	1.18 to -2.33	-1.38	.96
PDMS Manual Dexterity	2.33 to -2.33	-.873	1.08

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