Validity of the Miller Function and Participation Scales

Thesis

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By

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Abstract

This research study investigated the validity of the visual motor portion of the Miller Function and Participation Scales (M-FUN), which was released in 2006. This was accomplished by comparing scores on the Visual Motor portion of the M-FUN with those on the Visual Motor portion of the Developmental Test of Visual Perception, Second Edition (DTVP-2). There were 40 students who participated in the study, between the ages of 4 ½ - 6 ½ years of age. Results indicate that the M-FUN had a high correlation with the DTVP-2 ($r = .872$). The two tests achieved 87.5% agreement in identifying the children with or without a deficit in the area of visual motor function. Therefore, the M-FUN can be considered to be a valid measure of visual motor function. Further research is recommended in validity of the M-FUN in relationships to other evaluation, the impact of verbal function on scores of the M-FUN and how evaluators use the scoring manual and testing results.

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Chapter One

Introduction

Statement of the Problem

The Miller Function & Participation Scales (M-FUN) by Lucy Jane Miller is a new evaluation, introduced in 2006. It is intended for use in the evaluation of children ages 2 years 6 months through 7 years 11 months. The M-FUN is an evaluation of visual, fine, and gross motor integration in children of these ages. The test was designed so that each area of motor function may be tested individually or together as a whole. It was developed to provide data regarding a student's performance in these areas by testing functional situations in the format of fun games (Miller, 2006). The areas tested in the M-FUN are important in a student's ability to function within the school environment. Fine and visual motor ability affects a student's ability to complete handwriting and basic paper and pencil tasks within the classroom (Feder & Majnemer, 2007). The results of norm referenced evaluations such as the M-FUN are used to assist the therapist and a multi-disciplinary team in determining a student's eligibility for specialized services to address identified deficits (Schneck, 2001).

Whenever a new assessment is introduced, it is important to establish validity and reliability of the assessment (Van Den Wymelenberg, Deitz, Wendel, & Kartin, 2006). When the M-FUN was introduced, initial validity and reliability studies had been conducted. Basic test-retest, internal consistency, and inter-rater reliability were established by the authors in a series of studies concurrent with the standardization

process. Also, studies in test content, internal structure, and concurrent and diagnostic validity were completed, establishing the basic reliability and validity of the assessment. As there are changes in social and political contexts, the validity or reliability of an instrument may be affected. Therefore, it is important to continually re-evaluate the reliability and validity of an instrument (Miller, 2006).

Background of the Problem

As students progress to elementary school from a preschool or head start program, they spend a growing portion of the day working on visual motor tasks. In kindergarten, some children will spend nearly two thirds of the day completing fine motor or visual motor tasks. These activities are frequently paper and pencil (Marr, Cemak, Cohn, & Henderson, 2003). When students demonstrate difficulties in these areas, they are referred to occupational therapy for an evaluation. The occupational therapist assesses the student for the need for specialized services to address these deficits (Clark, Polichino, & Jackson, 2004). The students are evaluated through observation, interviews with applicable adults and with a standardized and norm referenced assessment tool. There are several standardized, norm referenced evaluations currently used by school-based occupational therapists. Some of the evaluations used to assess preschool and early elementary school students in the area of visual motor performance include the Peabody Developmental Test of Motor Skills, 2nd Edition, Bruininks-Oseretsky Test of Motor Proficiency, Second Edition, Developmental Test of Visual Perception, 2nd Edition (DTVP-2), and the Preschool Visual Motor Integration Assessment (PVMIA) (Asher, 1996, Melin, 2004).

It is important that the evaluator is comfortable and competent in the

administration of the evaluation tool. It is also important that the evaluation correctly assesses the components it is intended to evaluate (Haertlein, 1992). To ensure that students who need services are correctly identified, and also that typically developing students are not misidentified, the evaluations used need to demonstrate adequate reliability and validity in the area being assessed (Richardson, 2001). Reliability and validity are tested not only during the development of an evaluation, but should continue to be assessed throughout the use of the evaluation (Miller, 2006). Without an appropriate and valid evaluation, children who would benefit from specialized services may not be identified. It is also important that typically developing students are not identified as delayed. If children's delays and needs are correctly identified, then the therapist will have the appropriate data to develop a treatment plan for the student (Feder & Majnemer, 2007).

Research Approach

The M-FUN will be compared to the DTVP-2, as a gold standard measurement, to establish criterion related concurrent validity in the area of visual motor performance. The scores for both of the evaluations will be correlated. In addition, a discrimination analysis will be completed to determine if the M-FUN identifies the same children as typically developing or with possible visual-motor impairments as identified by the DTVP-2.

Significance

Visual motor integration and visual perception are difficult skills to evaluate because they require integration of complex systems such as cognition, sensory, and motor systems that are difficult to define. There are several tests currently available for

therapists to utilize in assessing young children for visual motor deficits. However, these tests are not intended to evaluate older students who have already developed writing skills and pre-writing skills. The M-FUN assesses these same performance areas and adds a unique component assessing handwriting. It also tests the student's abilities during functional tasks which may be more applicable than contrived tasks in older evaluations. The M-FUN also uses a game like format to engage the students in the evaluation and allows for the evaluator to use gestures to help the student understand the subtests (Hammill, Pearson, & Voress, 1993, Miller 2006). This may lead to a more valid evaluation for students who have language processing issues.

The results of this study will demonstrate if the visual motor portion of the M-FUN evaluates the same construct of visual motor integration as the DTVP-2. By further evaluating the validity of the visual motor portions of the M-FUN, occupational therapists can develop more credible treatment plans.

Research Questions

To evaluate concurrent and construct validity of the Miller Function and Participation Scales, the following questions will be answered.

1. Do scores on the visual motor subtest of the Miller Function and Participation Scales correlate with scores on the visual motor portion of the Developmental Test of Perception, 2nd Edition?
2. Do scores on the visual motor subtest of the Miller Function and Participation Scales discriminate the same children with visual motor delays as the visual motor portion of the Developmental Test of Visual Perception, 2nd Edition?

Limitations

The students used in this study will comprise a convenience sample of students within a mid-western urban day care center. This narrow sample pool and the use of a convenience sample may limit the external validity of the results (Ary, Jacobs, Razavieh, & Sorensen, 2006). Only the visual motor integration subtests of the DTVP-2 will be utilized. The DTVP-2 is intended to be used a measure of combined visual motor integration and motor reduced visual perception. While the test provides a raw score for both areas, the published procedures do not condone administering either the visual motor integration subtests or the motor reduced visual perception subtests alone (Hammill, Pearson, & Voress, 1993). As only one evaluator was used, and some portions of test scoring on both the DTVP-2 and the M-FUN are subjective, evaluator bias may limit the results of the study (Anastasi, 1988). Twenty children were included in the study who were known to receive occupational therapy services. This was done to assure a range of typical and developing performance in the area of visual motor integration was included in this study.

Chapter Two

Literature Review

Introduction

In this chapter, a description of the role of occupational therapists in the evaluation process in a school based setting is described. The research regarding the integration of visual motor skills into school tasks and the role of occupational therapy in the school setting is reviewed with an emphasis in the area of visual motor will be reviewed. This will be followed by a thorough review of The Miller Function & Participation Scales (M-FUN) and the Developmental Test of Visual Perception, second edition (DTVP-2) are reviewed. Test development and construct validity are described.

The Role of School Based Occupational Therapy

The majority of a school based occupational therapist's intervention time is spent in a therapy room providing direct service to students after they have been removed from the classroom. Usually a combination of compensatory and remedial techniques is used to address the student's occupational therapy goals during direct service intervention. Occupational Therapists also consult with teachers and other professions regarding the services needed to improve children's ability to learn and function in school. Since goals are developed using formal and informal evaluations of a student, by using evaluations with more classroom based items school based therapists can better develop goals that are relevant to the child's classroom performance even if

intervention does not occur directly in the classroom (Butts, & Nelson, 2002). The Miller Functional Participation Scales was developed to be such a test (Miller, 2006).

Test Development

For purposes of this research project, an assessment is a specific tool used in the process of evaluating a child for occupational therapy services. One purpose of the assessment is to determine how an individual functions in a given task at that given time in relation to others at the same functional age. When publishing a standardized assessment, it is essential to evaluate reliability and validity. In a norm referenced assessment, the results can be compared to others within the same functional age group to determine if the results are above, below, or at average function (Asher, 1996).

Reliability

Reliability is the ability of a test to consistently produce the same results for the same performance. Reliability can be increased by writing precise directions for the testing environment, verbal cues, and evaluator-student interactions. Test-retest reliability is the ability of an evaluation to produce the same results for the same child within a short time frame. The testing conditions of the two tests should be as similar as possible. Internal consistency indicates that the items contained within an evaluation test the same concept. High inter-rater reliability indicates that test results are the same when the test is administered by different people using the same guidelines. This is usually assessed by the same assessment session being observed and scored by at least 2 separate evaluators. As subjectivity in test scoring increases, a decrease in inter-rater reliability is expected (Asher, 1996). Reliability is frequently reported in the form of a

correlation coefficient. The higher the coefficient, the more reliable the evaluation is. When working with people, it is almost impossible to have a perfectly reliable test, so some error is acceptable. A coefficient of above .80 is considered high when testing people (Anastasi, 1988).

Validity

Validity of an evaluation tool is a measurement to determine how well the evaluation tool measures what it reports to measure. There are many different types of validity which are related in different ways. See figure 2-1 for how several types of validity are related. Testing validity is a process which continues throughout the life of the evaluation due to changing social and clinical contexts. It is not a concrete concept, but one which is fluid and requires repeated studying. As the environment around an assessment changes, the validity of the assessment may be affected. Such environmental changes could include new research of societal norms or changes in a society's reaction to situations which may affect testing. To ensure that a test has continued validity, it should be studied periodically in different geographical, cultural, and socioeconomic situations where the test will be or is used (Dunn, 1989). This is why using an assessment in a situation where it was not intended can lead to invalid results. A test has good face validity when an instrument assesses what it purports to be assessing. This is not measured statistically, but by reasoning and logic. Content validity determines that the test provides an adequate picture of the area being assessed. To determine if a test has content validity, a panel of experts in the area reviews the evaluation, comparing it to accepted meaning for the constructs the evaluation purports to assess (Anastasi, 1988).

Figure 2-1 Types of Validity

Construct validity is the extent to which a test evaluates what it purports to evaluate. Constructs are abstract concepts, and are unable to be directly observed. Before evaluating construct validity, the construct needs to be appropriately identified and described (Portney & Watkins, 2000). Construct validity can be assessed by comparing the new evaluation with a more established assessment that purports to assess the same construct. The two tests should have a moderate to high correlation. A high correlation is not expected, as this would indicate needless duplication of testing. To establish construct validity for a test involving children, age ranges are established. Content validity is tested with children only in the established age range to ensure there is not testing error due to normal maturation and skill development of the children (Anastasi, 1988).

Criterion related validity is the most objective and practical method to establishing test validity. Criterion related validity is the ability to predict the results of a test based on the results of another. Criterion validity can be assessed as either concurrent validity or predictive validity. Concurrent validity is established by

correlating scores of an assessment with another assessment which has already been accepted in the area of testing. The known-groups method is a statistical technique used to determine criterion validity of an evaluation. This technique requires the testing of two groups, who have already been identified as having or not having the attribute being tested. The test scores of the two groups are then compared for differences in test results of the new evaluation (Ary, Cheser Jacobs, Razavieh, & Sorensen, 2006; Anastasi, 1988).

Predictive validity refers to the ability of the evaluation to predict what function will be like at a later time. This is established by testing the student at two separate times. The first score is then evaluated to determine if it predicated the level where the student is functioning during the later evaluation. All of these components of validity and reliability are important to address when developing an assessment. As a consumer of evaluations, it is important that therapists know and understand how a test performs in the areas of reliability and validity (Dunn, 1989).

Visual-Motor Integration Assessments

When identifying a student for occupational therapy services, a standardized, valid, and reliable instrument is required as part of an evaluation of a student's total functional performance (Campbell, 1989). Currently there are several evaluation instruments used by occupational therapists to evaluate visual motor integration. The Peabody Developmental Motor Scales Assessment, 2nd Edition (PDMS-2) (Folio & Fewell, 2000), Preschool Visual Motor Integration Assessment (PVMIA) (Beitchman & Puttkammer, 2001), and The Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (BOT-2) (Bruininks & Bruininks, 2005) are some of the assessments currently

used by occupational therapists to identify students with deficits in the area of visual motor integration (Asher, 1996; Melin, 2004; Schneck, 2001). Each adds its own unique method of assessing visual motor skills. The Miller Functional Participation Scale (M-FUN) was developed to provide school based and clinically based therapists an option for a functional evaluation, presented in a game like format, with decreased emphasis on language skill.

The Developmental Test of Visual Perception 2nd Edition (DTVP-2)

The DTVP-2 is a standardized, norm referenced evaluation that has established reliability and validity in the area of visual motor integration (Hammill, Pearson, & Voress, 1993). This test is not biased relative to race, gender or handedness of students in the United States (Hammill, Pearson, & Voress, 1993, Schneck, 2001). The test takes approximately 20-30 minutes to administer when using only the visual motor integration subtests. Another 10-15 minutes is required for scoring. The developers of the DTVP-2 instruct an evaluator to administer all of the subtests in the order presented. This requires the examiner to administer both the visual motor integration sub-tests and the motor reduced visual perception subtests together. A composite scaled and raw score is provided for both visual motor integration and the motor free visual perception sections. A composite scaled and raw score is provided for the test as a whole to provide an overall picture of a student's visual motor function (Hammill, Pearson, & Voress, 1993).

The DTPV-2 has been used in published multi-disciplinary studies for evaluation of visual motor abilities (eg, Bonifacci, 2004). The DTVP-2 has also been used to in several published studies as a measure of neurological impairments (Fazzi et

al., 2004). The visual perceptual ability of children with developmental coordination disorder and Down syndrome has also been explored in published studies using the DTVP-2 (Shoemaker, et. al., 2001; Spano, 1999).

In 2005 a study was published regarding the use of the DTVP-2 in Hong Kong. The DTVP-2 was determined to be most useful with children who do not have difficulties following verbal directions (Cheung, Poon, Leung, & Wong, 2005). The study added 13 test items which were developed and approved for appropriate content validity by a field study, conducted in Hong Kong. Non-optimal testing situations were used where the evaluator proctored the exam to a classroom of students at the same time which may have led to invalid results. Differences in gender were noted in the results, along with a ceiling effect in subtests 1, 2, and 5. These differences indicate that the DTVP-2 may not be appropriate to use with students outside of the United States (Cheung, Poon, Leung, & Wong, 2005).

In previous testing of the DTVP-2 (Moryosef, 1996) found no relationship between gender and performance on the evaluation, as determined by the developers of the evaluation before release. As expected, the scores increased as students' age increased. This is expected because visual motor integration is considered to be a construct which improves over time and is influenced by age. Construct validity was also established as students who were previously identified as having a possible disability scored lower than the norms referenced in the original publication of the DTVP-2 (Moryosef-Ittah & Hinojosa, 1996).

The Peabody Developmental Motor Scales Assessment (PDMS-2)

The PDMS-2 (Folio & Fewell, 2000) is an evaluation of motor function for children starting at birth through 6 years 0 months. It was developed with feedback and further research on the original Peabody Developmental Motor Scales Assessment. The test consists of 6 subtests. The first, *Reflexes*, is administered only to infants younger than 12 months. This is because the reflexes typically are integrated into more mature movements by this age. The second, third, and fourth subtests (*Stationary*, *Locomotion*, and *Object Manipulation*) comprise the gross motor score. The fine motor score is created by the fifth and sixth subtests, *Grasping* and *Visual-Motor Integration*. The test can be administered in just one of the motor areas. Each motor area takes approximately 20-30 minutes to administer.

The PDMS-2 has demonstrated a strong correlation to another early intervention motor evaluation, the Early Intervention Developmental Profile (Maring & Elbaum, 2007). Convergent validity of the PDMS-2 and the Movement Assessment Battery for Children (M-ABC) has also been studied (Van Waelvelde, Peersman, Lenoir, & Englesman, 2007). While the two tests showed a moderate correlation, they had low agreement when identifying students for services. The PDMS-2 did not identify the same students as the M-ABC did as having a mild motor impairment, the PDMS-2 instead identified the students as not having a probable motor deficit (Van Waelvelde, Peersman, Lenoir, & Englesman, 2007). The PDMS-2 correlates for some age ranges with the first edition, Peabody Developmental Motor Scales. However, both tests did not identify the same students as having a motor impairment in the 4 year old age range. The percentile ranks of children fluctuated considerably between both evaluations, even

though most students were identified by both exams as not having a motor disability (Darrah, Magill, Volden, Hodge, & Kembhavi, 2007).

The Bruininks-Oseretsky Test of Motor Performance, Second Edition (BOT-2)

The BOT-2 (Bruininks & Bruininks, 2005) is an evaluation of motor function in students aged 4 through 21 years old. It contains 8 subtests. Four subtests assess gross motor function, 3 assess fine motor skills, and one measures the combination of both gross and fine motor. Published in 2005, it is based on an adaptation of a previously utilized motor evaluation of the same name: The Bruininks-Oseretsky Tests of Motor Proficiency. To administer the entire evaluation, or the “Complete Form”, 45-60 minutes are required.

The subtest assessing both fine and gross motor skills is a coordination task involving the arms, hands, and fingers. The first subtest to address fine motor skills individually focuses on the area of visual motor speed. The student is required to respond quickly to a moving target. The next subtest assesses visual motor control through several tasks which include both cutting and mazes. The cutting section requires a student to cut on a circular line. The evaluator measures deviation from the line with a provided measurement overlay to determine the student’s score. The mazes are smaller than the ones provided in the M-FUN, and do not have pictures at the start and finish. The mazes are linear in design, verses circular or labyrinthine style. The final fine motor subtest assesses both arm speed and dexterity through a battery of eight items. When scoring the BOT-2, a score is established for each subtest. Those scores are compiled to develop a gross motor and a fine motor score and can be added to develop a composite motor score.

A “Short Form” of the BOT-2 takes approximately 15-20 minutes to administer. It is only to be used when obtaining a general screening of a child’s motor function and provides just a single score for both gross and fine motor skills.

The BOT-2 includes the use of photos to demonstrate test items to complement verbal instruction. These items can be affected by some language barriers. The BOT-2 also has a moderate to strong inter-rater reliability and test-retest reliability for the total scores, but weak test-retest reliability for some of the individual subtests. The norms for the test have been updated with the new edition to better reflect the current demographics within the United States (Crosetto Deitz, Kartin, & Kopp, 2007).

The Miller Assessment for Preschoolers (MAP)

The MAP was designed for screening children age 2 years 9 months through 5 years 8 months who are at risk for pre-academic delays. It evaluates 5 different domains: neurological function, motor coordination, language, nonverbal cognition, and complex tasks. The evaluation is comprised of 27 subtests within these 5 areas. The subtests are presented in a game format. The resulting score is expressed in a functional percentile, indicating if further testing is needed to evaluate the student for deficits (Miller, 1988). The MAP was used by Miller to assess concurrent validity of the M-FUN.

The MAP has been determined to be a valid evaluation to predict the future performance of students in academic areas (Parush, Winokur, Goldstand, & Miller, 2002). It has been found to be an appropriate tool to screen pre-school age children. However, it should be noted that a passing or failing score during this screening process does not necessarily indicate a delay will develop but only a risk for developmental

delay is present. If a failing score is achieved on the MAP, further testing is suggested to provide a more complete picture of the student's functional abilities (Parush, Yochman, Jessel, Sharpiro, Maror-Karnesty, 2002).

The Preschool Visual Motor Integration Assessment (PVMIA)

The PVMIA (Deitchman & Puttkammer, 2001) was designed to assess the visual motor skills of children ages 3 years 6 months through 5 years 6 months. It was published in 2001 by two occupational therapists and consists of two subtests. The first is a drawing subtest to assess the child's ability to recognize and reproduce shapes and figures frequently encountered in the school environment. There are eight separate pictures for the students to copy, each with several components. The second subtest requires the student to recreate or match several block patterns. The blocks are of several common geometrical shapes, each shape is painted a different bright color. The first 9 patterns assess if the student can complete basic color and shape matching. The next 16 items require the student to recreate and then match a pattern from a picture, with and without color cues to assist the student.

The concurrent validity of PVMIA has been studied by Melin (2004). During this study, the portion of the PVMIA that uses the block patterns was not as sensitive as the writing portion. This indicated that a mild deficit may not be identified in this area. However, the PVMIA was determined to have concurrent validity when correlated with the Peabody Developmental Motor Scales,

The Miller Functional Participation Scales (M-FUN)

The Miller Functional Participation Scales (M-FUN) was developed by an occupational therapist, Lucy Jane Miller, for use by other occupational therapists,

physical therapists, and other early childhood intervention specialists. It was designed to incorporate functional activities of daily living for a preschooler or early elementary school student and offer a fun game-like experience to an evaluation. The M-FUN uses paper and pencil games, cutting, and fine motor tasks to evaluate the student's ability to integrate skills necessary to succeed in school and daily home tasks (Miller, 2006).

Purpose of the M-FUN

The M-Fun was developed to assess the visual motor function of children age 2 years 6 month through 7 years 11 months. The test was designed to identify mild, moderate, and severe delays in motor function. It was designed to provide norm referenced data to describe a student's ability in the area of motor function in comparison to his or her peers. The M-FUN was developed to provide professionals a testing option that uses school-based and game-like activities to assess children for possible motor impairments. The M-FUN's game-like items help maintain the attention of the students and make the testing experience more enjoyable. Any single portion may be administered by itself, or in conjunction with 1 or 2 of the other portions. The test can be given to a child several times over a prolonged period of time to document improvement in the areas of noted deficit. In addition to identifying areas and degree of motor delay, the evaluation is intended to assist in the development of goals and treatment interventions as part of a multi-factorial evaluation or intervention plan (Miller, 2006).

Test Construction of the M-FUN

The M-FUN was developed with two versions, one for children ages 2 years 6 months through 3 years 11 months and a second version for ages 4 years 0 months through 7 years 11 months. The test items were developed and chosen for their relationship to typical activities completed by pre-school and early elementary school students. To develop the test items, six focus groups were held in various cities in the United States with the participants consisting of mostly occupational therapists. During these focus groups, participants identified areas they would like to see addressed in evaluations so they would be better able to support their practice. The test was developed with separate portions within the examination to assess gross motor, visual motor, and fine motor skills. Data collection was completed within a functional and comprehensive context, which resembled environments familiar to the students where the motor tasks being tested would usually take place.

Test Standardization

The Miller Functional Participation Scales is a norm referenced evaluation, which enables the examiner to compare the scores of a child to those of other children of the same age. Test standardization was completed with a sample of more than 400 children from all areas of the United States. Those participating in the sample were representative of the most recent demographic data of the country as a whole in the areas of race, ethnicity, sex, and parental level of education. The sample size for each age group ranged from 45-60. Those who participated in the sample had to have sufficient motor skills to participate in the evaluation without modification. Of those

tested, 6.8% were reported to also receive specialized services for motor impairments within the school setting.

Before and during the standardization process the scores for each test item were analyzed to develop a scoring rubric. This was completed via several methods. A computer program was used to ensure scores entered were plausible and that no information was omitted. Scores were then compared across age groups to ensure progress was measurable. Also, the frequencies of the scores for typically developing children and those with delays were examined to ensure there was adequate differentiation between the two groups.

Items were then reviewed for difficulty, discrimination, ease and reliability of scoring. These data were used to eliminate several games from the original version. Certain testing games were selected to be used for only one of the two age groups. Some of the questions within the checklist were also removed from the final test version.

Reliability

The test-retest reliability of the M-FUN was evaluated by re-administering the evaluation to a sample of 27 children, then comparing the scores of those children. The time between the administrations of the two tests ranged from 0-21 days, the mean length of time being 14.5 days. The same examiners were used to administer the evaluation both the first and second times. Test-retest reliability listed as ‘acceptable’ in the text.

The internal consistency of the M-FUN subtests was assessed for both students who were identified as typically developing and those with motor delays. It was

measured using Cronbach's coefficient alpha, with a sample of 414 children. When including the data from all age ranges, the visual motor subtest had a coefficient of .85, the fine motor subtest .90, and the gross motor subtest .92. This indicates that internal consistency was good for each of the three portions of the evaluation (Miller, 2006). When the subtests are broken down further, to individual age brackets, internal consistency is lower for some age ranges. For example, the alpha coefficient for visual motor portion was .76 when all age ranges were combined. The coefficient was lowest for the specific age range of 7 years 0 months through 7 years 11 months, (cronbach alpha= .67).

To assess inter-rater reliability, five pairs of evaluators were organized. One person in each pair administered the evaluation to a child while the second observed the evaluation. Both the observer and the evaluator separately scored the student's performance on the evaluation. There was a high degree of agreement between both evaluators as to whether or not a student would be identified as having a motor deficit. Of the evaluators, 96% agreed on the visual motor subtest, 97% on the fine motor subtests, and 93% on the gross motor subtest. This suggests that there is a high degree of consistency between trained evaluators who administer the evaluation according to the standard instructions.

Validity

As of the time of publication, the M-FUN had been tested in the areas of test-content, diagnostic, concurrent validity, and the relationship among the three portions of the M-FUN. Test-content validity indicates that the content of the evaluation is consistent with the desired construct to assess and it relevant to the profession. The

content validity of the M-FUN was assessed by comparing the content of the evaluation through literature review and comparison to educational curriculum. Via focus groups, the input of professionals working with children and students regarding the tasks completed by children within educational environments was also utilized in determining the validity of the M-FUN. The feedback from these professionals was then used to modify the M-FUN to reflect school related tasks.

To assess the relationship among the three subtests, the scaled scores of the M-FUN were compared. The visual motor and fine motor evaluations had a correlation coefficient of .55. The fine motor and gross motor evaluations correlated with the highest coefficient of .58. The visual motor and gross motor evaluations correlated with the lowest coefficient of .47. These are considered fair to moderate correlations. A moderate correlation indicates a probable divergence of concepts measured. This would be expected when comparing the three subtests of the M-FUN. Each portion assesses a different area of motor function. However, since children who have a deficit in one area of motor function frequently have deficits in other aspects of motor function, a fair correlation would be expected (Miller, 2007).

To assess diagnostic validity of the M-FUN, the evaluation was given to 3 groups of children. Diagnostic validity is the ability of an assessment to identify a participant with a stated deficit. The purpose of the M-FUN is to diagnose students or children as probably not having or having a motor deficit. Each of the three sample groups was used to assess the diagnostic validity of one portion of the M-FUN. To be included in the study the children had to already be identified as having a motor delay in the same motor portion of the M-FUN as they were tested. For example, for as student

to be included in the group to assess diagnostic validity of the visual motor portion of the M-FUN, that student had to already have a documented deficit in the area of visual motor function. Those participating were from all parts of the country, of different socioeconomic, and ethnic backgrounds, and of both sexes. When using the criterion of 2 standard deviations below the mean, 100% of those with visual motor delays were identified and 95% of children who did not have visual motor delays were also correctly identified.

The concurrent validity of the M-FUN was assessed by comparing the scores of students who were assessed with both the M-FUN and the Miller Assessment for Preschoolers (MAP). Both evaluations utilize a game format to assess the motor skills of preschool and early elementary school students. A limiting factor of the study was that all of those who participated in the validity study were Caucasian. The gross motor portions of the MAP and M-FUN had the lowest correlation coefficient ($r=.47$). The fine motor portions of both evaluations had a correlation coefficient of $r=.83$, and the visual motor portions had a correlation of $r=.62$. These results indicate a moderate to high correlation between the MAP and the M-FUN (Miller, 2006).

Summary

When assessing a student for eligibility of services, it is important to use a reliable, valid, and norm referenced evaluation. By using a norm referenced evaluation, the results for any student can be compared to other students of the same age. There are several evaluations currently available for occupational therapists to assess the area of visual motor function. Some of these evaluations include the PDMS-2, MAP, M-ABC, PVMIA and BOT-2. All of these instruments have established validity in the assessing

the area of visual motor function. Each evaluation offers its own strengths and weaknesses in the different areas of visual motor function. A new evaluation, the Miller Function and Participation Scales has recently been released as an evaluation of visual, fine and gross motor skills. As a new evaluation, further research of validity is beneficial to determine how it can be used in the school setting.

Chapter Three

Methods

Introduction

This study will investigate the criterion related concurrent validity and construct validity of the Visual Motor portion of the Miller Functional Participation Scales (M-FUN). This chapter will establish a consistent vocabulary; discuss the research design, hypothesis, method of subject selection, data collection and statistical procedures.

Research Design

This study used a convenience sample of children between the ages of 4 years 6 months to 6 years 6 months. This age range was used as it is in the middle of the norm referenced age range for both of the evaluations. Both the DTVP-2 and the M-FUN had lower validity in the end age ranges than the middle when the tests were initially released. The more narrow age range may possibly provide more accurate results for the age ranges included in the study. The visual motor portions of the M-FUN and the DTVP-2 were administered to 40 children. The raw scores of the two evaluations were correlated and standard scores were compared.

Hypotheses

The following research hypotheses were used to guide this study:

1. The scores of the visual motor portion of the Miller Function and Participation Scales will have a moderate correlation with the scores on the

Developmental Test of Visual Perception, 2nd Edition.

2. The scores on the visual motor portion of the Miller Function and Participation Scales will identify the same students with visual motor delays as the visual motor portion of the Developmental Test of Visual Perception, 2nd Edition.

Participant Selection and Procedure

The participants were a convenience sample of children age 4 years 6 months to 6 years 6 months who attended an urban school district or one of two childcare centers in a large Midwestern city. The sample was comprised of both boys and girls of various socioeconomic backgrounds and races. There were 40 children who participated in the study. Of those students, 20 received occupational therapy services.

Signed informed consent was obtained by the parents or guardians of each child participating in the study prior to the student's participation. The children were screened via a questionnaire completed by the teacher or parent for known visual motor or visual deficits which are not corrected by glasses.

Instrumentation

Developmental Test of Visual Perception-2nd Edition, (DTVP-2)

The visual motor portion of the evaluation used is comprised of 4 subtests; Eye-hand coordination, copying, spatial relations and visual motor speed. For the eye-hand coordination subtest required each child to follow a specified path along the paper. Four points were possible for every subsection within the 4 questions of the eye-hand coordination subtest. Points were deducted from the student's score in relation to how far from the path the student deviates. The second visual motor subtest presented was

spatial relations. The student was provided a series of dot patterns to replicate. One point was awarded for each correct dot the student draws a purposeful line through. In the next visual motor subtest, copying, the student was provided with a series of shapes to copy. The student was awarded 0, 1, or 2 points for each question. Two points were awarded if the student's copied shape matches the gestalt of the stimulus. One point was awarded if the student's shape did not match the stimulus, but met the criteria presented in the scoring manual. No points were awarded if the student was unable to adequately demonstrate understanding of how to recreate the provided image. The final visual motor subtest administered was visual motor speed. The student was requested to replicate a pattern as quickly as possible within one minute. One point was awarded for each shape created that correctly fits the pattern (Hammill, Pearson, & Voress, 1993).

Miller Function and Participation Scales, Visual Motor Skills

The visual motor component of the M-FUN administered was comprised of 6 of the 11 total subtests. Not all of the subtests are included in both the versions of the assessment, as some were intended for either the older only age group (writing) or the only the younger age group (tracing and basic line formation). It took approximately 20 minutes to administer the visual motor subtests of the M-FUN. At least 15 minutes were required after that to score the evaluation. Only the workbook, a red felt-tipped marker, and stop watch were utilized during the testing, per the protocol defined in the examiner's manual. The subtests were administered in the order provided: the maze games, hidden figures games, draw a kid game, writing games, and finished with the fishing game. The games were administered in times allotted for each section. The

appropriate initial score for each portion of every subtest was recorded during testing. Within all of the games, the higher the score, the more advanced the student was in the skill being assessed. All of the subtests in the visual motor portion of the evaluation were paper and pencil tasks.

The first test, the *Amazing Mazes Game* assessed motor accuracy and motor planning; it was the only test which evaluates the student's grasp on the pencil. A score was determined in the areas of mature grasp for the first maze. A score was awarded in each of the 3 mazes in the areas of motor accuracy and motor planning. When all the items have been scored, they are added together to make a single score for the *Amazing Mazes Game*. See Table 3-1 for scoring details for the individual items.

Item	Motor Area	Points Possible	Motor Area	Points Possible	Motor Area	Points Possible
1. Mother dog/Puppy	Grasp	3	Motor Accuracy	3	Motor Planning	3
2. Girl/ Soccer Ball	n/a	n/a	Motor Accuracy	3	Motor Planning	3
3. Boy/Treasure	n/a	n/a	Motor Accuracy	3	Motor Planning	3
Amazing Mazes Total Scores:	Grasp Total	3	Motor Accuracy Total	9	Motor Planning Total	9

Table 3-1 Scoring for *Amazing Mazes Game*

The *Race Car Game* presented a spiral track divided into 14 sections along its length. For each section where the child remained within the boundary line of the track, one point was awarded. That raw subtest score was translated into a score for the

subtest using the scoring guide, with a total of 5 possible points. Both of these subtests evaluated the student's motor accuracy, motor planning, and midline crossing. This was accomplished by the student drawing a line through a maze or tracing a line along a darkened path. The student's motor accuracy and motor planning was evaluated by how far they deviate from the designated area on the page. These skills are required for school based activities such as coloring, pre-handwriting and handwriting tasks.

The *Hidden Forks Game* and the *Find the Puppies Game* assessed visual discrimination, figure ground, motor accuracy, scanning, and sustained attention. In the *Hidden Forks Game* subtest, the child was provided a picture of a kitchen scene and then asked to circle as many forks as possible within 30 seconds. The forks were disguised throughout the picture, for example, a fork was hidden in a table leg of the picture and another was used as the handle on the refrigerator. In the *Find the Puppies Game* the child was asked to circle as many puppies as possible within 30 seconds. In this game all the objects were presented in several lines along with other shapes such as an airplane. In both games, a score was earned for scanning all four quadrants of the page and circling only the requested object. The number of objects correctly circled for each game was totaled up, and then using the scoring guide the number was converted to a raw score. See table 3-2 for details for each motor area for the *Hidden Forks* and *Find the Puppies Games*. These skills relate to the child's ability to scan a page for symbols, such as needed for school worksheets, reading and pre-reading skills. Inaccuracies noted on these subtests could indicate a deficit in the area of visual perception. A score was provided in the areas of visual discrimination, figure-ground, and scanning/sustained attention.

Item	Motor Area	Points Possible	Motor Area	Points Possible	Motor Area	Points Possible
1. Marks Forks	Visual Discrimination	3	Figure Ground	3	Scanning/ Attention	3
The Hidden Forks Game Total						9
2. Marks Puppies	Visual Discrimination	3	Figure Ground	3	Scanning/ Attention	3
The Find The Puppies Game Total						9

Table 3-2 Scoring for *Find the Forks* and *Find the Puppies Games*

The final three subtests *Draw a Kid*, *Writing*, and *Go Fishing* (items 1-4 only), assessed motor accuracy, body awareness, grasp, bilateral hand coordination, and ability to automatically assist. These are important foundational skills for later literacy and math skills. The *Draw a Kid Game* also provided information as to the development of the child's body scheme and self perception. During the *Draw a Kid Game* body awareness and motor accuracy were each graded. Points were awarded corresponding to the accuracy and detail of the student's drawing. See table 3-3 for scoring details for the *Draw a Kid Game*.

The *Writing Game* was composed of 16 different items. Items 4-15 were divided into score groups by the type of writing assessed (copying letters, copying words, writing dictated letters). The scores were based on if the child attempted the task and produced a letter or word which resembled the letter or word in the allotted time frame requested by the examiner. The last items, copying a sentence, the student is asked to copy a sentence legibly in less than 90 seconds. A motor accuracy score was calculated in relation to the score received for each grouping of items. See table 3-4 for details of scoring the individual items on the *Writing Game*.

Item	Motor Area	Points Possible	Motor Area	Points Possible
1. Number of Parts	Body Awareness	3	Motor Accuracy	5
2. Impression	Body Awareness	3	Motor Accuracy	4
Body Awareness Total		6	Motor Accuracy Total	9
Draw a Kid Game Total				15

Table 3-3 Scoring for *Draw a Kid Game*

The final game, *Go Fish Game*, required the student to trace 4 segments of increasing complexity within provided boundaries. A bilateral hand coordination score was provided for each section based on how well the student used the non-dominant hand to stabilize the paper. See table 3-5 for details of scoring the different motor areas in the *Go Fish Game*. When administering both the visual motor and fine motor portions of the M-FUN, the *Go Fishing Game* would be continued. It was not continued during this study.

After the student had completed the fine motor portion of the M-FUN, the examiner completed the *Visual Motor Behavior Rating*. The student was scored on attention to detail, interaction with the examiner and ability to remain seated and attend to task. See table 3-6 for breakdown of scores in the *Visual Motor Behavior Rating*.

Item	Motor Area	Possible Points	Motor Area	Possible Points
1	Trace Letter	2	Tracing Total	2
2	Trace Letter	2		
3	Trace Letter	2		
4	Copy Letter	2	Copy Letters Total	2
5	Copy Letter	2		
6	Copy Letter	2		
7	Copy Letter	2		
8	Copy Letter	2		
9	Copy Letter	2	Write Letter Total	2
10	Write Letter	2		
11	Write Letter	2		
12	Write Letter	2	Write Letter Total	2
13	Write Word	2		
14	Write Word	2		
15	Write Word	2	Sentence Total	3
16	Copy Sentence	3		
		Writing Game Total		14

Table 3-4 Scoring for the *Writing Game*

Item	Motor Area	Points Possible	Motor Area	Points Possible
1. Tracing 1 Wide Curved Lines	Motor Accuracy	2	Bilateral Coordination	2
2. Tracing 4 Wide Curved Lines	Motor Accuracy	2	Bilateral Coordination	2
3. Tracing 3 Narrow Bumps	Motor Accuracy	2	Bilateral Coordination	2
4. Tracing 5 Narrow Bumps	Motor Accuracy	2	Bilateral Coordination	2
Motor Accuracy Total		8	Bilateral Coordination Total	8
Visual Motor <i>Go Fish Game</i> Total				16

Table 3-5 Scoring for the *Go Fish Game*

To achieve the final visual motor score, all the scores for the subtests were added together. This was the total score in the area of visual motor function. When administering the M-FUN as a whole, the visual motor section can stand alone or be used in conjunction with the fine and gross motor scores. For this study, it was used alone.

Area of Behavior	Almost Always	Frequently	Rarely	Never
1. Paid attention to instructions and details in tasks, sustained concentration	3	2	1	0
2. Planned before beginning; inhibited unnecessary talking, touching materials, touching examiner, was not impulsive	3	2	1	0
3. Performed without fidgeting, restlessness; remained controlled, appropriate activity level throughout.	3	2	1	0
Possible Total Score for the Visual Motor Behavior Rating				9

Table 3-6 Scoring for the *Visual Motor Behavior Rating*

Data Collection

Data collection took place in December 2008 through March 2009. The participants were evaluated only by this researcher while in attendance at their typical child-care center or school. Testing sessions were completed in approximately 40 minutes each, and allowed the student needed rest and movement breaks for student optimal performance. Every opportunity was provided to allow the student to complete each assessment within one session. Before the administration of each assessment, the evaluator spent time developing rapport with each child.

The group of 40 children was placed in a random order for testing. The first 20 children were assessed first with the visual motor integration portion of the DTVP-2 and then with the visual motor portion of the M-FUN. The remainder was evaluated with the same tests in reverse order. Only the visual motor activities of the M-FUN were utilized during this study, omitting the check lists. The check lists are used to provide background information regarding the student's performance at home or in the classroom and are not factored into the student's score.

Both evaluations were performed during the same testing session with the same evaluator for both testing sessions. Rest or movement breaks were provided at the discretion of the evaluator. If a child had been unable to attend to the evaluations, the tests would have been divided between two different testing sessions. This did not need to occur, as all children were able to attend to the whole session. All students will have both tests administered within seven days to avoid error due to change in age (Ary, Chester Jacobs, Razavieh, & Sorensen, 2006).

Evaluator bias was reduced by having a second evaluator score both evaluations from five randomly selected students and compare the scores to the scores obtained by the original evaluator. The second evaluator was an occupational therapy student who had already learned the scoring methods for both instruments. When the raw data was translated into standard scores no discrepancies were noted. As the evaluator knew 20 of the students before the study commenced, to improve impartiality all the test booklets and scoring booklets were labeled with a different ID number for each student. The master list of corresponding names to numbers was kept separate from the test booklets. Finally, none of the results were scored until the administration of all was completed.

All tests were scored on the same day to further promote consistent interpretation of student performance.

Testing was completed in a quiet, well lit environment with furniture fitted for the size of the student as best able as limited by the facilities, as recommended by developers of both assessments. The evaluations were administered per the protocols provided in the administration directions. When administering the test items the evaluator was unable to provide additional cues or to adapt the test item or reword questions, as doing so would invalidate the test results. Only the materials needed for the specific examination being administered, such as the student workbook and the evaluator scoring booklet were within the testing area so as to minimize distractions.

Data Analysis

To evaluate the first hypothesis, the scores on the M-FUN correlate with the scores on the DTVP-2, a simple correlation was used. A simple correlation assesses the “tendency for variation in one variable to be related to variation in a second variable” (Portney & Watkins, 2000, p. 742). Pearson-product moment coefficient was used and is stated in terms of ‘r’. The Pearson-product moment coefficient is based on the concept of covariance. Covariance, in the case of Pearson-product moment coefficient, means that as one variable changes, so will the second variable. Two variables with a correlation of .00-.25 are considered to have little to no relationship, values of .26-.50 have a fair correlation, .51-.75 have a moderate to good correlation, and above .75 indicates a good to excellent relationship (Portney & Watkins 2000). It was hypothesized that students who earn a high score on the DTVP-2 will also earn a high score on the M-FUN.

The Pearson product-moment coefficients of correlation were determined using the subtests of the DTVP-2 and the M-FUN and for the total raw scores of the evaluations. This coefficient was calculated for the scaled scores of the two evaluations. A moderate to good correlation was expected, as there are some differences between the two evaluations but they were thought to generally test the same construct.

To evaluate the second hypothesis, that the M-FUN and DTVP-2 identify the same students as typically developing or with a possible visual motor deficit a known groups method was used. The known groups method is a way to research construct validity (Portney & Watkins, 2000). Students were assigned to a group based on their scores on the DTVP-2. Students who earned a scaled score of 8 or higher were placed in one group. A second group was comprised of students who earn a scaled score of 7 or below. Students were then be assigned to the same groups according to their score on the M-FUN. To confirm construct or known groups validity via the DTVP-2, the students tested by the M-FUN would be placed in the same group by both evaluations as determined by the earned score.

Chapter Four

Results

Sample

Permission slips for participation in the study were distributed to 20 students who receive occupational therapy services. All of these permission slips were returned and all the students participated in the study. These students were assumed to have a deficit in the area of visual motor which qualified them for occupational therapy services. Ages for these students were 4 years and 6 months through 6 years and 6 months. Of the 20 occupational therapy students who participated, 9 were female and 11 were male. Three of the students were in full day kindergarten at the time of testing. Seventeen of the students were enrolled in special needs pre-school. Of the pre-school students, 10 were enrolled in all day pre-school and 7 were enrolled in half day pre-school. All of the students were enrolled in a major urban school district. Administration of both tests together took between 15 minutes and 40 minutes for each child.

Permission slips for participation in the study were distributed to 2 different day care centers. Both day care centers were located in suburban areas. At least 50 permission slips were distributed. One of the 2 centers copied an unknown additional number of permission slips and distributed them to children who met the age qualifications of the study. Of the permission slips distributed, 20 were returned. All of

these children participated in the study. None of the students had a diagnosed deficit in the area of visual motor skills, as documented in the records of the day care centers.

Ages, gender and settings of the children are presented in Table 4-1.

Group	Mean age	Age range	Boys	Girls	Preschool/ Daycare only	Kindergarten
Children receiving OT	5.9	4.5-6.3	11	9	17	3
Typical children	5.2	4.7-6.5	12	8	14	6
Total	5.4	4.5-6.5	23	17	31	9

Table 4-1: Demographic data of the sample

Correlation of DTVP-2 and M-FUN:

A Pearson-Product moment correlation was used to identify the correlation of the standard and raw scores of the DTVP-2 and the M-FUN. Two variables with a correlation of .00-.25 are considered to have little to no relationship, values of .26-.50 have a fair correlation, .51-.75 have a moderate to good correlation, and above .75 indicates a good to excellent relationship (Portney & Watkins 2000).

Overall, the individual subtests had fair to moderate correlations. The highest correlation between the DTVP-2 subtests and M-FUN subtests was the Eye Hand Coordination subtest and the Behavior Game ($r = .762$). The next highest correlation was between the Eye Hand Coordination and the Amazing Mazes Game ($r = .708$). Both

of these subtests evaluate a student's eye-hand coordination. The lowest correlation was the Visual Motor Speed score and the Find the Puppies Game (see Table 4-2).

When the total standard score for the DTVP-2 was compared with that of the M-FUN, the results indicate a high correlation ($r = .872$). This was similar to the result for the correlation between the raw scores of the two evaluations ($r = .835$).

Subtests	Eye Hand Coordination	Copying	Spatial Relations	Visual Motor Speed
Amazing Mazes	* .708	* .592	* .544	.438
Race Car	.464	* .574	.448	* .643
Hidden Forks	* .545	* .524		
Find the Puppies	* .535	.468	.463	.302
Draw a Kid	.489	* .690	* .610	* .584
Writing	* .539	* .685	* .659	* .638
Go Fishing	* .621	* .586	* .557	
Visual Motor Behavior	** .762	* .572	* .566	.422

** good to excellent correlation * moderate to good correlation

Table 4-2: Correlation of M-FUN subtest scores and DTVP-2 subtest raw scores

Disability Identification by DTVP-2 and M-FUN:

A known groups method was used to determine the construct validity of the M-FUN when compared to the DTVP-2. The M-FUN and the DTVP-2 had a high level of agreement when categorizing whether or not a student has a deficit in the area of visual motor function. The two tests agreed on the identification of 35 of the 40 students evaluated. This is agreement on 87.5% of the students who participated in the study. The M-FUN identified 3 children who did not qualify for services when tested by the

DTVP-2. The DTVP-2 identified 2 children who did not qualify for services when tested by the M-FUN (see Table 4-3).

Score on Evaluations	M-FUN Score >1.5 standard deviations below typical	M-FUN Score < 1.5 standard deviations below typical	Totals
DTVP-2 Score > 1.5 standard deviations below typical	20	3	23
DTVP-2 Score < 1.5 standard deviations below typical	2	15	17
Totals	22	18	40

Table 4-3: Identification of disability presence by evaluation

Summary

The standard scores DTVP-2 and the M-FUN have a high correlation ($r = .872$) when identifying both students with and without deficits in the area of visual motor functions, indicating a high concurrent validity. The M-FUN also demonstrated a high construct validity when compared to the DTVP-2, as both tests agreed on the identification of a disability in 35 of the 40 test participants, or 87.5% of the those tested.

Chapter Five

Discussion

Introduction

The current method by which a student in public schools to receive extra educational support, such as special education, uses standardized evaluation to determine a student's eligibility. Accurate evaluation and identification of students' abilities is important to ensure that students who need additional services receive them (Schneck, 2001). It is helpful to have multiple standardized evaluations from which to choose when assessing a student's abilities (Gentile, 1997). New evaluations should be compared to previous assessments to ensure validity and reliability of mutual content areas before and after they are published (Dunn, 1989, Miller 2006).

Concurrent Validity of the M-FUN

The M-FUN is a new evaluation, which has a component of visual motor function, recently introduced for children age 2 years 6 months through 7 years 11 months of age. Before its release the developers of the M-FUN evaluated its validity and reliability for the intended population. Even after an evaluation has undergone initial validity and reliability review, it is important to continue to appraise these attributes in order to detect any changes which may occur within the target population. This is to ensure that the evaluation measures the constructs that it purports to evaluate (Haertlein, 1992, Miller, 2006). One method for estimation of validity is to compare

results of an evaluation with those of a gold standard evaluation in the same area of interest (Asher, 1996). The DTVP-2 is an accepted evaluation of visual perceptual skills that is currently used by occupational therapists in a school based setting (Gentile, 1997).

The DTVP-2 has demonstrated validity in the area of criterion validity in the area of visual motor function for students aged 4-11 years (Hammill, Pearson, & Voress, 1993). When originally released in 2006, the M-FUN had been determined by the authors to be a valid instrument to measure visual motor skills (Miller, 2006). Both the DTVP-2 and the M-FUN are able to measure and provide a standard score in the area of visual motor function. The two evaluations differ in several aspects including presentation, how much the evaluator is able to guide a student during the sample questions, and variety of components assessed within each subtest (Hammill, Pearson, & Voress, 1993, Miller 2006). By correlating the standard total scores and the raw scores of the individual subtests of the DTVP-2 and the M-FUN, the concurrent validity of the M-FUN can be established.

This study used a Pearson-Product Moment coefficient along with a clinical analysis of testing results to establish concurrent validity of the M-FUN when compared to the DTVP-2. A Pearson-product Moment coefficient, a measurement of covariance, is presented in terms of 'r'. Covariance, in a Pearson product moment coefficient means that as one variable changes, so will the second variable. Two variables with a correlation of $r = .00-.25$ are considered to have little to no relationship, values of $r = .26-.50$ have a fair correlation, $r = .51-.75$ have a moderate to good correlation, and above $r = .75$ indicates a good to excellent relationship (Portney & Watkins 2000). The

results of this study indicate that there is a high correlation between the standard scores of the two tests ($r = .872$) and the raw scores of the two tests ($r = .835$). A high correlation indicates that the two tests measure the same functional performance (Anastasi, 1968). This indicates that the visual motor portions of both the DTVP-2 and the M-FUN test the same area of function, which in this case is labeled as visual motor function. A high correlation also indicates that the M-FUN is indeed evaluating the intended area, visual motor function. This means that the M-FUN has high validity as a visual motor assessment, and can be used with confidence by therapists to determine a student's visual motor function (Haertlein, 1992). As the M-FUN has demonstrated positive concurrent validity with the DTVP-2, a therapist can use the evaluation to identify students who need services (Richardson, 2001).

While the overall evaluation tools of the DTVP-2 and the M-FUN demonstrated a high correlation, not all of the subtests demonstrated the same level of correlation to the subtests of the other. A high correlation of several of the subtests was not expected, as they did not claim to evaluate the same constructs (Anastasi, 1968). An example is the correlation between the Find the Puppies and Visual Motor Speed subtest. Both evaluations incorporate speed and scanning. However, the Find the Puppies subtest focuses and reports on scanning and the Visual Motor Speed subtest focuses and reports on speed. Both subtests evaluate a portion of visual motor function, but they have different foci (Hammill, Pearson, & Voress, 1993, Miller 2006). Not all portions of a visual motor evaluation assert that they review the same aspects of visual motor function. This is useful information for the administrator to remember when scoring and interpreting test results. When choosing an instrument to use, the evaluator should

consider the characteristics of the subtest. Using the above example, if an evaluator had concerns regarding visual motor speed, he should choose the DTVP-2 (Clark, Polichino, & Jackson, 2004).

The highest correlation for two standard scores of the subtests was between the Eye-Hand Coordination subtest of the DTVP-2 and the Behavior subtest of the M-FUN ($r = .762$). This could be because the children need to incorporate the behaviors included on the Behaviors subtest, for instance good attention and focus, in order to succeed on the Eye-Hand Coordination subtest. The second highest correlation of standard scores was between the Eye-Hand Coordination subtest of the DTVP-2 and the Amazing Mazes subtest of the M-FUN. Both subtests use similar evaluation techniques of mazes to assess the constructs of motor accuracy and motor planning (Hammill, Pearson, & Voress, 1993, Miller, 2006).

Overall, the two measures were highly correlated. Because the correlation is not perfect, we know that the two tests measure different aspects of visual motor performance. A higher correlation might suggest that the tests were redundant but this is not the case. Each tool contributes unique information about the child's function. Different methods are used in each test to evaluate the skills of visual motor performance. A specific method of evaluation may be easier to some of the students and may be more difficult to other students within the group. It is impossible to administer both evaluations at the exact same moment in time when a child's levels of hunger, fatigue, mood, or interest are exactly the same. To reduce the chance of error caused by these variables, each test was administered within the same session (Anastasi, 1968).

Using the DTVP-2 to categorize children as having a visual motor delay, the M-FUN had 87.5% accuracy in identifying children into the same groups. There were 5 students with whom the DTVP-2 and the M-FUN did not agree on the presence or absence of a disability in visual motor function. Of the 40 students evaluated, the M-FUN and the DTVP-2 agreed on the identification of 35 of the students, or 87.5% of those in the study. Therefore, it can be determined that the M-FUN has demonstrated concurrent validity when compared to the DTVP-2 in the area of visual motor function (Ary, Cheser Jacobs, Razavieh, & Sorensen, 2006). Again, a perfect agreement among the M-FUN, the DTVP-2 and the previously identified group is not to be expected as there are differences in the two tests such as item presentation, portions of visual motor function evaluated, and scoring (Anastasi. 1988).

As evidenced by a study by Van Waelvelde et al (2007), the PDMS-2 demonstrated a moderate correlation with the Movement and Assessment Battery for Children (M-ABC). When the researchers looked further, the M-ABC identified more students than did the PDMS-2 as having visual motor deficits. This disagreement means that some children would qualify for services when tested by the M-ABC, but not when evaluated by the PDMS-2. This was not an issue with the M-FUN and the DTVP-2 as both studies agreed on the identification of 87.5% of those who participated. In this study there were 5 children (out of 40) who were placed in different ability groups by the two evaluations. Unlike the previously mentioned study, neither the M-FUN nor the DTVP-2 identified a much larger number of students as having or not having a visual motor deficit.

In 2005 a study was published regarding the use of the DTVP-2 in Hong Kong. The DTVP-2 was determined to be most useful with children who do not have difficulties following verbal directions (Cheung, Poon, Leung, & Wong, 2005). Of the 3 students who were placed in the typically developing group by the M-FUN and the group with a visual motor function deficit by the DTVP-2, 2 were known to have deficits in receptive language skills. Both of these students were receiving speech and language therapy to address their receptive language deficit at the time of this study. It is hypothesized that the speech and language deficits may have affected the outcome of the scores per Cheung's study and may account for differences in identification by the test.

Implications

The results of this study indicate that both the DTVP-2 and M-FUN can be used to identify students with a delay in the area of visual motor function. An evaluator should screen each of the students before administration of the evaluations. This screening allows the test administrator to determine what areas of visual motor function may be limiting to a student's performance in school. Once this is understood by the assessor, he or she is able to choose which evaluation best evaluates the abilities of the child. The therapist may choose the M-FUN when a functional evaluation is desired. When an evaluation of more basic core skills is desired, the therapist may choose the DTVP-2. Because this study found that the M-FUN has good validity in measuring visual motor function, a therapist has another option for evaluating a student. A therapist is able to administer either of the evaluations and expect the student to earn a similar score. However, the results of the M-FUN may also identify strengths and

weaknesses that are not discernable with the DTVP-2, such as pencil grasp, midline crossing, figure ground discrimination, body awareness, handwriting, and scanning. It is helpful to the professional to have the option of using the M-FUN to evaluate visual motor skills if these portions of function are of concern to the evaluator (Clark, Polichino, & Jackson, 2004).

The M-FUN also mimics the classroom setting more than evaluations such as the DTVP-2. The M-FUN has components frequently seen in classrooms, such as handwriting, copying, tracing, mazes, and scanning activities. The M-FUN is the first evaluation to combine all of these aspects of visual motor function into a single evaluation.

The subtests of the DTVP-2 and M-FUN did not correlate as highly as the total scores for each evaluation as a whole. Subtests measuring similar constructs, such as the Amazing Mazes Game and the Eye-Hand Coordination subtest, did demonstrate a good correlation ($r > .51$). This information can be used in practice by a therapist who wants to gather information on a student in just a specific area, such as eye-hand coordination. A therapist is able to use a correlating subtest to get a basic idea of a student's progress during treatment sessions.

The M-FUN is able to provide an evaluation which more closely reflects activities completed within a typical classroom while at the same time relying less on language. The administrator is permitted to use some gestures and point to assist the student in understanding the provided tasks. The provided directions, in general, use fewer words during explanation of the directions than the DTVP-2. This helps reduce the reliance on receptive language used during the prompts. Decreased reliance on

receptive language could provide a more accurate understanding of a student's true motor function and not his or her ability to follow directions.

There are other differences between the two evaluations which may influence why a practitioner would choose one test over the other. Both the M-FUN and the DTVP-2 have items using mazes or tracing within a provided area. The area for the student to write in is smaller than that of the M-FUN. The area provided within the M-FUN items is more realistic to the space provided for writing during pre-school, kindergarten and first grade assignments. Both tests provide items for copying. The M-FUN has letters, words, and sentences to copy which mimic more of a classroom setting. The copying portion of the DTVP-2 provides more abstract pictures, which should be new to the students, to copy. This may provide a better understanding of how a student will interpret new visual motor information.

The M-FUN also provides practitioners with a guide to writing evaluations and describing visual motor integration to caregivers and teachers. The scoring booklet breaks down each subtest into its basic motor components, such as motor planning, and bilateral integration. When subjectively reviewing the scores, the examiner may be able to detect patterns of deficits in certain motor areas such as motor accuracy that are not evident by the score as a whole. Having this information provides a strong base for the written report of the session. This information also provides ideas for treatment sessions and goals for the student to work toward in later occupational therapy sessions.

The use of the M-FUN also provides a more child-like assessment for use by therapists. The illustrations were more cartoon-like, larger and plentiful within the M-FUN than the DTVP-2. These more familiar pictures may be more engaging to the

children than the smaller more life-like illustrations in the DTVP-2. Most of the children verbalized excitement when completing the provided tasks. For example, during the Amazing Mazes subtest several children mentioned how they wanted to be a pirate. Then the children made pirate noises while completing the evaluation. By using an evaluation which is more engaging, a more accurate appraisal of a child's function may be achieved.

None of the appeal to the students would matter if the M-FUN was not a valid assessment of visual motor function. The high correlation between both the standard and raw scores of the M-FUN and DTVP-2 indicate strong concurrent validity between the two assessment tools. The M-FUN and the DTVP-2 also agreed on the identification of 35 of the 40, or 87.5% of students in the study. This high concurrent validity and agreement in identification of students means that both tests can be used by professionals to determine a student's level of visual motor function. The clinical implications of this are that a therapist can choose either the DTVP-2 or the M-FUN because of format, the set-up, or appeal to the students without compromise to the validity of the evaluation.

Limitations

The sample size for this study was small (n=40). The sample was not a random sample of students and children. Instead, it was a convenience sample of students. Therefore, the population cannot be deemed representative of the population frame. Despite best efforts of the evaluator, the testing environment was not the same for each child. The table placement and height was different depending on the day and building where the evaluations took place. For most students, the table was too high, and for 2-3

students, it was too low. The tables were placed in the hallway for 8 of the students. These differences could affect the student's ability to see the papers provided on the table and to manipulate or maneuver the pencil as required by the evaluations.

Although measures were taken to eliminate evaluator bias, some limitations still remain. The evaluator had a previous professional relationship with all student who were receiving occupational therapy at the time of the study. This may have influenced the scoring of items which had to be scored during student testing and were unable to be re-scored by the second evaluator, such as pencil grasp or the items on the visual motor behavior subtest of the M-FUN. This relationship and knowledge of student's previously demonstrated abilities in therapy sessions may have predisposed those students to either work harder for or dismiss the evaluator and the testing.

There was also a difference in the testing environment for different students. Some of the students were evaluated in a large room with a wall of windows without side distractions easily viewable, and a bright light which may have been distracting. Other students were evaluated in a dimly lit room, which may have impacted the children's ability to see details on the page. Several of the students were evaluated when at the other end of the room other students were having snack time. Approximately 75% of the students were permitted to snack during the evaluations on items such as candy bars, chewy candies, gum, or candies for sucking. The other 25% were not permitted by parent request, teacher request, or food allergy.

Future Research

Future research is recommended in the validity of the M-FUN. Miller encourages the continued study of validity in the evaluations used in practice. This is to

ensure that the evaluations remain valid for the changing population and to build the evidence supporting the validity of the work within the field (Miller, 2006). Further research of the validity of the M-FUN is therefore encouraged. In general, further knowledge of how the evaluation provides framework for development of the plan of care for each student could assist in further development and revisions of the evaluation.

Another area for further research would be the domain areas claimed to be tested by each subtest of the M-FUN. When the evaluation was developed, a peer review was used when determining the areas of motor function assessed by each subtest. Further research in this area would add to the evaluator's knowledge of the reasons why a student may score lower on a specific subtest. A third area, the effect of receptive and expressive language ability on the scores for both the M-FUN and the DTVP-2, could also be the subject of further inquiry. Many of the students who have visual motor delays also have a developmental deficit in the area of language. Researchers can further evaluate the scores of students with and without different types of language deficits and the scores earned on both of these evaluations to determine how deficits in language influence the results of these tests. This information could provide a better understanding of which visual motor evaluation may be more appropriate for use with different students and how the scores of these evaluations are influenced by factors other than a student's visual motor ability.

Conclusion

These results indicate that the construct validity via known groups of the M-FUN and DTVP-2 for students ages 4 ½ -6 1/2 years as both evaluations identified 87.5% of the same students. The M-FUN and DTVP-2 also demonstrated high

concurrent validity via the Pearson product moment correlation with $r = .872$. Both the DTVP-2 and the M-FUN can be used to determine a student's visual motor function. When both tests are administered, it is expected that a student will earn a similar score when the results of the evaluations are taken as a whole. There are some possible benefits in using the M-FUN over the DTVP-2 with certain populations of students. The M-FUN can be used by therapists as an alternative evaluation for students who have difficulty in language skills. This evaluation provides therapy practitioners a functional based evaluation presented in a kid-friendly and game like format which may better engage the students during testing.

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Appendix A: Parental Correspondence

The Ohio State University Parental Permission For Child's Participation in Research

Study Title: **Validity of the Miller Function and Participation Scales**

Researcher: **Jane Case-Smith and Sarah Diemand**

Sponsor:

This is a parental permission form for research participation. It contains important information about this study and what to expect if you permit your child to participate.

Your child's participation is voluntary.

Please consider the information carefully. Feel free to discuss the study with your friends and family and to ask questions before making your decision whether or not to permit your child to participate. If you permit your child to participate, you will be asked to sign this form and will receive a copy of the form.

Purpose:

The purpose of this study is to establish the validity of a new visual motor assessment (The Miller Function and Performance Scales). The research is being completed as part of a master's thesis at The Ohio State University.

Procedures/Tasks:

Those who participate in the study will be asked to complete the visual motor portions of two standardized evaluations; the Miller Function and Performance Scales, and the Developmental Test of Visual Perception, 2nd Edition. These are two paper and pencil evaluations of visual motor skills. Tasks include drawing pictures, copying shapes, writing, scanning pictures, and doing mazes. The testing will last about 30 minutes.

Duration:

The testing will occur at your child's school/day care. All testing will be completed during one 30 minute session if possible. If your child fatigues, the testing may occur in 2 sessions, 30 minutes total. All testing will be completed within 1 week for your child.

Your child may leave the study at any time. If you or your child decides to stop participation in the study, there will be no penalty and neither you nor your child will lose any benefits to which you are otherwise entitled. Your decision will not affect your future relationship with The Ohio State University.

Risks and Benefits:

Your child may be identified₂ via the assessments₂ to be at risk for a visual motor deficit that has not been previously diagnosed. If this occurs, you will be notified via a letter sent home with your child.

By allowing your child to participate in this study, validity can be established for this new visual motor assessment. Established validity can help students with possible deficits in the area of visual motor skills to receive the services that they need.

Confidentiality:

Efforts will be made to keep your child's study-related information confidential. However, there may be circumstances where this information must be released. For example, personal information regarding your child's participation in this study may be disclosed if required by state law. Also, your child's records may be reviewed by the following groups (as applicable to the research):

- Office for Human Research Protections or other federal, state, or international regulatory agencies;
- The Ohio State University Institutional Review Board or Office of Responsible Research Practices;
- The sponsor, if any, or agency (including the Food and Drug Administration for FDA-regulated research) supporting the study.

Incentives:

No incentives will be provided for participation in the study.

Participant Rights:

You or your child may refuse to participate in this study without penalty or loss of benefits to which you are otherwise entitled. If you or your child is a student or employee at Ohio State, your decision will not affect your grades or employment status.

If you and your child choose to participate in the study, you may discontinue participation at any time without penalty or loss of benefits. By signing this form, you do not give up any personal legal rights your child may have as a participant in this study.

An Institutional Review Board responsible for human subjects research at The Ohio State University reviewed this research project and found it to be acceptable, according

to applicable state and federal regulations and University policies designed to protect the rights and welfare of participants in research.

Contacts and Questions:

For questions, concerns, or complaints about the study you may contact **Sarah Diemand** at diemand.2@osu.edu or by telephone at 614-406-2864.

For questions about your child's rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-678-6251.

If your child is injured as a result of participating in this study or for questions about a study-related injury, you may contact **Jane Case-Smith** at case-smith.1@osu.edu.

Signing the parental permission form

I have read (or someone has read to me) this form and I am aware that I am being asked to provide permission for my child to participate in a research study. I have had the opportunity to ask questions and have had them answered to my satisfaction. I voluntarily agree to permit my child to participate in this study.

I am not giving up any legal rights by signing this form. I will be given a copy of this form.

Printed name of /child/student

Printed name of person authorized to provide permission for subject

Signature of person authorized to provide permission for subject

Relationship to the subject

Date and time

AM/PM

Investigator/Research Staff

I have explained the research to the participant or his/her representative before requesting the signature(s) above. There are no blanks in this document. A copy of this form has been given to the participant or his/her representative.

Printed name of person obtaining consent

Signature of person obtaining consent

Date and time

AM/PM

January 6, 2009

Dear Parent:

My name is Sarah Diemand, and I am an occupational therapist at Columbus City School District. I am also working on a research project at OSU to determine the validity of a new visual motor (hand eye coordination) evaluation for students age 4 ½-6 1/2.

Please sign the attached permission slip and return it to your child's day care if you agree to participate. The evaluation will last about 20-30 minutes. During this time your child will draw pictures, copy pictures, complete mazes, and write letters. Only group data will be used in the study, your child will remain anonymous throughout. If you want, I can report to you the percentile in which your child scored on the tests.

If you have any questions, please contact me at diemand.2@osu.edu or you can call my cell phone at 614-406-2864.

Sincerely,

Jane Case-Smith (case-smith.1@osu.edu)
Sarah Diemand (diemand.2@osu.edu)

Dear Parents

We are conducting a study to establish the validity of a new visual motor evaluation used for students in pre school or kindergarten classes. This study will determine if the new visual motor evaluation provides accurate information about a child's performance. Your child's class has been selected to be included.

If you choose to allow your child to participate in the study, a brief record review will be completed. All information regarding the identity of your child will be kept in a locked file cabinet, only the 2 investigators will have access to the information. Only group data will be used and your child's identity will not be reported.

If you allow your child to participate, he/she will complete 2 visual motor tests with one of the two investigators while at his/her school. The tests will be given at a time approved by his/her teacher in a separate room in the school. The visual motor tests involve mazes, drawing or completing pictures, basic letter writing or copying, and circling objects in a picture. The testing will be completed in one 30 minute session.

If you would consider allowing your child's participation, please return this letter signed and we will send you a permission form. If you have any questions, please feel free to contact us by either e-mail or telephone. Thank you.

Sincerely,

Jane Case-Smith (case-smith.1@osu.edu)
Sarah Diemand (diemand.2@osu.edu) 614-406-2864

Child Name

Parent's Signature

Date

Appendix B: Select Items from the M-FUN

Amazing Mazes Game Test Item 1, Mother dog/Puppy

Go Fish Game

Appendix C: Select items from the DTVP-2

Items 1-10 for the Copying Subtest

Visual Motor Speed Subtest