Construct Validity:

A Preliminary Comparison of

the Peabody Developmental Motor Scale - Fine Motor

and

the School Version of the Assessment of Motor and Process Skills

by

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ABSTRACT

The role of the occupational therapist (O.T.) working in the school system is to facilitate a student's task performance or ability to do purposeful and meaningful activities so they benefit from the educational experience. To do this O.T.s need assessment instruments that address functional performance issues in the classroom and provide information for effective programming and consultation. The School Version of the Assessment of Motor and Process Skills (S-AMPS) has been designed as an observational assessment of functional skills in the classroom. Common classroom activities are observed to assess a child's motor and process skills. This study examined the construct validity of the S-AMPS by comparing it to the Peabody Developmental Motor Scale – Fine Motor (PDMS-FM), the standard assessment used in local area school districts. Results suggest that the two assessments are measuring similar but not the same aspects of a child's performance. It appears that the two assessments differ in the level of function they are assessing.

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PROBLEM STATEMENT

"Occupational therapists working in school systems are concerned with a student's functional performance, in the activities or occupational tasks of self care, leisure and productivity required to participate in the school setting" (Graham et.al, 1990, p.5). In other words the role of the school-based occupational therapist is to facilitate a student's task performance or ability to do purposeful and meaningful activities in order to benefit from the educational experience.

Many children experience functional performance difficulties in the classroom. Children with Down syndrome, pervasive developmental disorder, cerebral palsy, spina bifida, traumatic brain injury and other conditions have difficulty in achieving success in their student role. As well many children with unidentified conditions are struggling in their attempts to produce in the classroom. For example, five percent of children in the school system in North America are observed to have difficulty with motor skills not attributable to neuromuscular or developmental diagnoses (Gubbay, 1975).

The literature suggests consultation is the most effective model for occupational therapy (O.T.) service delivery in the schools (Dunn, 1988; Hall et.al, 1992). Occupational therapists (O.T.s) who were working in school systems in the USA agreed that most students with disabilities should remain in the classroom and that the consultative model can have the most impact on student learning (Case-Smith & Cable, 1996). Therefore assessment instruments that address functional performance issues in the classroom and provide information for effective programming and consultation are needed.

To date no psychometrically established instruments have been developed to evaluate children's productivity within their natural classroom environment (Magalhaes, 1995). Available assessments either involve removing the child from the classroom for evaluation or employ a series of clinical observations that have not been evaluated for validity and reliability properties. The School Version of the Assessment of Motor and Process Skills (S-AMPS) was designed to be both psychometrically sound and focus on functional school related skills in the classroom. Elements of motor performance and process skills (e.g. organization, attention, and sequencing) are evaluated through observation in the classroom setting. The S-AMPS was originally developed by Magalhaes and Fisher in 1995 and continues to be revised by Fisher & Bryze (1998).

Within the Edmonton Public School System, where this study was conducted, O.T.s frequently use the Peabody Developmental Motor Scale – Fine Motor (PDMS-FM) to evaluate children, of kindergarten age, referred for productivity problems in the classroom. This assessment developed by Folio and Fewell (1983) was designed to assess fine motor development. It is a standardized, product-based assessment conducted in a one-to-one testing format outside of the classroom.

To examine the clinical utility of the S-AMPS in a kindergarten setting this study compared the S-AMPS to the PDMS-FM for construct validity. Both assessments evaluate aspects of fine motor performance, which is often a critical element in O.T. assessment. The S-AMPS also looks at process skills, adding valuable information about a child's task approach, which contributes to effective intervention. It was expected that the S-AMPS (motor scale) would correlate moderately with the PDMS-

FM (.6 or above) while there would be a lower correlation between the S-AMPS (process scale) and the PDMS – FM. Evidence of construct validity and practical application in the classroom will contribute to establishing the S-AMPS as a useful tool for school-based O.T.s.

LITERATURE REVIEW

Occupational Therapy's Role in the School System

Multidisciplinary teams regularly determine a child's educational goals because of the inclusion of students with special needs in regular education classrooms, early identification of children with special needs, and the increased mandate for individualized education. Along with teachers, psychologists, speech and language pathologists, physiotherapists, audiologists and nurses, occupational therapists are making a unique contribution to the provision of quality education. Thirteen percent of Canada's O.T.s work in school systems (CAOT, 1997a). "According to the model of occupational performance occupational therapists working in school systems are concerned with a student's functional performance, in the activities or occupational tasks of self-care, leisure and productivity required to participate in the school setting" (Graham et.al, 1990, p.5).

The Need for a Change in Occupational Therapy Focus

One difficulty O.T.s have experienced in developing their role in school systems relates to their historical roots in the medical system. Whereas the primary goal of O.T.s working in the schools is to develop the functional skills that enable children to perform their roles as students effectively, the focus of O.T.s working in medical settings is usually the remediation of impairments (Atchison, 1997; Kramer & Hinojosa, 1993). In the past, remediation in the clinical setting consisted mostly of individual therapy or a "pull-out model". The model of service delivery in schools is remediation carried out within the classroom through interdisciplinary assessment, program planning and consultation (Dunn, 1988; Hall et.al, 1992). To do this effectively O.T.s need to communicate their results using educational terms and thoroughly understand the skills required for success in the classroom (Powell, 1994). Many other challenges face O.T.s working in school systems. Large caseloads necessitate a method of service delivery beyond direct intervention. Multidisciplinary teams and interactions with many different teachers require flexibility and effective communication skills. Classroom environments can differ dramatically within the same school in terms of physical layout; rules and expectations; teaching style and student abilities and behavior (Atchison, 1997). All these factors influence a child's ability to learn and an O.T.'s ability to provide effective consultation.

The Need for Classroom Based Assessment Tools

Assessment is an important aspect of O.T. practice. The information gathered forms the basis for determining a child's need for service and also the basis for the development of their Individual Education Plans (IEP). Assessment also provides the information necessary to determine a child's progress and the effectiveness of intervention.

Bundy, 1995 (as cited in Atchison, 1997) outlined three deficiencies commonly found in assessments presently being used in O.T. school-based practice:

1. These assessments are often based exclusively on developmental paradigms (thus failing to provide a mechanism for functional analysis of a student's task performance).
2. They are performed outside of the context of a classroom, and
3. Many of these assessments have not been proven to be psychometrically valid or reliable.

Assessment from a purely developmental perspective may identify a child as needing service, but it does not give much information about the child's individual learning style or actual performance in the classroom. These assessments focus on a child's deficits, but yield little information about their strengths. In keeping with an O.T. functionally based perspective many therapists are calling for the development of functionally based assessments for use in the schools. Magalhaes (1995) stated:

> Occupational therapy assessments intended for use in school-based practice should be designed to evaluate functional school-related skills, things the student has to do on a daily basis that give support to learning and define the student role. For example, students have to use pencils or other utensils to write and draw, and they have to handle books to read. They have to pay attention to teachers' instructions, and organize their desks and materials. These are

functional skills that support the student role. Enabling students to do daily classroom tasks, therefore, should be the domain addressed by occupational therapists working in schools. The overarching question that occupational therapists in the school system should try to address is: With what kinds of classroom tasks is the student having trouble and why? (p.6)

A review of the literature revealed a lack of appropriate assessments to address the needs outlined by Magalhaes. There were a number of developmentally-based product-oriented assessments with acceptable psychometric properties (Magalhaes, 1995). However all of these required removal of the child from their natural setting (the classroom) and frequently measured items that were not relevant to school functioning. The therapist using these assessments must do a lot of extrapolating to make the information useful. As well many factors influencing the child's performance, such as classroom expectations and peer interactions, have to be evaluated through inferences made from informal observation and interview. Whereas a structured developmental assessment requires assessment of a task under specific conditions, a functional assessment allows a child to use compensating strategies, special equipment or assistive devices to accomplish their goals. Although training in task analysis and assessment of the child as a whole provides O.T.s with a wealth of clinical judgment, this does not replace the need for reliable and valid assessment tools (Atchison, 1997). Valid and reliable assessment tools are needed to form a basis for intervention plans and outcome measures that a therapist can implement with confidence.

Construct Validity (PDMS-FM and S-AMPS)

Ongoing construct validation is needed to establish the clinical utility of an instrument (Streiner & Norman, 1995). In order to make accurate inferences from assessment results the clinician needs to be confident that the instrument being used is measuring the constructs they are intending to evaluate. The literature supports that the PDMS-FM assesses the construct of fine motor development (Folio & Fewell, 1983; King-Thomas & Hacker, 1987; Palisano & Lydic, 1984). The S-AMPS is a new instrument measuring two unidimensional constructs; 1) motor performance and 2) process performance. If the PDMS-FM measures the construct of fine motor development and the S-AMPS measures two unidimensional constructs of motor performance and process performance it would be expected that the PDMS-FM would correlate moderately with the S-AMPS (motor scale) and less well with the S-AMPS (process scale). Although the S-AMPS (motor scale) assesses both gross and fine motor skills, primarily fine motor tasks, similar to those in the PDMS-FM, are used for assessment increasing the hypothetical similarity of the motor constructs measured.

Review of the Peabody Developmental Motor Scale – Fine Motor (PDMS-FM)

Unless referenced specifically, the information about this instrument is taken from the test manual (Folio & Fewell, 1983).

The PDMS-FM was developed to identify children whose fine motor skills are delayed or aberrant relative to a normative group. Although the PDMS consists of both a gross motor and fine motor scale, only the fine motor scale was used in this study.

The fine motor subscale consists of 112 items divided into 6 age levels. These items cover the domains of grasping, hand use, eye-hand coordination and manual dexterity.

Administration and Scoring

In the PDMS-FM the construct of fine motor performance is measured by tasks involving manipulative activities using the hands. These include, coloring, cutting, drawing, and manipulative tasks of building with blocks, winding string, holding tools, moving and placing pennies and imitating finger movements. Items from the PDMS-FM are presented with standardized verbal and visual instructions. All items between basal and ceiling levels are presented. (Basal level is that level where the child passes all items. Ceiling is where the child scores 0 on all items or 1 on one item only.) These tasks are then scored, using criterion reference, as 0 = unable, 1 = approximates, or 2 = competent. The various tasks are identified under the headings of 1) grasping, 2) hand use, 3) eye-hand coordination and 4) manual dexterity and subscores are obtained by summing the corresponding item scores. Subscores and total score (sum of subscores) are then converted to percentiles and standard scores using the PDMS manual.

Psychometric Properties

Normative data were obtained in 20 states in the USA with an ethnic distribution approximating that of the U.S. census, (N = 617). A review of the literature revealed numerous studies assessing validity and reliability for the fine motor scale (Folio & Fewell, 1983; Cole, Finch, Garland, & Mayo, 1994; King-Thomas & Hacker, 1987; Palisano & Lydic, 1984; Russel, Ward & Law, 1994; Stokes, Deitz, & Crowe, 1990; Stephens & Haley, 1991). Although the ethnic distribution of the USA does not exactly match that of Canada this is not expected to negatively affect the use of this tool with Canadian children of the same age.

Reliability

Test-retest reliability was good with ICCs between .80 and .99.

Inter-rater reliability was good with ICCs between .95 and .97.

The Standard Error of Measurement (SEM) was .7- 2.6.

Validity

Concurrent – The PDMS-FM was found to correlate moderately with the West Haverstraw Fine Motor Developmental Test (.62) and the Bayley Mental Scale (.78). A low correlation was found with the Bayley Motor Scale (.17-.36). These correlations were as expected as the West Haverstraw Fine Motor Developmental Test and the Bayley Mental Scale contain many fine motor items while the Bayley Motor scale consists mostly of gross motor items.

Construct validity was established by demonstrating 1) the total raw scores of the normative sample increase as a function of age, 2) total scores and skill category scores are correlated (i.e.) children without identified motor problems who score well on one skill area should perform well on all, and 3) children in the normative sample obtained higher scores than children with identified motor problems except for the 0-5 month age range.

No predictive studies were found, using PDMS-FM scores of kindergarten children, to predict present or future school performance in fine motor areas.

Clinical Utility

The PDMS-FM has a number of strengths for clinical utility including:

1. The assessment is quick and easy to use. It takes between 20 and 30 minutes to administer the complete fine motor scale.
2. The assessment kit is comparatively inexpensive (approximately $135.00 U.S.). Test items not included in the kit are relatively easy to find and not expensive.
3. Anyone experienced in the area of early childhood motor development can administer the assessment without specific test training.
4. The manual provides standardized scores often needed to determine eligibility for programming.
5. The assessment has good standardization, reliability and validity.

However disadvantages of using the PDMS-FM for measuring fine motor productivity in the kindergarten classroom include:

1. It is an assessment of fine motor development only. Process skills must be evaluated by clinical judgment, which is not validated psychometrically and is dependent on the skill and clinical experience of the rater.
2. The assessment is done outside the natural environment of the classroom where the programming derived from the assessment results will occur.
3. Assessment items do not necessarily relate well to actual classroom tasks. An assessment of the classroom must also be made to integrate with the information from the PDMS-FM (e.g. effects of peers, environment, teacher style, etc).

4. A child's performance can be influenced significantly by their comfort with the testing situation. Pull-out individual assessment can be intimidating or rewarding to a child reducing or enhancing their performance from what they normally produce in the classroom.

Examples of sample items and scoring from the PDMS-FM are found in Appendix D.

In this study the PDMS-FM was chosen as the comparative instrument for the S-AMPS for a number of reasons. The review of the literature established the PDMS-FM as being both reliable and valid in assessing fine motor development of kindergarten aged children. As well this assessment is frequently used by occupational therapists to assess children having performance difficulties in kindergarten.

The S-AMPS addresses a number of the concerns identified as disadvantages of the PDMS-FM, hence it is being evaluated for applicability and clinical utility for use with children in kindergarten.

The School Assessment of Motor and Process Skills (S-AMPS)

Unless otherwise referenced specifically, information for the S-AMPS is from Fisher & Bryze (1998).

The S-AMPS is an observation based, criterion referenced, assessment conducted in the child's classroom setting. It was designed to provide school-based occupational therapists a valid and reliable means to evaluate a child's performance of functional school based tasks. The assessment was developed by modifying the Assessment of Motor and Process Skills (AMPS) (Fisher, 1997) which is a tool to evaluate the effectiveness of a person's functioning during the performance of activities of daily living (ADL).

Administration and Scoring

Students are observed in the classroom without interaction with the assessor. A number of tasks including cutting, coloring, printing, pasting, keyboarding and manipulatives have been identified for use in the assessment. The assessment of the task takes place from the beginning of the teacher's instructions to either task completion and clean up or transition to a new schoolwork task. Only those tasks identified in the S-AMPS manual are chosen for observation. However, as these tasks are routinely found in all classrooms, there is a great deal of flexibility in the specific product produced.

The S-AMPS uses similar tasks to the PDMS-FM to assess motor skills (e.g. printing, cutting, drawing, coloring, pasting, keyboarding and manipulatives). Criterion referenced scoring on a 4-point scale (1 = deficient, 2 = ineffective, 3 = questionable, and 4 = competent) is used to achieve a composite motor skill score. Motor items (N=16) are grouped under the headings of posture, mobility, coordination, strength & effort and energy. Process skills are also involved in the 'act of doing' which is the focus of the O.T. assessment. Using the same tasks, criterion referenced scoring (on the same 4-point scale), provides a composite process skill score. Process skill items (N=20) are grouped under the categories of attention, using knowledge, temporal organization, space & objects, and adaptation. Although process skills may influence a child's performance of fine motor skills they are not per se part of the construct of fine motor performance. See Appendix E for samples of tasks and items. Specific classroom expectations are considered in the scoring. These are determined through interviews with the teacher for clarification before and after the assessment. Two or three separate tasks are observed for a complete assessment. Ideally these should be tasks that have been identified by the teacher as problematic for the child.

Statistics for the S-AMPS require the use of multi-faceted Rasch analysis (Linacre, 1987-94). A child's performance is placed on a linear continuum through calibration of the difficulty of the task performed, the difficulty of the items passed, the number of items passed and the severity of the rater. See Rasch analysis p. 15.

Psychometric Properties

Numerous studies have established the validity and reliability of the AMPS (Fisher, 1997) (see also Robinson & Fisher, 1996; Goldman & Fisher, 1997; Fisher, Liu, Velozo, & Pan, 1992; Fisher, 1993; Nygard, Bernspang, Fisher, & Winblad, 1993; Magalhaes, Fisher, Bernspang, & Linacre, 1996; Dickerson, 1996) Studies to date that have established the validity and reliability of the S-AMPS include Atchison (1997), Magalhaes (1995), [Atchison & Fisher (in press), & Fisher, Bryze & Atchison (in press) as cited in Fisher & Bryze, 1998]. The latter two studies have been conducted using the second research edition of the S-AMPS. Atchison and Fisher (as cited in Fisher & Bryze, 1998) studied 54 students between 3 and 7 years who were typically developing or had educationally-related disabilities (e.g. learning disability, developmental disability, multiple disability). Fisher, Bryze & Atchison (as cited in Fisher & Bryze, 1998) studied 208 students aged 3 – 15 years who were typically developing or had educationally-related disabilities. These studies supported the psychometric properties of rater reliability and internal scale and person response validity of the S-AMPS, furthering the development of a functional assessment that can be implemented in the school systems.

Reliability

Intra-rater reliability was found to be perfect by Atchison (1997), (MnS1=1, z=0). It was acceptable (MnSq < 1.4, z <2) in the Atchison & Fisher study and was (MnSq <1.4, z< 2) for 5 out of 6 raters in the study by Fisher, Bryze, & Atchison (as cited in Fisher & Bryze, 1998).

Validity

Scale validity was assessed to be acceptable if 95% of the items fit the Rasch Model (see Rasch Analysis, p.15). Out of 20 items it would be acceptable if only 1 item did not fit the scale. Revisions to the process scale items were made from recommendations arising from the Magalhaes (1995), and Atchison (1997) studies. These were implemented in the subsequent two studies; Atchison & Fisher and Fisher, Bryze, & Atchison (as cited in Fisher & Bryze, 1998). In the most recent study by Fisher, Bryze & Atchison acceptable goodness of fit to the many faceted Rasch model was found for internal scale validity of tasks and skill items. An acceptable goodness of fit was reported for student responses, 93.3% on the motor scale and 89.5% on the process scale. The assessment continues to be revised to ensure unidimensionality of constructs.

Rasch analysis was also used to establish construct validity for the AMPS & S-AMPS. The ordering of the items was compared to how the items were expected to be ordered and also as to whether the order made clinical sense (Fisher, 1997; Andiel, 1995).

Rasch Analysis

Like its parent instrument, the AMPS, the S-AMPS was developed using the Rasch model. Fisher (1997) describes this process as:

> The many faceted Rasch model used to develop the AMPS *(and the S-AMPS)* is based on the assertions that a) a person is more likely to obtain a higher score on an easy skill item than on a hard skill item, b) easy skill items are more likely to be easier for all persons than are hard skill items, c) raters are more likely to award higher scores for easy skill items than for hard skill items, d) lenient raters are more likely to award higher scores to all persons than are severe raters, e) all persons are more likely to obtain higher scores on simple tasks than on more complex tasks, and f) persons with higher ability are more likely to score higher over all than are persons with lower ability. When items, tasks, raters, or persons (subjects or clients) demonstrate response patterns across the AMPS skill items and tasks that do not conform to these assertions, they do not demonstrate acceptable goodness-of-fit to the many faceted Rasch model of the AMPS. (p.27)

This model incorporates three fundamental concepts: 1) unidimensionality, 2) order, and 3) additivity. When scores are calibrated as described above and found to fit the model they are considered to measure a unidimensional construct. When only one construct is being measured it is possible to order the data along a linear scale in equal intervals. In this way the difficulty of the *tasks* (e.g. printing, cutting, keyboarding), *items* (motor e.g. bends, reaches, calibrates; process e.g. heeds, inquires, adapts), and *rater severity* are all calibrated onto two linear continuums of the constructs motor performance and process performance. Mathematically this is done through logistic transformation of the proportion of persons obtaining a given item score. A specific person's performance or the person ability measure is the estimated location of the person on that continuum. These scores are expressed in equal interval units of measurement based on the logarithm of the odds probability units or logits.

There are a number of clinical advantages when using Rasch analysis (Andiel, 1995):

1. Rasch analysis ensures unidimensionality of a scale through goodness of fit calibrations. When an instrument measures more than one construct (multi-dimensional) different patterns of scores can yield the same result leaving the clinician uncertain of the actual area of deficit.
2. Rasch analysis converts ordinal data into interval data. When measuring treatment efficacy a clinician needs interval data to make comparisons. Ordinal data does not indicate whether a change between 2 and 3 is more than, less than or equal to a change between 3 and 4. Uneven intervals between scores could result in what appears to be a plateau in a client's progress when in fact the distance to the next increment is just harder to achieve.
3. Rasch analysis allows for meaningful comparisons between different tasks. Because the scale is calibrated for task difficulty, test item difficulty, rater severity and subject performance different tasks can be placed on the same continuum for comparison. Because the scale is unidimensional it can be assumed that a person is capable of tasks lower than their placement level on the continuum and would have difficulty with tasks higher on the continuum. In this way the instrument is 'test

free' in that individuals do not need to be assessed on tasks that are either too easy or too difficult for them. This also provides flexibility of testing tasks, allowing for the client's interests and the availability of task items.

4. Rasch analysis is also described as 'sample – free'. This means that the normative data does not have to be derived from a representative sample. This allows the instrument to be used with clients from various cultures and with a variety of disabilities. Consistent differences between sample groups may provide diagnostic or prognostic profiles.

Clinical utility

Advantages of the S-AMPS include:

1. Inexpensive test materials and scoreforms.
2. Relatively quick to use.
3. Provides information on both motor and process skills.
4. Is relevant to classroom performance as it assesses actual school tasks in a naturalistic setting without assessor intervention.
5. Tasks can vary according to classroom environments, teacher style and student expectations. As well students can use adaptive strategies or equipment to accomplish the task.
6. Computer analysis provides information on a child's performance strengths and weaknesses and performance relative to peers.
7. Preliminary studies suggest good reliability and validity but further research is needed.

8. The S-AMPS has psychometric properties of Rasch analysis including unidimensionality, order and additivity.

Users of the S-AMPS must attend an administration and scoring course and be calibrated as a rater. The author of this study has completed the necessary requirements.

OBJECTIVE

The objective of this study was to investigate the construct validity of the S-AMPS. To do this the S-AMPS was compared with the PDMS-FM. Research questions were:

1. Do the PDMS-FM and the S-AMPS motor scale appear to be measuring a similar construct? (Correlation of PDMS-FM and S-AMPS motor score.)
2. Is there a relationship between the PDMS-FM and the S-AMPS process scale? (Correlation of PDMS-FM and S-AMPS process score.)
3. Are the same children identified as being 'at risk' by the two instruments? (Comparison of the children identified by each assessment)

METHOD

Subjects

42 children from five kindergarten classes from Edmonton Public Schools were included in the study. Sample size calculation is included in Appendix A. This was a sample of convenience and included all children in the kindergarten classes between the ages of 5 years 0 months and 7 years 0 months for whom parental permission was received. Children with a neuromuscular diagnosis (e.g. cerebral palsy, spina bifida), autism, severe sensory disability (e.g. severe vision or hearing impairment) or severe behavior problems cannot be assessed with the PDMS-FM using standardized testing procedures and so were excluded from the study.

The kindergarten classes were composed of children with a range of academic and motor abilities. Each class had 15-20 regular education students from the local community and 4 - 5 children with identified school related problems from the early education programs. Fourteen of the 42 children assessed were from the early education program, with the remaining 28 registered in the regular kindergarten program. The children from the early education programs had a variety of delays including speech, motor, perceptual or cognitive difficulties.

The catchment area composed of a mixture of lower and middle-income families. The children in the early education programs were bused from different parts of the south side of Edmonton and were from families with a variety of income levels.

Data Collection

This study was designed to evaluate a new assessment instrument (School Version of the Assessment of Motor and Process Skills, S-AMPS) for use in occupational therapy school-based practice. Two instruments were compared for construct validity.

Ethical approval as required by the University of Alberta and Edmonton Public Schools was obtained before the study was conducted. Consent forms were distributed by classroom teachers and returned to the principal investigator.

Each child was assessed using the S-AMPS and the PDMS-FM on the same day (morning or afternoon depending on the kindergarten placement of the child). Children were randomly assigned to groups where either the S-AMPS or PDMS-FM was given first.

The PDMS-FM was conducted with the rater and child at a child-sized table in a quiet room. As the S-AMPS is an observational assessment, administered in the classroom, the rater did not need to interact with the child. A number of classroom activities fit the S-AMPS criteria and were observed during regular classroom programming. See Appendix E for S-AMPS tasks. Each child was observed doing two tasks. A short interview with the teacher was conducted before the assessments to clarify issues such as; what product was in keeping with the teacher's expectations for a typically developing child and what level of independence and cleanup was expected.

The same rater assessed all subjects. The rater was not informed about the children's classroom performance or clinical diagnoses before assessment.

RESULTS

Each child was scored on the three different measures. Raw scores were converted to interval data. For the PDMS-FM, z scores were calculated using the test manual (Folio & Fewell, 1983). For the S-AMPS (motor scale) and the S-AMPS (process scale) logit scores were derived using the many-faceted Rasch measurement computer program (Linacre, 1987-1994).

Descriptive statistics of mean, standard deviation and standard error of mean are presented for the PDMS-FM, S-AMPS (motor scale) and S-AMPS (process scale) in Table 1. These provide an outline of how the data can be applied to a curve and can be used in analyzing the scatterplots in figures 1, 2, and 3.

Table 1 Descriptive Statistics

Descriptive Statistics of Mean, Standard Error, and Standard Deviation for the PDMS-FM, S-AMPS motor and S-AMPS process

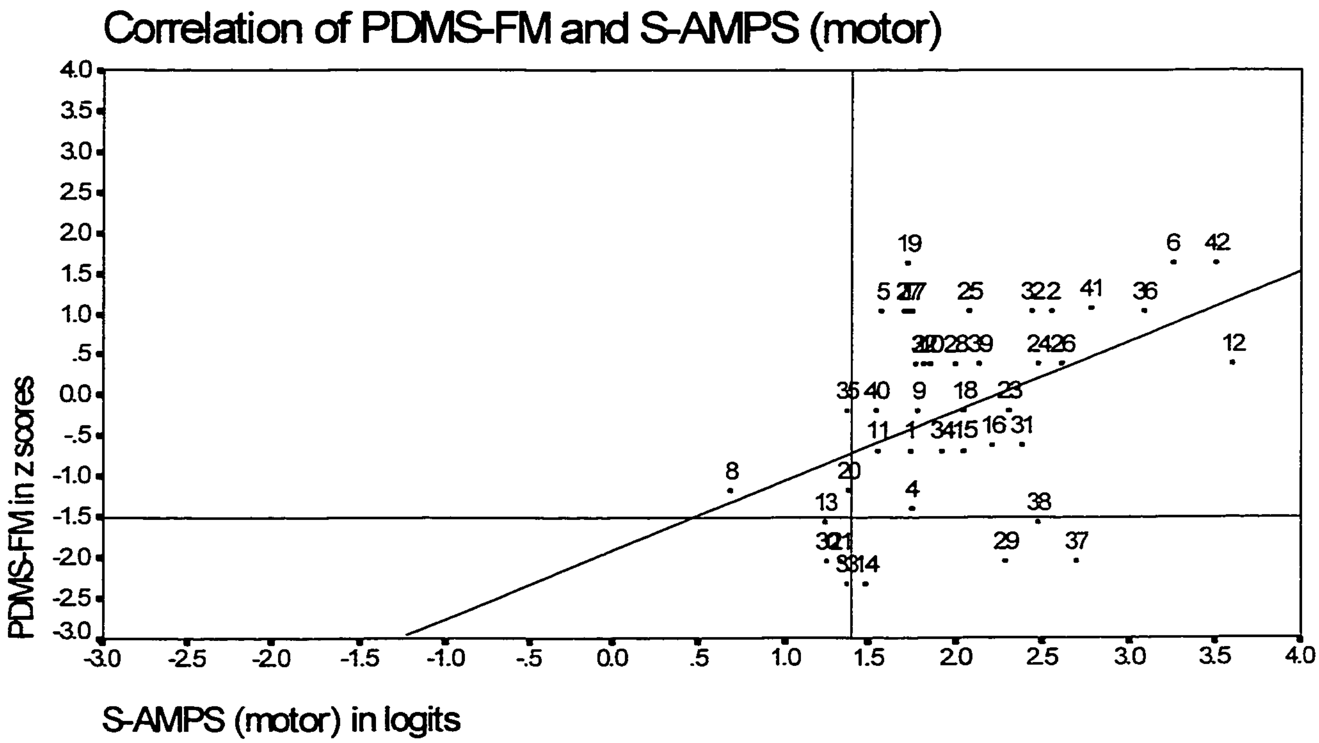
Variable	Mean	S.E. Mean	Std Dev	Minimum	Maximum	Valid N
PDMS-FM	-.17	.18	1.19	-2.33	1.64	42
SAMPSMOT	2.03	.10	.63	.69	3.60	42
SAMPSPRO	.73	.10	.67	-1.13	3.01	42

Pearson Correlation Coefficients were calculated to examine the relationship between each child's performance on each instrument. The results were as expected with the motor scale of the S-AMPS correlating higher with the PDMS – FM ($r = .4531$, $p < .005$) (Table 2, Figure1) than the process scale of the S-AMPS with the PDMS – FM ($r = .3485$, $p < .025$)(Table 3, Figure 2). A lower correlation than expected was found between the PDMS-FM and the S-AMPS (motor).

Table 2

Correlation of PDMS-FM and S-AMPS motor

	PDMSFM	SAMPSMOT
PDMSFM	1.0000 (42) P= .	.4531 (42) P= .003
SAMPSMOT	.4531 (42) P= .003	1.0000 (42) P= .



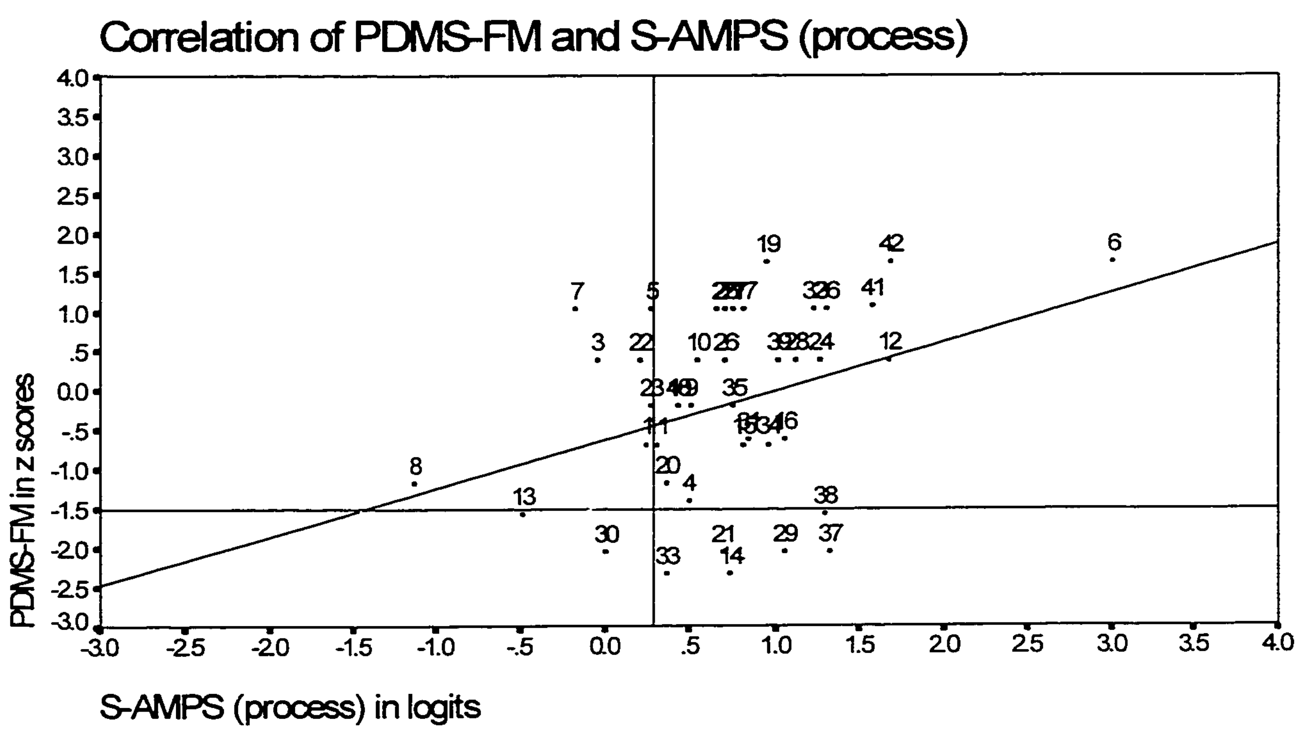
Horizontal & vertical lines indicate cut-off points
Diagonal line = line of regression (Y= a + bx)
Points on scatterplot are labeled with child ID numbers

Figure 1

Table 3

Correlation of PDMS-FM and S-AMPS process

	PDMSFM	SAMPSPRO
PDMSFM	1.0000	.3485
	(42)	(42)
	P= .	P= .024
SAMPSPRO	.3485	1.0000
	(42)	(42)
	P= .024	P= .



Horizontal & vertical lines indicate cut-off points
Diagonal line = line of regression (Y= a + bx)
Points on scatterplot are labeled with child ID numbers

Figure 2

Cut-off scores of 1.5 standard deviations below the mean were used to identify children "at risk". The PDMS-FM manual (Folio & Fewell, 1985) indicates that a child with a score below –1.5 standard deviations from the mean should be viewed as "at risk". No cut-off scores have been determined for the S-AMPS. Personal communication from Dr. Anne G. Fisher, June 21, 1999, co-author of the S-AMPS stated the following:

> Preliminary examination of the School AMPS data suggests the likelihood that the cut-offs will be similar to those on the AMPS. If this proves to be true, then children below 2.0 logits on the School AMPS motor scale are likely those who experience increased effort when performing school AMPS tasks. An important point here is that we expect younger, typically developing children to experience increased effort. Therefore, school motor ability measures below 2.0 should not necessarily be interpreted as evidence of a problem or performance that is not appropriate for one's age. Similarly, school process ability measures below 1.0 logit are likely ones that indicate that the child demonstrated inefficient use of time or space, evidence of a safety risk, or decreased ability to compensate for problems encountered during the course of his or her school work task performances. Again, younger children would not be expected to be efficient or to compensate, so, therefore, it is important not to interpret such findings as evidence of performance that is below age level.

As described by Dr. Fisher, considering all the children who score below the AMPS cut-off scores (motor 2.0 logits and process 1.0 logits) as "at risk" would be meaningless as most typically developing young children would fall in this range. Dr. Fisher's correspondence indicates that preliminary data suggest that cut-off scores will be similar to those of the AMPS. Subsequently, for this study, cut-off scores to determine children "at risk" on the S-AMPS motor and process scales were derived using the mean and SD of the AMPS data (Fisher, 1997) and a cut-off score of 1.5 SD below the mean (comparable to the PDMS).

Table 5 shows the Means and Standard Deviations for the AMPS and the study sample. The study sample was composed of a higher proportion of children with special needs than would be expected in the population as a whole. For this reason it was expected that the study means would be lower than the means for the population. Table 5 shows that the study means were lower as expected.

Table 5

Means and Standard Deviations of Study Sample and AMPS Data

	Study mean	AMPS mean	Study SD	AMPS SD
S-AMPS motor	2.03	2.50	.63	.70
S-AMPS process	.73	1.20	.67	.60

Of the 17 children identified by one or both of the instruments as being "at risk" only 4 children were identified by both instruments.

Four children were identified as being "at risk" by both the PDMS-FM and the S-AMPS (motor scale). As well four children were identified by the PDMS-FM that were not identified by the S-AMPS (motor scale) and three children were identified by the S-AMPS (motor scale) that were not identified by the PDMS-FM. See Table 6, Figure 1. Two children were identified by both the PDMS-FM and the S-AMPS (process scale). Both had also been identified with the S-AMPS (motor scale). The S-AMPS (process scale) also identified six children that were not identified by either the PDMS-FM or the S-AMPS (motor scale). See Table 6, Figure 2.

Table 6

Children identified as 'at risk'

Numbers indicate subjects ID – see Appendix F

PDMS	S-Amps Motor	S-Amps Process
		3
		5
		7
	8	8
		11
13	13	13
14		
	20	
21	21	
		22
		28
29		
30	30	30
33	33	
	35	
37		
38		

DISCUSSION

The objective of this study was to examine the construct validity of the S-AMPS by comparing this new assessment to an established measure, the PDMS-FM. Three research questions were posed:

1. Do the PDMS-FM and S-AMPS (motor scale) appear to be measuring a similar construct?
2. Is there a relationship between the PDMS-FM and the S-AMPS (process scale)?
3. Are the same children identified as being 'at risk' by the two instruments?

A discussion of the findings follows under three primary headings: construct validity, identification, and clinical utility.

Construct Validity

It was hypothesized that there would be a moderate correlation between the PDMS-FM, a measure of fine motor development and the S-AMPS (motor scale) a new measure of goal-directed school motor skills (using predominantly fine motor tasks). A low-moderate correlation (.4531) was obtained, suggesting the constructs measured are not as similar as expected.

A lower correlation was found between the PDMS-FM and the S-AMPS (process scale) (.3485), than the PDMS-FM and S-AMPS (motor scale). This suggests that though the S-AMPS (motor scale) is not measuring the same construct as the PDMS-FM there are elements in common in the fine motor domain.

The PDMS-FM has been validated as measuring the construct of fine motor development (Folio and Fewell, 1983) while the S-AMPS is described by the developers as: "...a systematic and thorough way of examining the transaction between the student, the schoolwork task, and the environment, and evaluating the quality of a student's schoolwork task performance, measured at the level of disability and not impairment." (Fisher and Bryze, 1998, p.5). Thus while the PDMS-FM evaluates the construct of fine motor development, the construct represented by the S-AMPS (motor scale) appears to be better labeled as school related fine motor performance. The low correlation between the two tests revealed in this study is most likely influenced by both the different constructs represented in the two tests and the very different assessment processes.

The PDMS-FM specifically targets performance of fine motor skills (e.g. grasping, cutting, drawing, block construction). These items are criterion referenced with time to completion and accuracy contributing to the fine motor performance score. The S-AMPS (motor scale) incorporates a broader view of motor performance by including measures of strength, endurance and fine motor skills as they apply to the student role. With the S-AMPS (motor scale) the child's performance is assessed considering the ease, fluidity, effectiveness and control of their movements and not on the outcome (e.g. circular form, or straightness of a line). Only two or three tasks (activities) are included in any individual S-AMPS assessment, which may limit the variety of fine motor skills tapped.

The S-AMPS measures school related fine motor performance within the context of activity, role and environment. It addresses the performance components, areas and contexts outlined in two important models: Canadian Model of Occupational

Performance (CAOT, 1997b) and the Model of Human Occupation (Kielhofner, 1995). The S-AMPS is ideally suited for use in the practice of O.T.

In addition to differences in construct, the assessment processes used in administration of the tests are also very different. The PDMS-FM employs a standardized procedure in a controlled setting. All children are assessed at a child-height table, situated in a quiet room, using specific materials, tasks and instructions and cueing procedures. These procedures are employed to minimize the influence of factors within the child other than fine motor ability, (e.g. language, intelligence or process skills), and to control the environment. In contrast the S-AMPS (motor scale) measures the child's motor performance within the naturalistic setting. Motor performance is being measured in the context of the child's ability to function in their student role. Factors such as the task difficulty are accounted for in the scoring procedures and judgements on the environmental influences are noted on the score form. While the PDMS-FM attempts to minimize the influence of factors such as process skills the S-AMPS attempts to quantify process skills during motor performance in order to determine the relative effect upon the child's performance.

These differences in item content and assessment process can have a significant effect on a child's performance. A child who is distractible or lacks the ability to initiate and sequence tasks may perform much better in the structured, one-to-one environment required to administer the PDMS-FM where these factors have been minimized and they are able to concentrate on their fine motor performance. Another child who is anxious about new situations and new people, has auditory processing problems and /or lacks adequate grip strength may actually perform better in the classroom where the setting is familiar, the teacher's pattern of giving instructions is known, and there are other children to take visual cues from. Adaptations available in the classroom such as easy grip scissors and temporal flexibility such as alternating their cutting with other tasks can improve their performance by reducing fatigue. It would follow then that a child who performs poorly on the PDMS-FM would not necessarily perform as poorly on the S-AMPS (motor scale) and vice versa.

It would also follow that a child who performed poorly on the PDMS-FM may perform very well on the S-AMPS (process scale) where fine motor product is not being measured but rather the child's approach to the task. In reverse a child with attention problems in a busy classroom environment, but ability to control their focus in a structured one-to-one setting would score very poorly on the S-AMPS (process scale) but show no deficits on the PDMS-FM.

Given the marked differences in the content and administrative procedures for the PDMS-FM and S-AMPS (motor scale) the two assessments are not measuring the same constructs, but there are sufficient common elements to explain the level of correlation found between the two scales in this study. It is common for children who have difficulty in school to show deficits in a number of areas (e.g. both motor and process skills). As well many children perform well in both areas. These children would create some correlation between the PDMS-FM and S-AMPS (process scale), which would explain the correlation found between these two scales.

Identification

Of the 17 children identified by either the PDMS-FM or the S-AMPS, only four children were identified as "at risk" by both assessments. The two assessments did not appear to identify the same children, which supports the previous finding that the two assessments are measuring different constructs. A breakdown of which children were identified by which assessment is found in Table 6.

Many factors contribute to the difficulty in determining which test is better at identification of children "at risk". They include lack of psychometric development of cut-off scores on the S-AMPS, different constructs of the tests, a heterogenic population, and lack of a gold standard to independently evaluate the abilities of the children. As cut-off scores are not yet available for the S-AMPS those determined for this study may not have accurately identified children who did poorly on this assessment. The sample in this study was composed of a very heterogeneous population with a variety of problems including none, speech and language, fine motor, attention deficit or multiple difficulties. Different tests may be better at identifying different problems. Whereas the PDMS-FM is designed to identify only those children with delayed or aberrant fine motor skills the S-AMPS might identify children having difficulty with classroom motor tasks for a variety of reasons.

Results of the study were shared with each child's teacher. From this, exchange the researcher was able to gauge how well the assessment results matched the teacher's perception of the child's performance. The S-AMPS appeared to reflect the degree of concern expressed by the classroom teachers more closely than the PDMS-FM. As both the S-AMPS and the teacher evaluation apply to the same tasks, under similar conditions, the probability of achieving better understanding of the strengths and weaknesses in the child's performance is considerably higher.

Three of the four children identified by the PDMS-FM, but not the S-AMPS, were not considered to be having problems by their classroom teacher and would not have been referred for occupational therapy services. Of the three children, who were not identified by their teachers, one was having an allergic reaction to the playground environment, which may have affected his performance. Each child's assessments were conducted in the same half-day; however, suggesting his ability to concentrate and perform on the classroom tasks assessed by the S-AMPS should have been similarly affected by his allergic reaction. Additionally the assessment was conducted within one month following this child's 6^{th} birthday, placing him in a higher age group on the PDMS-FM. Had he been assessed a few days earlier, his normative group would have been younger and he would not have been identified as "at risk". Similarly another child not identified by the teacher was assessed on her birthday making it necessary to compare her performance to a different normative group. If she had been assessed the day before she would not have been identified as 'at risk'. A third child, identified by the PDMS-FM only, was identified by the classroom teacher as having speech and language concerns, but had not been referred for occupational therapy services or identified as having significant fine motor problems. The fourth child, who had been identified by her teacher, was severely visually impaired. It was notable that this child was not one of the identified early education, special needs children in the classroom. She was attending her community kindergarten, and had only been identified at this school as needing service after she arrived. Her score on the S-AMPS (motor scale) was just above the identified cut-off for this study.

Of the four children identified as “at risk” by the PDMS-FM and the S-AMPS (motor scale), two of them were also identified by the S-AMPS (process scale). In post-assessment discussions with the classroom teachers they had concerns about the performance of all four children. Three were identified as "at risk" by the S-AMPS (motor scale), but not by the PDMS-FM. One of these was also identified by the S-AMPS (process scale). All of these children had been identified by their teachers and referred for occupational therapy services.

It was noted that four of the six children identified by the S-AMPS (process scale), but not the PDMS-FM or S-AMPS (motor scale) were not formally identified by their classroom teachers. In each case the children's performance was affected by their distractibility and off-task behavior during an unstructured center activity in a rather chaotic environment. Further investigation would be necessary to see if this was typical of their performance. The other two children had been identified by their teachers and referred for occupational therapy services.

Clinical Utility

As the PDMS-FM and the S-AMPS do not appear to be measuring the same constructs one assessment is not a substitute for the other in the clinical setting. Use of the assessments needs to be evaluated by the clinician according to the information desired. Assessment is done for a variety of reasons:

1. Identification for purposes of qualification for services or funding
2. Evaluation for treatment planning and intervention
3. Evaluation of progress
4. Prioritizing service delivery.

1. Identification for purposes of qualification for services or funding

At present the PDMS-FM is being used as one measure for establishing a child's need for service within the school system where the study was conducted.

The S-AMPS needs further development, including established cut-off scores, in order to be used effectively for identification. Once established however this assessment of complex task performance could identify occupational performance deficits that would directly measure areas of concern to teachers. In the school system O.T.'s are hired primarily to support classroom staff making response to teachers concerns paramount. The S-AMPS would also provide an assessment that responds to the recommendation of a 'top down' assessment approach outlined at the 1991 Symposium on Measurement and Assessment: Direction for the Future in Occupational Therapy (Coster, 1998). This approach suggests assessment should initially focus on a child's ability to participate in a life role such as that of a student and how the child is able to perform the necessary tasks and activities inherent in this role.

2. Evaluation for treatment planning and intervention

The four children (Child A, B, C, and D) who were identified by both the PDMS-FM and S-AMPS (motor scale) are described in the following section to compare and contrast the information obtained from the two evaluation tools.

The PDMS-FM gives normative data in four areas of fine motor development:

A. Grasping

B. Hand use

C. Eye Hand Coordination

D. Manual Dexterity

(See appendix D)

For the developmental level of the children assessed in this study (i.e. kindergarten) all 42 children achieved maximum scores on the areas of grasping and hand use so discriminative information was only available on eye hand coordination and manual dexterity.

The S-AMPS categorizes the motor information into 16 items under 5 categories:

A. Posture

B. Mobility

C. Coordination

D. Strength and effort

E. Energy

The process items are categorized into 20 items under 5 categories

A. Energy

B. Using Knowledge

C. Temporal Organization

D. Space and Objects

E. Adaptations

(See appendix E)

Child A

On the PDMS-FM Child A had a delayed score on eye hand coordination but did not have trouble with manual dexterity. Specific observations included apparent difficulty with spatial relations or attention to detail in block designs, trouble folding paper accurately, questions about whether he understood instructions for coloring within the lines, a lack of attention to detail and evidence of tongue overflow when drawing. He held his pencil with a mature tripod in the right hand and stabilized his paper appropriately with the left. He completed all tasks required of him, but did not appear too concerned about the products.

Two tasks were scored using the S-AMPS yielding the following observations. Child A moved smoothly around his environment without evidence of gait, balance or navigation problems. When seated he sometimes leaned to one side or the other but did not appear to have problems with postural stability or strength. Some awkward positions such as leaning back in his chair, sitting on one foot and leaning on the hand needed to stabilize the paper interfered with his ability to print and cut neatly. Leaning back in the chair also created a safety issue that required repeated intervention by the teacher. Other safety issues were noted. He repeatedly poked himself with the pencil, dropped it and once inadvertently hit himself in the eye with it. Some fine motor coordination difficulties were noted: repeatedly dropping tools, misdirection of glue, poor quality cutting, excessive effort squeezing the glue bottle, excessive pencil pressure and overflow tongue movements. He held his pencil in a mature tripod grip with the right hand. Although his fine motor products (e.g. printing and cutting) were of acceptable quality for kindergarten, the quantity produced was below his teacher's expectations. The most significant deficits noted were in the areas of process skills. This child required repeated redirection by the classroom teacher to accomplish anything. Classmates, visual stimuli and what appeared to be internal factors distracted him. He was not able to attend to the initial instructions or the task at hand without frequent redirection including help with initiating, continuing and terminating the task. He had not internalized classroom expectations for the sequence or details of the task or for rules of sharing tools and cleaning up, though he had done similar tasks for eight months. He did not consistently use tools for their intended purposes or handle them correctly and did not organize his personal workspace. There was no evidence that he was able to successfully modify his performance for more than one to two minutes after redirection. Child A was producing poor to mediocre fine motor products in the classroom. The most significant contributing factors however appeared to be in the areas of attention and organizational skills required to perform these tasks.

Child B

Child B showed deficits in both eye hand coordination and manual dexterity on the PDMS-FM. Poor manipulative skills were characterized by shaky and slow movements. She had difficulty coloring within the lines, drawing diagonals and folding paper. She demonstrated a mature tripod grip of her pencil with the right hand and was able to dissociate finger movements to use scissors. Scissors skills were not established so she snipped rather than cut.

On the S-AMPS tasks Child B demonstrated difficulty with postural control, fine motor coordination, strength and effort, pace, spatial and temporal organization, using her knowledge and adapting to overcome her difficulties. She did not sit squarely in her chair, consistently leaning to one side or the other, shifting position and positioning her body in an awkward manner to handle the tools. Her upper extremity movements were shaky and very slow. She demonstrated awkward grip of crayons and the seeds she was gluing, as well as excessive squeezing of the glue bottle. She frequently dropped the seeds she was working with. Although Child B was able to complete the task with only one intervention from staff she asked numerous questions that she should have known the answers to. As well the difficulty of her task completion was compounded by her disorganization of her workspace.

Child C

Child C demonstrated problems with eye-hand coordination and manual dexterity on the PDMS-FM. His skills were not scattered but appeared to show overall fine motor developmental delay. He demonstrated a mature tripod right-hand pencil grasp and was able to use scissors independently, but movements were jerky and imprecise.

On the S-AMPS this pattern of overall delay was evident in process skills as well as motor skills. Child C required a significant amount of adult intervention to complete the task both in a structured and in a less structured task setting. His work was influenced by poor posture, poor fine motor coordination, increased effort and an erratic pace. He lacked independent work skills having difficulty initiating, continuing or terminating a task without intervention. He did not handle tools and materials in an acceptable manner and was disorganized in his task approach including a lack of attention to detail. Distraction by the environment and self-distraction influenced his progress.

Child D

Child D appeared to have developmental delays in many areas. He had difficulty on the PDMS-FM in both eye-hand coordination and manual dexterity. Although he held both crayons and scissors with his right hand he did all manipulative tasks such as moving pennies and putting raisins in a bottle with his left hand. He demonstrated a mature tripod pencil grip and consistent pencil pressure but had difficulty controlling the pencil direction.

On the S-AMPS Child D demonstrated no difficulty with mobility and appeared posturally secure in his chair. However he tended to lean on his hand while drawing or coloring and positioned his arm in awkward postures. His printing and coloring product was effected by an awkward pencil/crayon grip, difficulty manipulating tools and jerky movements. Work was generally slow. He was disorganized both spatially and temporally in his task approach. He did not always appear to know what was expected of him, needed adult intervention to begin, sequence and finish a task and did not always attend to the teacher when she was speaking. Both S-AMPS tasks observed with Child D were fairly structured table tasks. It is hypothesized that the types of problems he was having would have been exacerbated in a nonstructured setting.

The information obtained from the S-AMPS provided a more comprehensive picture of the child's performance in the classroom. This information could easily be interpreted to identify problem tasks, environmental factors, lack of supportive equipment and difficulties with task approach outlining areas for OT consultation and intervention. Using a 'top down' continuum, further investigation of specific activity performance such as isolating fine motor skills could proceed from this assessment with the use of the PDMS-FM. Continuing further there may be a need for assessment at the level of impairment (e.g. muscle, ROM or strength testing).

An example of an O.T. approach to intervention using this information is given for Child B. After assessment with the PDMS-FM the O.T. would do an observational assessment in the classroom to determine how the deficits noted were effecting the child's occupational performance. Indicators of strength and coordination issues might indicate further testing of these components using a dynamometer and a screening tool looking at soft neurological signs. Using this information the O.T. would consult with the classroom teacher about adaptive equipment and compensatory techniques the child might use in the classroom to minimize these deficits. If appropriate, individual treatment might be arranged.

After using the S-AMPS the O.T. would consult with the teacher about seating height and position to maximize the child's stability and functional posture. Equipment adaptations such as glue sticks or liquid glue applied with a popsicle stick might be suggested to compensate for the difficulty squeezing the glue bottle. The child might be encouraged to use adaptive materials such as fatter or triangular crayons and easy grip scissors. Both the child and the teacher would be counseled on the need for stable body position when doing manipulative tasks including stabilization of the arm to minimize shakiness. Organization of the workspace, visual cue cards of the instructions and monitoring the child's attention during verbal instructions might be valuable in managing her process difficulties. Further investigation and/or intervention may involve tests of specific skills (e.g. PDMS-FM) or impairments (e.g. dynamometer) if the O.T. has further questions or if remediation does not result in improved performance.

The most significant difference between the two assessments is the immediacy with which the O.T. is able to understand the teacher's concerns and address them. In order to consult effectively the O.T. needs to understand the strengths and weaknesses of the child as well as the tasks they are expected to perform and the environmental factors that may influence their performance. The S-AMPS provides a framework for a detailed analysis of all of these factors, obtained in a short amount of time without disrupting a child's classroom routine. The PDMS-FM must be combined with an additional assessment time to observe classroom performance. However, at present, this observation is not psychometrically established. Although both assessments will give valuable information for providing intervention the S-AMPS is ecologically more sensitive and more efficient.

3. Evaluating Progress

Outcome measures and program evaluation are necessary for justification of the occupational therapy role in school based practice. In order to be valuable for evaluating progress an assessment needs to be sensitive to change. The S-AMPS has potential for being a valuable tool in this area. It is changes in the child's productivity in the classroom that we want to measure or their ability to perform their student role. Assessment in the naturalistic environment may be more sensitive to these changes when they are the result of environmental modifications or adaptations, and modifications made by the child, which result in increased functional performance. When used for evaluating progress the standardized PDMS-FM administration precludes the use of adaptations to the environment or many compensations developed to improve productivity in the classroom. If the underlying impairment remains then reassessment with these tests may reflect little or no change beyond that expected with developmental maturation. Another problem in measuring change is the measurement error associated with measuring at only two points in time, pretest and posttest. For reliability of results standardized tests can only be given with a minimal interval between pretest and posttest. This is primarily to reduce the learning effects on performance of the test items. In clinical practice this interval may be too long for continuation of intervention without some measurement of effectiveness. Again the clinician needs to rely on psychometrically unsubstantiated methods in the interim.

An observational test such as the S-AMPS does not require a fixed interval between administrations, as there are no prescribed, standardized, tasks to create a learning effect. Reevaluation can be done periodically giving multiple observations across time, which limits the effects of measurement error (Streiner & Norman, 1995).

Developmental tests are normed within a certain population or age range. In the case of the PDMS-FM this is children between birth and seven years. The ability of these tests to discriminate is lessened at either end of the range by baseline and ceiling effects. As well the nature of the tasks and method of administration will be tailored to a certain group. The types of tasks and method of interaction used in the PDMS-FM, for example, would not be socially appropriate for a child in late elementary or middle school. Observational tests of functional performance such as the S-AMPS, however, are not limited by these factors and can be applied to age appropriate tasks across the life span. This allows clinicians multiple comparisons as opposed to continuous switching of evaluation tools as the child moves out of the normed age range.

4. Prioritizing intervention

As consultants in school-based practice, the OT is called upon to provide service to maximize the child's ability to benefit from classroom instruction. In order to maximize successful intervention, occupational therapists need to be able to determine what type of intervention will be best suited to each client. Measurement of change can be used not only to monitor the effectiveness of intervention with an individual client, but also to measure effectiveness of programs across clients, and to determine prognostic indicators for positive response to intervention. Economic reality forces the issue of accountability. Efforts need to be made to identify the effectiveness of treatment approaches, and in matching the approaches to the client. A method of collecting relevant data frequently, within a clinical setting, contributes to the development of occupational therapy professional knowledge and benefits to the client. The S-AMPS could provide such a method.

CONCLUSIONS

The PDMS-FM and the S-AMPS (motor scale) do not measure the same construct though there are common elements. Whereas the PDMS-FM measures the construct of fine motor development the S-AMPS (motor scale) appears to be measuring school related fine motor performance. Similarly there are commonalties to a lesser degree in the PDMS-FM and the S-AMPS (process scale) but they are not measuring the same construct. The two assessments did not identify the same children as "at risk".

Both assessments have clinical utility for the occupational therapist working in school-based-practice but one assessment is not a substitute for the other. Further development of the S-AMPS including cut-off scores is needed for this assessment to be used to identify children for eligibility criteria. The S-AMPS demonstrates strengths in providing information on a child's productivity abilities and limitations in their role as a student. Obtained in the actual classroom situation, this information is easily applicable to consultation and intervention in classroom modifications, adaptations and compensatory strategies. The S-AMPS measures actual changes in classroom performance, allowing the child the benefit of environmental modifications and compensatory strategies. Multiple evaluations over time allow a more accurate assessment of change in performance, which can be used to assess effectiveness of treatment approaches for that child, and continued need for service. This evaluation is not restricted by pretest – posttest intervals or limited by normative age limits. The S-AMPS, being a psychometrically sound assessment and one that is easily administered, should provide a valuable tool for assessment, treatment planning and evaluating change of children in school settings. As well it is a useful tool for the advancement of clinical knowledge and accountability for the occupational therapy profession.

LIMITATIONS AND FUTURE RESEARCH

This study was conducted using a sample of convenience of kindergarten children from regular and special education in Edmonton, Alberta, Canada. Replication of results, with children of other ages, giving greater attention to variations in socio-ethnic backgrounds is needed before these findings can be generalized. As well, the high prevalence of children with identified special needs in this sample may have resulted in higher correlations than would have been obtained had children been randomly drawn from the general school population.

The S-AMPS (motor scale) appeared to identify children who had been recognized by their classroom teachers as in need of assistance better than the PDMS-FM. The usual method of referral in school-based practice is through teacher identification and referral. This referral process then would screen those children who would be evaluated using the S-AMPS in clinical practice. A study correlating the scores of children identified by the S-AMPS (motor and process scales) as needing intervention and those identified by their classroom teachers as needing services would be valuable. This type of study would look at the referral process and whether those children who may benefit from occupational therapy services are indeed being referred to O.T.

Continued reliability and validity studies of the S-AMPS will contribute to its clinical utility. It appears that the S-AMPS would be an ideal tool for evaluation of outcomes in the clinical setting. Studies are needed looking at change measurement using this tool. The naturalistic aspect of the S-AMPS makes it easily translatable into classroom programming and consultation. Clinical trials using this assessment would provide feedback to guide clinicians in its possibilities for clinical utility.

As cautioned by Magalhaes (1995), Atchison (1997), and Fisher & Bryze (1998), it is important to choose an assessment task that is a challenge for the child in order to maximize observations. For the purposes of this study no prior knowledge was obtained about the children before assessment, beyond eligibility for participation. Tasks, therefore, were chosen to accommodate the setting and time. In clinical usage, prior discussion with the classroom teacher would reveal referral concerns about the child, which would allow the occupational therapist to choose tasks with the appropriate level of challenge. It is likely that this choice would result in increased reliability of the assessment results.

The S-AMPS is in the early stages of development and the instrument and the process show promise of providing useful information that is directly related to program development. However, cut-off scores need to be determined and further research will need to be published which demonstrates how this assessment procedure facilitates intervention before it will be considered to be an effective evaluation of the need for special services (i.e., additional expenditure) within school systems.

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Appendix A

Calculation of Sample Size (Kraemer & Thiemann, 1987)

Where n = v + 2

v = (p-po)/(1-ppo)

With .80 considered an acceptable Pearson Product Moment Correlation Coefficient and .60 considered too low:

(.80-.60)/1-.8x.6) = .38

Using the table with an alpha of .05 on a one-tailed test and a power of 80%, v = 40

v + 2 = 42

Appendix B

Information Letter

Title Construct Validity: A Preliminary Comparison of the Peabody Developmental Motor Scale – Fine Motor and the School Version of the Assessment of Motor and Process Skills.

Investigators:

Pat Fingerhut, BSc.OT (C) (Formerly occupational Therapist for the Hazeldean Early Education Program). This study is in partial fulfillment of a Master of Science in Occupational Therapy at the University of Alberta.

Dr. Helen Madill, Supervisor, Department of Occupational Therapy, U. of A.
Dr. Sharon Warren, Rehabilitation Research Centre, U. of A.
Dr. Megan Hodge, Department of Speech & Language Pathology, U. of A.
Dr. Johanna Darrah, Department of Physical Therapy, U. of A.

Background & Purpose:

This study is being done in the kindergarten classes at Hazeldean School. We are looking at a new assessment called the School Version of the Assessment of Motor and Process Skills. The assessment is to see if children are having difficulty with skills such as drawing, printing and cutting. Children who are having difficulty with these skills are often referred to occupational therapy for assistance. This test would allow them to be assessed in the classroom.

Procedure:

Two assessments 1) School Version of the Assessment of Motor and Process Skills (S-AMPS), and 2) Peabody Developmental Motor Scale – Fine Motor (PDMS-FM) will be given to each child. We will compare the two tests to see how similar the information is. Both assessments involve the child doing drawing, cutting, pasting and playing with toys. The S-AMPS involves 10-20 minutes watching the child at work during center time in the classroom. The PDMS-FM will be 10 – 20 minutes of similar tasks at a quiet table in the red room. Your child will be assessed on one day only during their kindergarten time. Half the children will receive the PDMS-FM first and the other half will receive the S-AMPS first. Assessments will take place in January and February 1999. All children will receive a small gift.

Benefits and Risks:

The PDMS-FM is used in the Hazeldean early education program. The children generally enjoy the activities. The S-AMPS involves watching your child working in the classroom. There are no known risks to the children. The information will be used to help develop better ways to help children prepare for grade one.

Confidentiality:

All results will be confidential. If your child has any difficulty with the assessments his/her teacher will be informed. If the teacher has similar concerns they will seek your permission to make a referral to occupational therapy services with Edmonton Public Schools. The data will be stored in a secure place accessible by only the research team for a period of 7 years. At this time it will be destroyed.

Freedom to Withdraw:

You can choose not to participate or to withdraw from the study at any time without any negative consequences. Your child's unwillingness to participate will be accepted as withdrawal. You can also choose to withdraw your child's information from the study at any time.

Contacts:

If you have any questions please contact:

Ellen Olgilvie, Principal, Hazeldean Elementary School, 433-7583 or
Dr. Helen Madill, Professor and Supervisor for this thesis, Department of Occupational Therapy, U. of A., 492-2342.

If you have any concerns about any aspect of this study, you may contact Dr. Anne Rochet, Associate Dean of Graduate Studies and Research in the Faculty of Rehabilitation Medicine, University of Alberta at 403-492-9674. Dr. Rochet is independent from the study investigators.

Appendix C

CONSENT TEMPLATE

Title of Project: Construct Validity: A Preliminary Study of
the Peabody Developmental Motor Scale – Fine Motor and
the School Version of the Assessment of Motor and Process Skills

Principal Investigator: Pat Fingerhut, BSc.OT (C) 281-398-5866

Co-Investigators:

Dr. Helen Madill, Professor, Dept. of Occupational Therapy 780-492-2342
Dr. Johanna Darrah, Professor, Dept. of Physical Therapy 780-492-9142
Dr. Megan Hodge, Professor, Dept. of Speech Pathology and Audiology 780-492-5898
Dr. Sharon Warren, Director of Research, Faculty of Rehabilitation Med. 780-492-7856

Do you understand that your child has been asked to be in a research study? Yes No

Have you read and received a copy of the attached information letter? Yes No

Do you understand the benefits and risks of this study for your child? Yes No

Have you had an opportunity to ask questions and discuss this study? Yes No

Do you understand that you are free to refuse to participate or withdraw your child from the study at any time? You do not have to give a reason and it will not affect your child's schooling. Yes No

Has the issue of confidentiality been explained to you? Do you understand who will have access to your child's results (i.e. The research team and the classroom teacher)? Yes No

Do you understand that your child's assent will be assumed by their willingness to participate? Yes No

This study was explained to me by: ________________________________.

I agree for my child to take part in this study.

________________________________ ________________________
Name of Research Participant Date

________________________________ ________________________
Signature of Participant's Parent/Guardian Printed Name

I believe that the person signing this form understands what is involved in the study and voluntarily agrees for their child to participate.

________________________________ ________________________
Signature of Investigator or Designee Date

Appendix D

Sample items from the Peabody Developmental Motor Scale – Fine Motor (PDMS-FM)

Fine Motor Scale continued

	Skill Categories A	B	C	D		
15-17 Months						
55. Unwrapping Cube		___				
56. Filling Cup			___			
57. Building Tower			___			
58. Imitating Scribble			___			
59. Grasping: Pronation	___					
60. Placing Pegs			___			
61. Removing Socks		___				
62. Inserting Shapes			___			
Cumulative Maximum	42 +	40 +	38 +	4	=	124
18-23 Months						
63. Placing Pellets				___		
64. Separating Beads		___				
65. Turning Pages				___		
66. Inserting Shapes			___			
67. Building Tower			___			
68. Imitating Stroke			___			
69. Stringing Beads				___		
70. Snipping Scissors			___			
Cumulative Maximum	42 +	42 +	46 +	10	=	140
24-29 Months						
71. Turning Knob		___				
72. Placing Rings			___			
73. Removing Cap				___		
74. Separating Beads		___				
75. Imitating Stroke			___			
76. Building Train			___			
Cumulative Maximum	42 +	46 +	52 +	12	=	152
30-35 Months						
77. Building Tower			___			
78. Building Bridge			___			
79. Copying Circle			___			
80. Washing Hands		___				
81. Unbuttoning Buttons				___		
82. Cutting Paper			___			
Cumulative Maximum	42 +	48 +	60 +	14	=	164
36-41 Months						
83. Showing Hand Preference		___				
84. Removing Cap		___				
85. Stringing Beads				___		
86. Winding Toy				___		
87. Cutting Line			___			
88. Copying Cross			___			
Cumulative Maximum	42 +	52 +	64 +	18	=	176

Sample Scoring for child X

Age 60 months

Skill Categories

A = Grasping
B = Hand Use
C = Eye–Hand Coordinatio[n]
D = Manual Dexterity

Scoring Criterion Reference (0,1,2)

Fine-Motor Scale continued

	Skill Categories				
	A	B	C	D	
42-47 Months					
89. Tracing Line			___		
90. Holding Marker	___				
91. Copying Cross			___		
92. Copying Square			___		
93. Cutting Circle			___		
94. Lacing Shoe				___	
Cumulative Maximum	44 +	52 +	72 +	20 =	188
48-59 Months					
95. Dropping Pellets				___	
96. Buttoning Button				___	
97. Building Gate			___		
98. Folding Paper			___		
99. Cutting Square			___		
100. Placing Clips			___		
Cumulative Maximum	44 +	52 +	80 +	24 =	200
60-71 Months					
101. Connecting Dots			___		
102. Building Pyramid			___		
103. Touching Fingers				___	
104. Winding Spool				___	
105. Coloring Within Lines				___	
106. Placing Pennies				___	
Cumulative Maximum	44 +	52 +	84 +	32 =	212
72-83 Months					
107. Copying Word			___		
108. Drawing Person			___		
109. Copying Diamond			___		
110. Touching Fingers				___	
111. Building Steps			___		
112. Placing Pennies				___	
Cumulative Maximum	44 +	52 +	92 +	36 =	224

Scoring

GROSS MOTOR	Cumulative Basal Score		Sum Through Ceiling Age		Raw Score	Max. Score	Max. Age
Skill A		+		=	*	24	8
Skill B		+		=			
Skill C		+		=			
Skill D		+		=			
Skill E		+		=			
Total Score		+		=			

FINE MOTOR	Cumulative Basal Score		Sum Through Ceiling Age		Raw Score	Max. Score	Max. Age
Skill A		+		=	*	44	42
Skill B		+		=	*	52	36
Skill C		+		=			
Skill D		+		=			
Total Score		+		=			

* Do not transfer to cover page if child is as old as or older than age listed *and* obtains maximum score. Instead, record N (for "normal") in the appropriate space on the front cover.

Motor Development Profile

	z	−5.0	−4.0	−3.0	−2.0	−1.0	0	+1.0	+2.0	+3.0	+4.0	+5.0
	T	0	10	20	30	40	50	60	70	80	90	100
	DMQ	25	40	55	70	85	100	115	130	145	160	175
GROSS MOTOR	A – Reflexes											
	B – Balance											
	C – Nonlocomotor											
	D – Locomotor											
	E – Receipt and Propulsion											
	Total Score											
FINE MOTOR	A – Grasping											
	B – Hand Use											
	C – Eye-Hand Coordination											
	D – Manual Dexterity											
	Total Score											

Comments/Recommendations:

Appendix E

SCHOOL AMPS TASK DESCRIPTIONS

draft II with revisions

Pen/Pencil Writing Tasks

W-1. ***Circling and connecting*** **(P-K)**

This task involves using a crayon, marker, pen, or pencil to circle letters, words, or numbers, or to connect figures (e.g., dot-to-dot, connecting matching figures).

W-2. ***Word or number copying*** **(K-1)**

This task involves using a pencil to copy letters, single words, or numbers (e.g., penmanship practice). Practicing writing one's name is an acceptable alternative. The use of a pen to copy letters, single words, or numbers is an acceptable alternative, provided its use is acceptable to the teacher.

W-3. ***Short answer (numbers or words)*** **(K-3)**

This task involves using a pencil to fill in short answers (i.e., one to two words) in workbooks or worksheets. Short answers to word or number problems commonly are written in blank spaces that are included in workbooks or on worksheets. Writing short word or number problem answers on blank paper is an acceptable alternative. The use of a pen to write the answers also is an acceptable alternative, provided its use is acceptable to the teacher.

W-4. ***Composition - one to two sentences*** **(1-3)**

This task involves using a pencil to write one to two short sentences. The sentences may be copied from the blackboard or another paper, or created by the student (free-writing). The use of a pen or marker to write the sentence(s) is an acceptable alternative, provided their use is acceptable to the teacher.

W-5. ***Composition - paragraphs*** **(3-6)**

This task involves using a pen or pencil to write between one-half to a full page of text that is created by the student. Copying sentences from the blackboard or another paper is not acceptable.

Drawing and Coloring Tasks

DC-1. ***Scribbling*** **(P)**

This task involves free-coloring a blank paper in a manner that results in no recognizable figures or objects (e.g., scribbling). A critical feature of this task is that the student is directed to only put color on the page and not to draw any recognizable figure or to color in a predrawn design (e.g., "Put your favorite colors on this page."). Even if the student does draw a recognizable figure or object, he is still scored based on the teacher's directions to scribble.

DC-2. ***Coloring shapes and spaces*** **(P-1)**

This task involves using crayons, markers, or colored pencils to color (fill-in) ***predrawn*** designs or pictures. A critical feature of this task is that the spaces to be colored are predetermined by the predrawn lines (e.g., those included in workbooks or worksheets provided by the teacher). Even if the student only scribbles on the page, he is still scored based on the teacher's directions color predrawn figures.

DC-3. ***Free-coloring*** **(P-1)**

This task involves using ***crayons or markers*** to draw a simple picture on a blank paper and then color in the essential objects or figures. A critical feature of this task is that the student is expected to draw recognizable objects (e.g., "Draw a picture of your house. Show me the color of your house."). Scribbling is not an acceptable alternative. Therefore, if the teacher directs the students to draw and color in recognizable objects, but the student only scribbles, he is still scored based on the teacher's directions use crayons or markers to draw a simple picture.

DC-4. ***Free-drawing*** **(K-6)**

This task involves using ***colored pens, pencils, or fine markers*** to draw a complex picture on a blank paper and then color in the essential objects or figures. Using a pen, pencil, or fine marker to draw a picture with fine details or elaborations is an acceptable alternative to coloring in the essential objects or figures. A critical feature of this task is that the student is expected to draw a picture with embellishments (e.g., "Draw a picture of your house. Be sure to show me where the windows and the doors are."). Even if the student only scribbles or draws a simple picture, he is still scored based on the teacher's directions to draw a complex picture.

Cutting and Pasting Tasks

CP-1. ***Cutting and pasting - straight lines*** **(P-2)**

This task involves cutting along straight lines (predrawn or free-form squares or lines) and pasting the cut pieces onto another piece of paper.

CP-2. ***Cutting and pasting - curved lines*** **(K-3)**

This task involves cutting along predrawn curved lines (circles, hearts, wavy lives) and pasting the cut pieces onto another piece of paper.

CP-3. ***Pasting with no cutting*** **(P-K)**

This task involves pasting five or more items (e.g., pieces of paper, cotton balis, noodles) onto a flat surface (e.g., piece of paper, paper plate). Pasting a large [illegible] onto another paper is an acceptable alternative [illegible]

CP-4. ***Cutting with no pasting*** **(P-K)**

This task involves cutting straight lines on paper with no requirement to paste (e.g., cutting along the edge of a sheet of paper to make fringe, cutting strips of paper to make bookmakers).

Computer Writing Tasks

CM-1. ***Simple answer or matching - spatial*** **(K-3)**

This task involves using any input device (e.g., mouse, keyboard, touch screen) to select an answer to a problem. Selecting the answer requires that the student choose one answer from among several available static objects; the demand is spatial. The student is not scored on turning on or off the computer or opening the program.

CM-2. ***Academic computer game - spatial/temporal*** **(1-4)**

This task involves using any input device (e.g., mouse, keyboard, touch screen) to play an academic computer game that involves moving objects. Scoring or obtaining the answer requires that the student time his or her response. The student is not scored on turning on or off the computer or opening the program.

CM-3. ***Keyboard copying*** **(1-4)**

This task involves using any input device (e.g., keyboard, touch screen) to copy or write letters, words, or short sentences. The student is not scored on turning on or off the computer, opening the program, or printing the document.

CM-4. ***Word processing*** **(4 and above)**

This task involves using any input device (e.g., keyboard, voice activated) to copy or write sentences and paragraphs. The student is expected to open the program, print or save the document (data), and exit the program. Turning on and off the computer is optional.

CM-5. ***Graphics*** **(5 and above)**

This task involves using any input device (e.g., keyboard, mouse, touch screen) to create graphic designs (shapes, tables, graphs, histograms). Adding word text to the created design is an expected part of this task. The student also is expected to open the program, save the document (data), and exit the program. Turning on and off the computer and printing the document are optional.

Manipulative Tasks

M-1. ***Simple manipulatives*** **(P-K)**

This task involves using small objects ("manipulatives") commonly used for early learning (e.g., rods, cubes, small toys) to count, develop number concepts, or develop color concepts. Writing is not part of this task. If the student is asked to write answers, score the student on task M-2.

M-2. ***Math manipulatives with written answers*** **(P-1)**

This task involves using small objects ("manipulatives") commonly used for early learning (e.g., rods, cubes, small toys) to solve simple math problems, and using a pencil to write the answers on worksheets or blank pieces of paper. The use of a pen to write the answers also is an acceptable alternative, provided its use is acceptable to the teacher.

SCHOOL AMPS SCORING FORM

DEMOGRAPHIC DATA

STUDENT:____________________EXAMINER:____________________

AGE:______________SCHOOL GRADE LEVEL:______________

ETHNICITY:
WHITE/EUROPEAN:__ BLACK/AFRICAN:__ HISPANIC/BRAZILIAN:__
ORIENTAL/SE ASIAN:__ MIDDLE EASTERN:__ NATIVE AMERICAN:__
PACIFIC ISLANDER:__ OTHER:__

GENDER: MALE ___ FEMALE ___

DIAGNOSIS:____

DATE OF EVALUATION: ____________

TASK OBSERVATION NUMBER: 1:___ 2:___ 3:___ 4:___

TASK#:________ TASK:______________________________

ASSISTIVE DEVICES: NONE ___ WHEELCHAIR ___ WALKER/CANE ___

OTHER (SPECIFY) ______________________________

AIDE/RESOURCE ROOM (hours/day):________________

CLASSROOM ENVIRONMENT:
__ EXTREME QUIET
__ RELAXED ORDER
__ INCONSISTENT
__ CHAOTIC

LEVEL OF TEACHER CONCERN:
__ NOT AT ALL CONCERNED
__ MINIMALLY CONCERNED
__ MODERATELY CONCERNED
__ MARKEDLY CONCERNED

ITEM RAW SCORES

COMPETENT = 4 QUESTIONABLE = 3 INEFFECTIVE = 2 DEFICIT = 1

POSTURE	
Stabilizes	4 3 2 1
Aligns	4 3 2 1
Positions	4 3 2 1
MOBILITY	
Walks	4 3 2 1
Reaches	4 3 2 1
Bends	4 3 2 1
COORDINATION	
Coordinates	4 3 2 1
Manipulates	4 3 2 1
Flows	4 3 2 1
STRENGTH AND EFFORT	
Moves	4 3 2 1
Transports	4 3 2 1
Lifts	4 3 2 1
Calibrates	4 3 2 1
Grips	4 3 2 1
ENERGY	
Endures	4 3 2 1
Paces	4 3 2 1
Attends	4 3 2 1
USING KNOWLEDGE	
Chooses	4 3 2 1
Uses	4 3 2 1
Handles	4 3 2 1
Heeds	4 3 2 1
Inquires	4 3 2 1
TEMPORAL ORGANIZATION	
Initiates	4 3 2 1
Continues	4 3 2 1
Sequences	4 3 2 1
Terminates	4 3 2 1
SPACE AND OBJECTS	
Searches/Locates	4 3 2 1
Gathers	4 3 2 1
Organizes	4 3 2 1
Restores	4 3 2 1
Navigates	4 3 2 1
ADAPTATION	
Notices/Responds	4 3 2 1
Accommodates	4 3 2 1
Adjusts	4 3 2 1
Benefits	4 3 2 1

Appendix F Study Data

Subject	S-AMPS motor	S-AMPS process	PDMS-FM
	In logits	In logits	In z scores
1	1.74	.25	-.68
2	2.55	.67	1.04
3	1.77	-.05	.39
4	1.75	.50	-1.40
5	1.57	.28	1.04
6	3.25	3.01	1.64
7	1.70	-.18	1.04
8	.69	-1.13	-1.18
9	1.78	.51	-.18
10	1.86	.55	.39
11	1.55	.31	-.68
12	3.60	1.67	.39
13	1.24	-.48	-1.56
14	1.48	.74	-2.33
15	2.05	.82	-.68
16	2.21	1.06	-.61
17	1.75	.82	1.04
18	2.05	.44	-.18
19	1.72	.95	1.64
20	1.38	.37	-1.18
21	1.33	.70	-2.05
22	1.82	.21	.39
23	2.30	.28	-.18
24	2.47	1.27	.39
25	2.07	.71	1.04
26	2.61	.71	.39
27	1.72	.76	1.04
28	2.00	1.12	.39
29	2.28	1.06	-2.05
30	1.25	.00	-2.05
31	2.38	.85	-.61
32	2.44	1.23	1.04
33	1.37	.37	-2.33
34	1.92	.96	-.68
35	1.37	.76	-.18
36	3.08	1.30	1.04
37	2.69	1.32	-2.05
38	2.47	1.29	-1.56
39	2.13	1.02	.39
40	1.54	.44	-.18
41	2.78	1.58	1.08
42	3.50	1.68	1.64