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Early childhood fine motor assessment

Naomi Kapaun

University of North Dakota

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EARLY CHILDHOOD FINE MOTOR ASSESSMENT

by

Naomi Kapaun, MOTS

Advisor: Gail Bass, Ph.D., OTR/L

A Scholarly Project

Submitted to the Occupational Therapy Department

of the

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In partial fulfillment of the requirements

for the degree of

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This Scholarly Project Paper, submitted by Naomi Kapaun in partial fulfillment of the requirement for the Degree of Master's of Occupational Therapy from the University of North Dakota, has been read by the Faculty Advisor under whom the work has been done and is hereby approved.

\[\text{Signature} \]

Faculty Advisor

\[4-30-07\]

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ABSTRACT

The development of hand function is ongoing from infancy through adulthood. Hand function is especially important in the early years as a child prepares for school. As with all skills, the level of hand function can range from “excellent” to “average” to “clumsy” or “immature.” Stability, strength, and endurance are key components of adequate hand skill development. These components are often areas of weakness in today’s society of technology and passive activities. Creating an assessment designed specifically for the identification of skill acquisition, as it pertains to hand function and fine motor development, in the early childhood years will assist therapists in establishing an intervention plan for that child. In turn, this will facilitate the development of pre-writing, pre-cutting, and grasp or manipulation skills. Early childhood education programs are designed to ensure school readiness and it is an appropriate location to incorporate an early childhood fine motor assessment tool for the initial and ongoing analysis of a child’s development in hand function and manipulation skills.

The methodology used to gather the information for the development of the early childhood fine motor assessment included an extensive review of literature and research regarding the developmental milestones and the ancillary factors contributing to fine motor development in children age eighteen months to five and one half years of age. Consultation and feedback pertaining to the assessment was obtained from professionals within the field of occupational therapy and early childhood special education. Practice
trials of the early childhood fine motor assessment tool included one hospital based pediatric setting, one early childhood classroom setting, and one rural consultation based early childhood school setting.

The information gathered from an extensive literature review led to and supported the need to develop a quick, user-friendly early childhood fine motor assessment tool for children age eighteen months to five and one half years of age. The assessment tool is specifically intended to serve children in early childhood settings however, it may also be of benefit in the medical model setting. The assessment is specifically designed to address fine motor skill development in children 18 months to five and a half years. The tool can be administered in its entirety, in specific sections, or in segments to accommodate the early learner’s attention span and specific needs. Information gathered during this process is meant to be used as baseline for comparative data, for treatment planning, conference reporting, and for classroom, caregiver, and/or parent education.

The Early Childhood Fine Motor Assessment Tool administration manual provides brief descriptions of each component to observe. The manual also provides age approximations, skill completion techniques, and observation cues to assist data collection. Each suggestion is intended only as that, as it is certain that each child develops individually and may utilize alternative successful techniques to achieve skills and each child may progress at varying speeds of development.
CHAPTER I

INTRODUCTION

Occupational therapists work with individuals to achieve their maximal level of independence in their identified occupations. For children these occupations include self-care, play or social skills, and learning. (American Occupational Therapy Association [AOTA], 2002). Many children struggle in the development of successful skill acquisition needed for school readiness. This is when the intervention practices of occupational therapy become critical. Early intervention has been proven to significantly impact a child’s ability to gain readiness skills needed for academic success prior to entry into kindergarten. A child’s environment and life experiences create lasting effects on brain development and cognition (Chugani, Phelps, & Mazziotta, 1987). According to E.C. Herschkowitz & N. Herschkowitz, a child’s brain cell development begins in utero and excels from infancy through age ten. Brain cells not only form most of the connections they will maintain throughout life but during this time they retain their greatest malleability. Occupational therapists in early intervention settings are essential contributors during this time of opportunity and development in a child’s life.

Statement of the Problem

The development of hand function is ongoing from infancy through adulthood. Hand function is especially important in the early years as a child prepares for school. As with all skills, the level of hand function can range from “excellent” to “average” to “clumsy” or “immature.” Stability, strength, and endurance are key components of
adequate hand skill development. These components are often areas of weakness in today's society of technology and passive activities. Creating an assessment designed specifically for the identification of skill acquisition, as it pertains to hand function and fine motor development, in the early childhood years will assist therapists in establishing an intervention plan for that child. In turn, this will facilitate the development of pre-writing, pre-cutting, and grasp or manipulation skills. Early childhood education programs are designed to ensure school readiness and it is an appropriate location to incorporate an early childhood fine motor assessment tool for the initial and ongoing analysis of a child's development in hand function and manipulation skills.

Purpose of the Product

The purpose of this scholarly project was to develop an early childhood fine motor assessment to address developmentally appropriate fine motor skills in children age 18 months to five and a half years old. This assessment tool was designed for use in early intervention programs to address functional development, grasp and manipulation skills, strength, endurance, and pre-academic skill development. It is intended that the assessment tool be used for initial evaluation, reevaluation or to screen an identified student or population not currently receiving services. The tool could also be used as an educational component for providing feedback to families or other professionals about the child's present level of performance or the child's progression. It can serve as an easy reference to present progress of a child throughout their early childhood experience. It can also be referenced when establishing a list of recommended activities for parents or teachers to use for continued work on developing the child's skills.
Theoretical Model Used

The information included in this assessment tool was designed to incorporate findings from an extensive literature review and the Occupational Adaptation (OA) model. The developmental theory was also taken into consideration in support of the product created because typical child motor development was analyzed as it pertained to the development of fine motor skills.

"The occupational adaptation practice model emphasizes the creation of a therapeutic climate, the use of occupational activity, and the importance of relative mastery" (Schultz & Schkade, 1992, p. 917). Practice based on occupational adaptation directs occupational therapy interventions toward the child's internal processes which are facilitated to improve occupational function. Occupation is defined as any meaningful activity that a child participates in; play is a child's mainstay of occupation (Case-Smith, 2000).

The occupational adaptation practice model is holistic. The child's occupational environment is influenced by physical, social, and cultural properties. These are as important as the child's sensorimotor, cognitive, and psychosocial development and the child's experiences of personal limitations and potential. The integration of these concepts drives the treatment and assessment process. Practice of the OA model secures occupational skill building through activities driven by the child and adaptation or modification of the context, occupation, or assistance provided. These adaptations for successful performance lead to relative mastery which refers to an internal sense of efficiency, effectiveness, and satisfaction of one's performance in occupation (Schkade and Schultz, 2003).
The developmental theory founded by Piaget was referenced during the construction of the assessment tool. Each component on the assessment is reflective of a child’s developmental components that pertain to the foundational development of fine motor skills. Silverthorn (1999) summarized Piaget’s work considering the following stages which outline the progression of a child’s cognitive development. This included the sensorimotor stage, preoperational thought stage, concrete operations and finally the formal operations stage of development. The sensorimotor period and the preoperational thought period were referenced during the creation of the early childhood fine motor assessment since these stages develop between birth and age six to seven. The sensorimotor period (birth to two years) implies that infants and toddlers "think" with their eyes, ears, hands, and other sensorimotor elements. Piaget said that a child’s cognitive system is limited to motor reflexes at birth, but the child builds on these reflexes to develop more sophisticated procedures. The preoperational thought period (two to six or seven years) involves the acquisition of representational skills in the area of mental imagery, and especially language. During this phase of development, children are self-oriented, and have an egocentric view of the world.

Summary

In an effort to support the development of the assessment tool, an extensive review of literature was completed, the methodology was identified, and recommendations for use of the assessments were included. This chapter concludes with a reference to appendix A for definitions of common terminology used throughout the document and the assessment tool. The second chapter includes the compiled findings from the extensive literature review. The third chapter describes in greater detail the
methodology used to develop and support the assessment, which is included in its entirety in Chapter IV. The final chapter is a summary of the identified strengths and areas of growth found within the literature review findings and the product that was developed. The fifth chapter also includes recommendations for further research in this topic area and ongoing recommendations of further scholarly research support. The text ends with Appendices: A, terminology, B, hand development, C, standardized fine motor assessment examples, and D, descriptors of hand treatment programs in practice.
CHAPTER II

REVIEW OF LITERATURE

Introduction

Hand skill development in pre-school aged children is a critical need. Children today are limited in the amount of hands-on exposure and experience they receive prior to the onset of an ever-growing academic agenda. In an effort to address this concern, an early childhood fine motor assessment has been developed. The assessment will assist therapists in establishing an intervention plan for that child and to facilitate the development of postural core strength, pre-writing, pre-cutting, grasp, and in-hand manipulation skills. Chapter II is a review of the literature and research that was foundational to developing the assessment. This chapter is divided into sections, which contain supportive findings that pertain to the importance of early intervention programs and their role in the assurance of school readiness skills. This project will emphasize the identification of the child’s current level of fine motor function that is established through the utilization and interpretation of the early childhood fine motor assessment tool.

Theoretical Perspectives

In order to understand how and when a child should perform and achieve specific fine motor tasks, it is necessary to understand how typical child development flows. Fine motor skills include reach, grasp, carry, release, in-hand manipulation, and bilateral hand use. Grasp success is dependent upon normalization of development, which is directly influenced by postural control, motor planning, eye-hand coordination, tactile and
proprioceptive input, and somatosensory processing (Edwards, Buckland, & McCoy-Powlen, 2002). Erhardt (1974) summarized and compared the works of several theorists whose mission was to provide their interpretation of motor development and more specifically the development of prehension. In addition to Gesell, Halverson, and Piaget theoretical perspectives on hand skill development, there are also several approaches. Eclectic, perceptual-motor, developmental, motor control, sensory integration, and neuro-developmental all contain components on the development of hand skills and the most beneficial approach to enhance these skills. Further definitions of these approaches can be divided into process oriented or task oriented.

**Perspectives**

Erhardt and Meade (2005) established perspectives on skill attainment dividing skill development into task oriented and process oriented perspectives. Task oriented perspectives are typically carried out by teachers and parents. This idea provides more specific exposure to the underdeveloped desired functional outcome. The perspective emphasizes underlying development of skill refinement through additional direction and practice of “steps” or “sections” of the desired task. Once this is mastered, generalization of the skill component is incorporated into the task-oriented activities chosen to be of importance by the teacher and or parent. The process-oriented perspective is typically therapist directed and involves focused purposeful direction on the underlying mechanisms affecting upper extremity skills. It is believed that correction or development of skill acquisition of underlying components will evolve into adequate performance without the need for additional direction or practice of the task components.
Approaches

According to Erhardt and Meade (2005), the eclectic approach is process oriented and consists of the perceptual-motor theory, developmental theory, motor control theory, sensory integration theory and the neuro-developmental theory. This approach is being used more frequently by occupational therapists. The sensorimotor theory is an eclectic approach of practice and it is being shown to assist children in self-organization of their bodies in order to have more successful motor skills. It supports the sensory integration approach and is based on the concept that postural development depends on a stable base from which to move. The goal of this approach is to integrate stability with mobility, so the body can function in and through space in a three dimensional manner. Without postural development, upper body control for hand use and eye hand skills would be labored and unsuccessful.

The motor control approach is a combination of process oriented and the task oriented perspectives. The approach includes motor control, motor learning, and motor development. These areas account for how motor control is organized, how skills are acquired, and how motor behaviors can change (VanSant, 1991). Kinesthetic processing and motor processing control the speed and direction of the motor output. Deficits in these areas appear in errors of speed, stroke direction, and pressure force used. Motor planning is a higher-level cognitive based skill that includes the subconscious or habituated choice of a starting point, direction and speed of movement, change of directions needed, and a precise terminal point. If motor planning is lacking, preservation, over or undershooting toward a target, or poor memory recall of a skill may occur. In addition, drawing, writing, or skill generalization will be negatively affected.
During motor learning, a task-oriented approach is taken as the emphasis and focus is placed on practicing movement patterns and development of underlying components used for the entire sequence of the movement pattern. Accurate feedback, facilitation techniques, and practice are essential to this perspective without these; the result would be failed efforts (Erhardt & Meade, 2005). Finally, the neuro-developmental approach (NDT) looks at proximal stability for distal mobility based on the effective mechanical uses of the body. Joints of the shoulder girdle need flexibility and stability to allow vast movement potential in a controlled and refined manner. The sternoclavicular joint is the only stabilizing component of the shoulder girdle. Its alignment is directly affected by the alignment of the thoracic cavity and pelvis. Asymmetrical alignment at the pelvis or thoracic cavity will directly impact the alignment of the sternoclavicular joint and secondarily the stability of the shoulder and motor functional output of the hand. The NDT approach also emphasizes task-oriented behaviors for the purposeful treatment of misaligned or moving motor components (Exner, 1990).

**Specific Theorists**

Gesell, Piaget, and Halverson are child development theorists who have contributed studies and framework theories on the specifics of prehension development. Gesell’s work involves the observation of reflex, voluntary, spontaneous, and learned behaviors in over 10,000 infants. Gesell believed that the maturation of motor patterns was dependent upon reflex integration and neuromotor readiness rather than environmental contributions. Gesell considered hand development to be a direct correlation to the maturation and expansion of the reflexive system. What he did not
believe in or address was whether environmental components could or would inhibit
development, integration, and maturation of reflex patterns thus affecting the maturation
and development of the child’s motor skills (Gesell, 1969).

According to Rhoda Erhardt (1974), Piaget provided theoretical input based on
the expertise established through observations and analysis of his own three children
during their sequential progression of motor development. His premise of belief was that
a child’s development was dependent upon self-regulation influenced by internal
reinforcement and it was not in any way influenced by external positive or negative
reinforcement factors. In addition, Erhardt noted that Piaget believed that the
environment’s role is to present non-influential experiences that the child may choose to
engage in. When this occurs, the child’s skill acquisition will be affected because the
experience will have an internal influence for the child. Erhardt also wrote that Piaget
believed that through repetitive exposure of a chosen experience adaptation,
accommodation, and assimilation occurs. The degree of success in this process is based
again on the child’s ability to self-regulate and transfer the information into internal
reinforcement.

Halverson researched through analysis of video containing the progression of
visual attention, approach, and grasp (Erhardt, 1974). According to Erhardt, Halvorson,
like Gesell, believed development of infant prehension was based upon a hierarchical
order of development. Halvarson also saw infant movements as reflexive and crude due
to immature inhibitory systems connected to the central nervous systems. In effect, if an
infant is not allowed positional intentional experiences for reflex integration or if a child
presents with a neurologically based lesion, abnormal motor patterns will continue unless purposeful and intentional reflexive opportunities and maturation of development are facilitated.

Erhardt has completed extensive studies in the area of prehension development. She developed two primary hypotheses based on a four-year study of a premature child with cerebral palsy beginning when the child was fifteen months and ending when the child reached five years of age. The first hypothesis was that a child must progress through each stage of identified prehensile development. In effect the lesser phase needs to be mastered in order to have the base skills essential to enter the next phase of development. Secondly, it is essential to treat a child in accordance to their determined prehensile age instead of the child’s chronological age (Erhardt, 1994).

In addition to extensive studies on hand development, creation of assessment measures and treatment regimes, Erhardt compiled a grasp development diagram based on the beliefs of Gesell, Piaget, and Halverson. This has been summarized in Appendix B and the summary contains additional information and cross-referencing from the studies of Edwards, Buckland, and McCoy-Powlen, (2002). The information provides specific prehension development from age 12 weeks to 52 weeks.

Upper Extremity and Hand Development

Visuomotor skills, grip gradation, sensory processing regulation, finger isolation, and motor control are needed in order to perform any hand manipulation skills. True hand skills depend upon the motor control action more than the visuomotor action. These tasks are difficult to create. A study conducted by Ruff, McCarton, Kurtzberg, & Vaughan (1984) revealed that infants are drawn more to mouth hard objects than soft thus
engaging their visual systems. They are also drawn to explore objects that vary in texture and shape more than objects of various colors. As an infant develops, movement progresses from asymmetrical to symmetrical to differentiated asymmetrical, and finally to bilateral hand use. Asymmetrical movements dominate until three months of age followed by symmetrical movements from three months to ten months of age. Differentiated movements emerge between eight to ten months, and by 12 to 18 months items are stabilized with and without grasp (Exner, 1992, p. 35-45). Exner noted that simultaneous manipulation or bilateral hand use is present in children typically between two to three years of age. During the asymmetrical stage, power grip emerges followed by an infant’s ability to transfer an object from one hand to the other. This skill is powered by a maturing visual system and is not successful unless the object is in sight. This method of grasp is crude and it is the onset of precision grip that allows the eventual unending opportunities of hand skills. When separation and discrimination of the child’s two sides of their body occurs, it allows the onset of sophisticated two hand-dissociated use. Once bilateral hand use is present, the child begins to engage in highly differentiated activities such as cutting with a scissors. According to Exner (1992, p.35-45), in order to engage in higher-level bilateral hand activities, a child is required to demonstrate active supination and pronation adjustment. This can be promoted through presentation of thin or round objects vertically for supination and with larger objects presented horizontally for the promotion of pronation. Thirty degrees of supination is the minimum amount needed in order to achieve some degree of functional hand use at a tabletop surface. Ninety degrees of supination will allow several other functional activities to be completed such as eating and dressing.
It is important to consider how the motor pattern is being accomplished and not just if it is accomplished. This way of observing the movement pattern will allow the observer to identify areas of inefficiency and assist in determining the treatment methods that may work best for the child. There appears to be a “zone of proximal development” in practice that indicates a child may have a developing range of skills that they cannot yet do independently but can do with the assist of another, a second hand, or surface support (Vygotsky, 1978). Vygotsky noted that because of this gradual emergence of skills, it is difficult to “assess” a child’s imminent manipulation levels. A task may need repeating in order to observe if there is an independent level of performance, if the child changes technique or compensatory patterns, and to determine what the end degree of assistance is needed in order to allow maximal independence of task completion.

One common problem present in the development of grasp and fine motor coordination skills is the lack of isolated movements. Children with developmental delays tend to move through patterns of flexion or extension and have difficulty combining the two synergies. A second common problem for children with delays is poor gradation of movements. This is due to inadequate motor control creating under or over approximation of the target and typically it results from a lack of joint stability. These problems are most common in children with sensory integration dysfunction, muscle weakness, or abnormal tone (Exner, 1992). Another common problem in development is the timing of the movement patterns, which is also caused by instability in the joints. Disorders of bilateral integration are common and present in children unable to cross midline or work at midline with both their hands. Finally disorders of trunk movement, stability, and control inhibit a natural base of stable support for
effective arms to act upon. The child may need intermittent or constant use of their arms to support their body in midline limiting their freedom of hand use (Edwards, Buckland, & McCoy-Powlen, 2002). Each of the problems listed may eventually lead to compensatory patterns that are ineffective or inefficient.

Sequence of Hand Manipulation Skills

*Prehensile versus Nonprehensile Grasp*

Manipulation may involve the movement of an object through a grasp sequence or with a static hold. Nonprehensile movements are those that do not include a grasp but may involve the entire hand or isolated finger use to push or lift an item. Prehensile patterns involve the actual grasp of an object and can be divided into power or precision function. Power grips are essentially static and include the hook, power, and lateral grasp. Precision grips include tip, pad-to-pad, three-point, or superior forefinger grasp (Bridgeman, 2002).

In-hand manipulation is the complex process of both holding and moving a grasped object within one hand. In-hand manipulation is used to adjust an object for more effective placement in the hand prior to use, placement on a surface, or for release (Bridgeman, 2002, p. 28).

As previously noted, hand skills surge around the age of two years. In-hand manipulation without stabilization begins to emerge as early as eighteen months and with repeated opportunity matures into complex in-hand manipulative use. In-hand manipulation skills begin to develop prior to the age of three, primarily hand skills surge between two and two and a half. These skills require a balance of stability with mobility of the hand. They also require the ability to separate movement between the ulnar and radial side of the hand (Thompson, 2004).
Finger-to-Palm Translation

According to Bridgeman (2002), translation is a linear direction of movement to include finger-to-palm or palm-to-finger relocation of an object. Either direction can involve the use of one item or it can involve the transfer of one item while stabilizing other items in the palm of the hand. Exner (1992) defines finger-to-palm translation as an object held by the distal finger and thumb for movement toward the palmar surface of the hand. It is the most basic pattern of manipulation and requires the transaction of finger extension into finger flexion. It also requires separation of the ulnar side of the hand from the radial side. This skill can be seen when picking up a coin and moving that coin to the palm of the hand. This motion along with simple rotation is the easiest and earliest in-hand manipulation skill to emerge. This skill can be checked on children as young as three years; these children can typically demonstrate this ability with at least one object. Four year old children, on average, can manage up to four objects and five year olds can handle five (Henderson, Pehoski, & Tickle-Degnen, 1997).

Palm-to-Finger Translation

Palm to finger movement is more difficult than finger to palm. The movement may be more difficult because it requires more thumb, metacarpal transverse arch, and finger extension to complete. It also requires forearm supination, intrinsic muscle control, and cognitive and perceptual processing. During palm-to-finger translation, objects are moved from the palm of the hand to the distal tip of the finger surface. It is seen when moving a coin from the palm up to the tip of the fingers for placement in a slot. As a child refines this movement pattern, the child begins to be able to use gravity to assist in controlled movement of the object. Children as young as three may be able to
complete this pattern; but they often depend on stabilization techniques or pronation until the age of five and a half. The three year old's ability to transfer more than three objects is limited (Henderson, Pehoski, & Tickle-Degnen, 1997).

**Shift**

According to Bridgeman (2002), shift is a linear movement and is used in order to adjust an object, placed at the pads of the fingers for use, between or among the fingers. Shift may be utilized to refine the placement of an object being held in the fingertips and movement can be vertically or horizontally. This can be seen during shift of a pencil or pen for writing or to further shift a key to the distal pads for more refined insertion into a slot. This manipulation skill may also occur with or without stabilization of a separate object in the palm.

**Simple Rotation**

Rotation may be simple or complex and is the movement of an object around its axis; objects may be turned horizontally or end over end (Henderson, Pehoski, & Tickle-Degnen, 1997). In order to achieve this movement pattern, finger and thumb movement isolation needs to exist. Thumb opposition is more demanding during this type of manipulation than in translation or shift of an item. Visuomotor skills need to be advanced and grip regulation is needed in order to achieve an efficient movement pattern. When an object is rotated, it is turned or rolled over between the pads of the fingers and thumb; one example of its use is the opening of a jar. This process may also occur with or without stabilization (Henderson, & Pehoski, 1995). In the process of determining the tactile effects on fine motor function, Henderson, Pehoski, and Tickle-Degnen (1997) discovered that there is a significant correlation between the age of the child and the
speed at which the child can rotate a small peg amongst their fingers. The researchers found the greatest advancement of timed success was from the developmental period of three to three and a half to four years of age. It was also discovered that the variables of timed performance was significantly greater in three year old children than in children six and a half years. Data showed that a more refined distal non-supported style of rotation was more commonly achieved as a child increased in age. Children three and three and a half consistently required the use of their other hand or a surface to rotate the peg successfully. Of those children, 53% age three years old could not rotate the peg even one time. At age four, children demonstrated a significant increase in the ability to rotate the peg without the use of a surface or supporting hand; this age group also demonstrated the emergence of ten consecutive peg rotations. Approximately 60% of the children in the five to five and a half age range could rotate the peg consecutively and successfully. Overall, three year olds did not present with the in-hand skill of rotation. Grip force gradation for children four and under was difficult, and children four to five years old could demonstrate tip or distal finger rotation; object size to hand size needs to be considered.

*Complex Rotation*

Complex rotation is considered the last and the most difficult in-hand manipulation skill to develop. During complex rotation, the object is moved between isolated fingers and the thumb 180 to 360 degrees (Exner, 1992). A person utilizes this skill during tasks such as rotating a paper clip for placement. The action on the fingers occurs when the ulnar side of the hand is stabilizing a secondary object.
Ancillary Systems and the Relationship to Upper Extremity Function

Primitive Reflex Integration

At birth, a baby does not exhibit any voluntary movement patterns all movement is primarily controlled by primitive reflexes. As the baby matures and grows in a nurturing environment, higher more sophisticated regions of the brain develop and begin to supersede primitive reflexes. The early survival primitive patterns are integrated or inhibited and replaced with more mature postural reflex patterns (Goddard, 2002). The integration or inhibition of the primitive reflexes is essential in order to lay a foundation for later voluntary movement skills. Not all children successfully inhibit their primitive reflexes either due to cerebral infarcts such as cerebral palsy, anoxia, or due to unknown or environmental reasons. These children struggle motorically to advance in their voluntary movement skills and postural reflexes because primitive patterns continue to interfere. Ongoing primitive reflexes may also create sensory processing dysfunction causing hyper or hyposensitivity in the child (Goddard, 2002). Ancillary movements, eye functioning, visual perception, balance, and auditory processing may also be systems affected negatively by ongoing primitive reflexes.

Some specific primitive reflexive behaviors are necessary in the development of the upper body and its readiness for hand reach and grasp development. According to Edwards, Buckland, and McCoy-Powlen, (2002), the asymmetrical tonic neck reflex (ATNR), the traction response, avoiding response, and the grasp and instinctive grasp reaction all have an effect on the long range outcome of reach and grasp development. The ATNR is considered a “tonic” or stabilizing reflex that will later allow the body to maintain it’s posture against the force of gravity allowing eventual weight bearing and
trunk and limb dissociation from the right and left sides of the body (McCormack & Perrin, 1997). If the ATNR has poor integration, the result may be poor midline or cross midline orientation, delay with transference of objects, and substandard hand to mouth movements (Edwards, Buckland, & McCoy-Powlen, 2002). The integration of the traction response is essential for the progression and development of reach and grasp. Avoidance response integration allows for the progression of development in reach, grasp and release of an object, and in the gradation development of grip required for successful holding of an object. The grasp reflex must integrate in order to attain the skill of purposeful release of an object. Integration of the instinctive grasp reaction is critical for refinement of hand positioning for the purposeful grasping of objects (McCormack & Perrin, 1997).

The symmetrical tonic neck reflex (STNR) was not included with the other descriptors of essential primitive reflex behaviors, however it too has been proven essential (Goddard, 2002). One reason it may not always be considered a primitive reflex is the timeframe of its onset; the STNR typically emerges 4-6 months post-natally. This reflex is developmentally essential for reciprocal four point crawling patterns (DeBoer, 2002). According to Goddard (2002), if the STNR does not appear or integrate, a child may present with poor muscle tone, eye hand coordination, slumping posture, and an inability to separate the sides of their body. Separation of the lower aspect of the body from the upper and one side from the other is needed for cross midline and high level motor activities such as swimming, running, kicking a ball, and writing. Children will also present with an inability to sit upright when writing at a tabletop surface and they tend to remain in a flexed upper posture and extended lower posture when asked to
perform any complex fine motor skill. Goddard also noted the importance of the Tonic Labyrinthine Reflex (TLR) and implied full integration may not be completed until age three and a half. Poor processing of this reflex may cause tone abnormalities, toe walking, poor balance, motion sickness, orientation and spatial difficulties, oculo-motor difficulties, and visual-perceptual problems.

**Posture/Strength/Positioning Effects**

Strength, posture, and positioning for optimal reach are also critical pieces in preparing the hands to develop power and precision grasp abilities. Hand strength and testing of that strength was examined by Bush, Link, and Lukens (1995) in order to determine how best to measure it and if any underlying factors affect strength projection such as arm positioning, gender, hand dominance, and hand size. The researchers noted that dynamometer gauge testing is not appropriate for preschool children; because hand width appears to have a direct correlation on grip strength output. They determined the use of a 4cm vigorimeter bulb would be a more appropriate tool for data collection of baseline grip strength and progressive comparisons for preschool children. The vigorimeter provides objective information of grip strength in children, however, norms have not been established and it would not yet be considered use of a standardized tool. Handedness and gender were shown to have no significant effect on hand strength performance.

Development occurs proximal to distal and caudal to cephalic (head to toe). Knowledge of this process supports the need for effective and consistent stability and support of the trunk in order to allow optimal control and performance of the limbs. Not only are strength, control, and support needed in the trunk but also in the shoulder girdle.
This is supported in Case-Smith, Fisher, and Bauer’s (1989) article on the analysis of the relationship between proximal and distal motor control. According to the authors, children who experience poor postural control or low muscle tone need to exert more energy into obtaining and sustaining upright posture. When energy is used for basic sitting balance and control, the result is deterioration of pencil use including: fatigue, light pressure and tight grasp, slumped posture, and switching hands. Slow writing, illegible formations, and poor academic work can also be associated to an inadequate tool grasp (Smith-Zusovksy & Exner, 2004).

According to Smith-Zusovksy and Exner (2004), understanding the principle need for core strength, stability, and support provide the premise of correct postural seating; correct seating should reflect a 90 degree bend at the elbows, hips, and knees with adequate support provided at the feet, trunk, and forearms. It is also important to note that the back of the seat should not rise above the inferior angle of the scapula so it does not restrict protraction or horizontal abduction in the frontal and sagittal planes. In their study, Smith-Zusovksy and Exner demonstrated this positioning need for optimal object manipulation skills in typically functioning children. Their study data showed that the furniture to support sitting needed to fit the child’s size and that this was even more important during complex hand skills such as in-hand manipulation with stabilization.

**Sensory Systems**

Ayres defined sensory integration as, “The organization of sensory input for use” (Ayres, 1979, p.184). An intact sensory integration system results in unlimited environmental interactions and experiences that provide positive reflections for the person. Each experience is taken in, processed, and responded to in some manner.
deemed appropriate or inappropriate based on society norms and expectations of behavior. Ayres (1964) introduced the idea that skilled movements such as grasp and release are directly controlled and affected by the function of the central nervous system. Should apraxia exist, a dysfunction involving awareness of position in space, integration of the two sides of the body, figure ground depiction, and tactile defensiveness may emerge. Ayres also believed that a dysfunction of the tactile system created a dysfunction in skilled finger movements and manipulation patterns. Our body experiences the world through two groups of senses; the first group includes sight, sound, smell, and taste. The second group consists of the proprioceptive system, the tactile system, and the vestibular system (Arkwright, 1998).

The proprioceptive system gathers information through muscles and joints. Successful integration of this information results in smooth and coordinated motor movements. Dysfunction in the system may result in an inability to gage grip strength, position ones body correctly for movement, and/or adjust ones body for accuracy of work. As a result, children with proprioception problems may be more dependent upon the visual system to have success in task completion (Arkwright, 1998).

Tactile defensiveness, poor bilateral integration, and dyspraxia are the most common dysfunctions of the sensory system affecting fine motor skill performance (Volman, van Schendel, & Jongmans, 2006). Case-Smith (1991) set out to determine the effects of tactile discrimination, graphesthesia, and tactile defensiveness’s role in the efficiency of in-hand manipulation skills among 50 children age four to six years. She found that there was not a significant influence on in-hand manipulation skills in children that possessed either a tactile defensive pattern or in children with low tactile
discrimination skills. However, if the child exhibited both tactile inefficiencies a significant negative impact on in-hand manipulation skills occurred. In addition, if a child has tactile sensitivity, the child will have greater sensitivity when performing an activity that involves active touching than they will from being touched. This data provides supporting information on the prediction that the tactile system has an effect on normal development and functional use of fine motor skill use in the classroom.

The vestibular system informs the body as to whether it is moving or standing still. The sensors for this system are located in the inner ear. Dysfunction in this area may appear in the child who gets car sick, hates to be upside down or to swing, confuses their right and left sides of their body, and lacks coordination in the use of both sides of their body (Arkwright, 1998).

**Oculomotor System**

The oculomotor system is comprised of much more than basic sight. Binocularity, tracking, fixation, depth perception, peripheral vision, convergence, and divergence are all needed for successful fine motor control and coordination (Optometric Extension Program Foundation, 2003). Refer to Appendix A for detailed definitions of the visual eye systems listed above. Visual perception is also part of this system and is considered as “the ability to organize and interpret what is seen” (Wendelburg, 2006, p.1). It involves the recognition, discrimination, and processing of sensory integration through the eyes and the central nervous system (Ayres, 1964). Areas of visual perception include: perception, discrimination, visual memory, spatial relations, form constancy, sequential memory, figure ground, and visual closure (Gardner, 1996). These terms are further defined and can be accessed for review in Appendix A at the end of the
Effective and efficient visual perception skills are essential to the identification of shapes, colors, objects and orientation of items or the body in space, and the relationship between items or one’s body. Spatial relations and form consistency contribute the most to successful handwriting performance (Erhardt, 1992).

**Gender**

It is a common belief that female children have more refined hand skills and that they develop these skills earlier than male children. Henderson, Pehoski, and Tickle-Degnen (1997) pursued this possibility in a study of one hundred and fifty-four culturally diverse children aged three to six years eleven months. The study data showed that gender does not play a key factor in the development or refinement of rotation and translation in hand manipulation skills. In a study of the determination of hand preference, Murray (1995) found a gender effect; more right-handedness is present in females than in males. Magill-Evans and Yakimishyn (2002) also found a gender factor in their study of tool use, surface angle, pencil orientation and grasp use among children. They found more girls not only were right handed but also presented with a more refined grasp pattern.

**Hand Dominance**

Hand preference or dominance is defined as the use of the arms in an asymmetrical manner favoring one side for the completion of a range of skills. It essentially refers to the degree one hand is used over the other (Murray, 1995). The establishment of a hand preference typically emerges by age two and a half to three years (McManus et al., 1988). Some children may develop a preference as early as eighteen months where other children may still exchange hands during tasks in kindergarten,
typically age five to six years. Handwriting performance in children who continue to alter their hand preference is more labored and these children on average receive lower academic scores (Whittington & Richards, 1991).

Statistically, 85-90% of children develop a right-handed preference leaving 10-15% of children as left hand dominant. Within the 10-15% of the left handed population, a portion of the children's academic performance is presented in the gifted region of verbal, math, art, and music skills. The other portion of the left handed population included children with learning disabilities, epilepsy, mental retardation, language deficits, and autism (Murray, 1995). Overall, there are more male left-handed children than female. Left handedness has been linked to genetics, brain damage, and the right shift factor which implies that in utero when development of speech occurs in the left hemisphere motor development shifts into the right hemisphere (Murray, 1995).

There are several theories considered in determination of a child's hand dominance. These beliefs range from using simplified observations to using a more complex assessment tool for evaluation of hand dominance. One simple measure is to observe which hand a child uses consistently to complete tasks such as drawing a picture, reaching for an object, or to eat. Another way to determine a children's hand preference or dominance is through the use of the Edinburgh Inventory. The administrative process of the inventory includes the task of writing, throwing, spoon use, and opening a box. The tool is best used with children who are at least four years in age. The tool has managed to show a distinct preference of use by age four without patterns of handedness related to age or sex (Longoni, & Orsini, 1988).
Assessments of Hand Function

According to Edwards, Buckland, & McCoy-Powlen (2002, pp.1-10), clinical assessment involves the inspection of the history of the hand, prior injuries, pains, birth abnormalities, and the child's use of their arms to date. Examination of the hand's general appearance including: skin, hand and wrist creases, circulation, ligament and muscle movement and tone, bone shapes, width, length, joint range of motion, and the arches that form the curvature of the hand for grasp should also be examined. Simplified sensory testing to include two-point touch and generalized touch is needed to eliminate any tactile discrepancies that may exist. There are motor and sensory component effects that occur secondary to nerve impingement or injury. The residual effects of a radial nerve motor component injury would be wrist drop, which in turn would contribute to an alteration of the web space and the functional ability to grasp large objects such as the use of a disc or spherical grasp. A sensory injury of the radial nerve, however, would have little effect on prehension abilities. A motor component injury to the median nerve would affect the following power and precision grasps: tip, cyndrical, dynamic tripod, hammer, interdigital tripod, three jaw chuck, ring grasp, opposed palmar, pad to pad, oblique palmar, neat pincer and forearm pronation. A sensory injury to the median nerve would result in significant alterations to prehension abilities. Finally, if there is a motor component injury to the ulnar nerve, a claw hand appearance will result and in effect limit power grasping to include lateral, lumbrical, cylindrical, hook, palmar, and the hammer grasp. The hand would also be limited in stabilization needed for mature grasping required during pencil use. A sensory injury would result in altered feedback from the dorsal and volar aspects of the ulnar digits.
Assessments pertaining to body symmetry, movement, and function provide foundational information on the proper mechanics needed for controlled reach, grasp, and release. These areas are useful as component characteristics examined when addressing a child's holistic potential. These areas alone, however, do not fulfill all the findings essential when determining a child's fine motor functional level. Range of motion, tone, trunk and scapulo-humeral control, ulnar to radial control, stability with mobility, balance and righting skills of the trunk, shoulders, elbows, and wrists are all factors contributing to integrity and movements of hand development. Tools such as the goniometer or the dynamometer, tensiometer and vigorimeter are used to obtain objective data on range of motion and strength of the upper extremity. Standardized tools such as the Brigance Diagnostic Inventory of Early Development, the Bayley Scales of Infant and Toddler Development- 3rd edition, the Peabody Developmental Motor Scales- 2nd edition, the Early Intervention Developmental Profile, and the Hawaii Early Learning Profile attempt address the specifics of manipulation skills and generalized fine motor development attained in the early childhood years (Exner, 1990). For descriptors of several of these instruments, refer to Appendix C.

Consequences of Handwriting Delay

Handwriting is an essential fine motor skill needed for academic success. It requires the engagement of cognition, attention, visual system, and motor control. Core strength, positioning, posture, scapular stability, and sensory processing are additional contributing characteristics to enhance writing production. The activity of handwriting involves the use of paper or other surface areas and writing tools. The actual engagement of the activity constitutes approximately 3.7% of a center based preschooler’s day, 19.3%
for the average kindergartener, and 26% to 51% of the day for second, fourth, and sixth graders (Marr, Cermak, Cohn, & Henderson, 2003; McHale and Cermak, 1992). A study completed by Volman, van Schendel, and Jongmans (2006) found that handwriting problems in children grades two and three are linked to ineffective visual-motor integration. Additionally, fine motor control and unimanual dexterity were found to be the precursors to the quality of the handwriting in typically functioning children.

In-hand manipulation skills are defined as the process of using one hand to adjust an object for more efficient object placement in that hand prior to use, placement, or release; the object remains in that hand and usually does not come in contact with a surface during in-hand manipulation (Exner, 1992). In-hand manipulation skills are one of the most critical precursors for success in handwriting. If children do not develop adequate prerequisite hand skills, negative compensatory patterns of grasp will develop; this will limit the child’s potential to regain an efficient grip and it will have a negative impact on their academic work. It also has been shown that children with poor or illegible handwriting, on average, receive lower academic scores (Sprouse & Webb, 1994). Graham, Beminger, Weintraub, & Schafer (1994) found that teachers assign higher scores to children with good handwriting skills. Tait (1998) reported that approximately 98% of occupational therapists working in the school setting noted receiving referrals for students with inadequate handwriting. One study completed with four hundred students in first grade classified 27% of these students’ handwriting to be “dysfunctional” (Karlsdottir & Stefansson, 2002). It is estimated by the authors that overall approximately 6% of typical students struggle in handwriting causing difficulties in their academic achievements.
Treatment Regimes and Effectiveness

Case-Smith (2000) completed a study to address the potential benefits, if any, occupational therapy services might have on the refinement and progression of fine motor and functional performance skills in preschool aged children. She looked at the use of in-hand manipulation skills, eye-hand coordination skills, and visual perception before and after the course of twenty treatment sessions which involved activities of sensory integration, motor manipulation, self-care, and play interactions. The results according to pre and post test scores indicate that children made significant gains in all the areas measured. The study also revealed that children elicited more participation when approached through play and playful activities. In addition, the study revealed that preparatory activities aimed to arouse, promote attention, and postural tone had a positive impact on the child's readiness to move and learn. More specifically, vestibular and proprioceptive activities created the largest impact on learning readiness.

Amundson (1998) also provided perspectives on handwriting and fine motor intervention programs. He believed that successful handwriting and fine motor skills were dependent upon postural alignment, perceptual motor development, appropriate sensory input, and the encouragement and support given to the student to develop practical and successful motor strategies. Sugden and Chambers (1998) noted that there are basic principles to follow in the management of functional motor skills. They support intervention in the child's most natural environment within the context of their routine, interests, and abilities. Intervention approaches should be chosen after thorough assessment of the child's competencies, needs, and movement patterns. Additionally, the child, parent, family, and/or caregivers should play pivotal roles in the development of
goals and effective treatment strategies. Exner (1992) supports these beliefs and adds that the child must have preparation for movement. This includes positioning for stability and control, normalization of tone, improvement of joint mobility, and chosen activities to enhance postural control. Following preparation, the child should be engaged in hand function developmental activities to emphasize isolated arm and hand movements, reach, grasp, controlled release, isolated finger movements, in-hand manipulation activities, and bilateral hand use activities. Finally integration of the newly learned skills should be carried over into functional activities. Some examples of treatment intervention through environmental or tool modification include the use of heavy items for limitations in controlled movement patterns. Lightweight items are helpful for children with limited muscle strength. The placement of items on a slippery surface will promote bilateral arm use as one hand must stabilize the item for the other to act upon the item.

There are many treatment programs on the market for the promotion of hand skills and handwriting skills in children age four or five and into the early elementary years. Such programs include: Fingermania, Handwriting Without Tears, Handy Learning, Fine Motor Olympics, and The Sensible Pencil: A Handwriting Program. Appendix D provides a brief description of the foundation to each program listed. According to Exner (1990), one approach to successful handwriting intervention is the use of Handwriting Without Tears (Olsen, 2005) and specific treatment components within this perspective. There are several key opportunities that can be presented to a young child in order to enhance their hand development, which will lead to improved handwriting skills. One technique is to have the child draw or explore with chalk, paint, crayons, markers, etc. while lying on their stomach or while standing at a vertical surface.
This positioning promotes postural strengthening, wrist extension, and requires added scapular stabilization to perform. Body symmetry is easier to attain in standing or lying than sitting and results in less postural efforts for a child with weakness. The use of chalkboards are more effective than dry erase boards as chalkboards provide a degree of resistance which gives proprioceptive feedback into the fingers, hands, arms, and shoulders (Erhardt, 2006). Varying sizes of the writing tools will also help the child to explore various grasps. Smaller tools will promote more intrinsic muscle use and facilitate an appropriate grasp. Providing visual and/or verbal cues and reinforcements also was proven to improve a child’s learning potential of a skill and the quality of their end performance of that skill (Exner, 1990).

Need for Early Intervention

The California Department of Education publication of Infant/Toddler Learning and Development: Program Guidelines (2006, pp. 2-5) indicates that 58% of infants and toddlers spend time in non-parental care. The need for quality care particularly for lower income families is in demand (Fuller & Holloway, 2001). If this goal can be accomplished, the resulting benefits will include; school readiness, safety from abusive and neglectful situations, and the assurance of appropriate care for all children. Children thrive in locations of safety, which in turn allows them to express and explore themselves and their surroundings. For decades, child development studies have identified the academic benefits of good quality care for young children.

A large-scale national study conducted by the National Institute of Child Health and Human Development (NICHD, 1997) looked at home-based and center based care. The NICHD researchers observed more than 600 non-maternal child care settings of all kinds. The NICHD study documented that safe, clean, stimulating environments with small groups and low adult-to-child ratios were correlated with sensitive, responsive, and cognitively stimulating care. (p. 4).
The result of high quality care has shown to be directly related to language development, cognitive development, and school readiness (NICHD 2000). Helburn (1995) edited a research study involving 400 childcare centers in four different states. The researchers found that children attending a high-quality child care setting presented with higher cognition and social skills when entering early elementary schools.
CHAPTER III

METHODOLOGY

The methodology used to gather the information for the development of the early childhood fine motor assessment included an extensive review of literature and research regarding the developmental milestones and the ancillary factors contributing to fine motor development in children age eighteen months to five and one half years of age. Consultation and feedback pertaining to the assessment was attained from professionals within the field of occupational therapy and early childhood special education. Practice trials of the early childhood fine motor assessment tool included one hospital based pediatric setting, one early childhood classroom setting, and one rural consultation based early childhood school setting.

From the literature review, it was found that early childhood intervention promoting fine motor development is a major contributing factor to ensuring school readiness skills. Appendix B provides typical developmental milestones based upon the works of Erhardt (1974) and Edwards, Buckland, and McCoy-Powlen (2002). Currently, there is no occupational therapy based early childhood fine motor assessment tool in practice. Many tools, screeners, and assessments exist but none address the eighteen month to five and a half year range of skill development within the early childhood school setting. Appendix C provides descriptors of current assessment tools in practice. In addition, current tools do not consider all the ancillary components of fine motor development such as vision, sensory, strength, manipulation, reflexes, hand dominance,
body symmetry, upper extremity development, grasp, scissor skills, handwriting, and hand integrity. Literature supports that each piece of development has a role in the success of a child's hand usage and future academic success. The assessment summary form is designed to provide a clear picture of the findings for review and development of fine motor programs in collaboration with family and/or caregivers. Appendix D provides descriptors of current treatment regimes in practice.

From the consultations with other professionals, feedback was graciously accepted pertaining to the need for an early intervention fine motor assessment tool. Participants provided comments and recommendations regarding the format, content, administration, interpretation, and use of the assessment. This information guided the modification of the assessment and summary form to its current content and layout. A consultation request was also made to the developers of the Schoodles fine motor assessment tool. A reply has not been received at this time.
CHAPTER IV

PRODUCT

The information gathered from an extensive literature review led to and supported the need to develop a quick, user-friendly early childhood fine motor assessment tool for children age eighteen months to five and one half years of age. The assessment tool is specifically intended to serve children in early childhood settings however, it may also be of benefit in the medical model setting. The assessment is specifically designed to address fine motor skill development in children 18 months to five and a half years. The tool can be administered in its entirety, in specific sections, or in segments to accommodate the early learner's attention span and specific needs. Information gathered during this process is meant to be used as baseline for comparative data, for treatment planning, conference reporting, and for classroom, caregiver, and/or parent education.

The product binder is intended to be photocopied and utilized as often as deemed necessary for data collection of the child's developmental performance level. It has been designed to meet the needs of an occupational therapist but it may also be beneficial to physical therapists, teachers, and special education teachers working with children eighteen months to five and one half years. Information gathered can be used directly from the worksheet provided or it can be transcribed onto the assessment report format set by the professional work setting. The information may also be included on the summary form provided to assist in the presentation of the child's progressions during academic conferences, to determine if there is a need for occupational therapy services,
and for individual education program, (IEP), meetings or individual family service plan, (IFSP) meetings. The Early Childhood Fine Motor Assessment Tool administration manual provides brief descriptions of each component to observe. The manual also provides age approximations, skill completion techniques, and observation cues to assist data collection. Each suggestion is intended only as that, as it is certain that each child develops individually and may utilize alternative successful techniques to achieve skills and each child may progress at varying speeds of development.
Early Childhood
Fine Motor Assessment

Developed by
Naomi Kapaun, MOTS
Gail Bass, PhD, OTR/L, Advisor
University of North Dakota
Occupational Therapy
Preface

The information gathered from an extensive literature review led to and supported the need to develop a quick, user-friendly early childhood fine motor assessment tool for children age 18 months to 5 and one half years. The tool is specifically intended to serve children in early childhood settings however, it may also be of benefit in the medical model. The purpose for an early childhood specific tool is to eliminate skill expectation confusion and to secure a clear understanding of it's intent.

The tool can be administered in its entirety, in specific sections, or in segments to accommodate the early learner's attention span. Information gathered during this process is meant to be used as baseline and comparative data, for treatment planning and conference reporting, and for classroom, caregiver, and/or parent education. Information gathered can be used directly from the worksheet provided or transcribed into assessment reports formatted by the facility. The information may also be included on the summary form provided to assist in the presentation of progressions during academic conferences, to determine the need and benefit of occupational therapy services, and for easy reference during individual family service plan, IFSP, meetings or individual education plan, IEP, meetings.

The product binder is intended to be photocopied and utilized as often as deemed necessary for data collection of the child's developmental performance level. It has been designed to meet the needs of an occupational therapist but it may also be beneficial to physical therapists, teachers, and special education teachers working with children 18 months to 5 and one half years of age.

The Early Childhood Fine Motor Assessment Tool user's manual provides brief descriptions of each component to observe. The manual also provides age approximations, skill completion techniques, and observation cues to assist data collection. Each suggestion is intended only as that, as it is certain that each child develops individually and may utilize alternative successful techniques to achieve skills and each child may progress at varying speeds of development.

Author- Naomi Kapaun
Editor- Gail Bass
EARLY CHILDHOOD
FINE MOTOR ASSESSMENT

USER’S MANUAL

Developed by
Naomi Kapaun, MOTS
Gail Bass, PhD, OTR/L, Advisor
University of North Dakota
Occupational Therapy
USER’S MANUAL

The purpose of the user’s manual is to define terminology, clarify techniques, and to suggest observation areas to consider. Some sections on the screener include an age range in parenthesis. This is representative of the age span when that skill typically will occur. Each suggestion is intended only as that, as each child develops individually and may utilize alternative successful techniques to achieve skills children may also progress at varying speeds of development.

Hand Dominance

Hand dominance is defined as the use of the arms in an asymmetrical manner favoring one side for the completion of a range of skills, (Murray, 1995). Hand dominance is considered for two reasons:

1) To determine if the child has already established a dominance

2) If a hand dominance is apparent, to present items to the child on their dominant side as this has been proven to improve performance.

Testing tips:

• Place the writing tool aligned at the center of the body with the tip facing away from the child.

• Complete each request more than once if a hand dominance is not obvious.

• Children as old as 5 years may switch hand preferences in tasks.

• Note hand dominance information in home activities or treatment recommendations.

Observation tips:

• Document a pattern of initiation of the hand.

• Document if the child has better coordination on one side versus the other even if they do not realize it yet
- Document any delayed responses, over or undershooting of the target, or if a medical concern with one hand limits its use.

**Body Symmetry**

Asymmetry in posture or movement can have negative effects on balance, arm use, and the way a child interacts with the world, (Smith-Zuzovsky & Exner, 2004).

**Observation tips:**

**Tone:**
- Low: Child may present with "marshmallow" hands, slumped posture, or an inability to maintain a neutral pelvis position.
- Average: Child appears to look similar to their peers.
- High: Child may present with rigid movements, an inability to maintain a midline position, or an inability to control their motor movements.

**Head Alignment:**
- Right or Left tilt, forward or backward posture of head.
- Consider that the child may have a perceptual deficit, torticollis, or tone imbalance.

**Sitting Posture:**
- Anterior pelvic tilt: Consider the child may have a tone imbalance, guarding, or incomplete reflex integration.
- Posterior pelvic tilt: Consider the child may have a tone imbalance, muscle weakness, or incomplete reflex integration.
- Document changes in posture such as head tilt, associated movements, or abnormal positioning of paper during tasks.

**Standing Posture:**
- Symmetrical: The child appears similar to peers.
• Asymmetrical: Document any aspects of the child's posture that is not balanced such as an anterior pelvic tilt, leg length discrepancies, flexor withdrawal, or possibly an inability to hold a static standing posture.

• Note if the child can stand still or if they need to continuously be moving some aspect of their body. Typically, continuous movement is a sign of core weakness, an attention deficit, or cognitive impairments.

Reflexes and Postural Stability
Primitive reflexes typically integrate prior to age one. Primitive reflexes are directly linked to reach and grasp development. If appropriate integration does not occur, a child may not develop postural reflexes which will inhibit their motor growth (Goddard, 2002).

ATNR: Asymmetrical Tonic Neck Reflex- Promotes body separation, midline orientation, crossing midline, transferring objects, and hand to mouth movements (Edwards, Buckland, McCoy-Powlen, 2002).

Testing tips:
• It can be helpful to make the posture into a game.

• The child may locate objects in the room or follow an item of interest.

• If this child won’t cooperate, a second technique can be tried which involves the child placing their hand on their opposite shoulder and looking toward that hand.

• Ensure the child is on a flat surface.

Observation tips:
• Observe if child’s legs bend.

• Observe if child’s arms bend.

• Observe how far the child can turn their head and if they can either direction.
• Observe how long the child can hold the position and if they can rock forward and back while in the position.

**STNR:** Symmetrical Tonic Neck Reflex- Promotes integration of the upper and lower body, sitting posture, muscle tone, eye-hand coordination, and attention (Goddard, 2002).

**Testing tips:**
• In an effort to complete the task, songs or finger plays may be helpful to promote rocking.

• Placing an object of interest on a wall for the child to look up at or to lean forward to touch will aide in the amount of assist and direction you may need to provide.

**Observation tips:**
• Observe if child’s arms bend

• Observe if child’s legs straighten

• Observe if child can keep their head vertical or in midline

• Observe if child is symmetrical

• Observe if child can rock

• Observe if the child’s feet lift off the surface or if their hands shift from a front position.

**TLR:** Tonic Labyrinthine Reflex- Promotes posture, tone, balance, orientation and spatial relations, oculo-motor function, and visual perception skills, (McCormack & Perrin, 1997).

**Testing tips:**
• Remember that there is a supine and prone component to this reflex. One or both may not be integrated.
• A common sign of poor integration of prone TLR is toe walking. Check heel cord range if toe walking is observed during the assessment.

Observation tips:
• Observe if child can attain positions
• Observe how long child can hold positions
• Observe for symmetry or asymmetry

Postural Stability: These skills also involve the successful use of muscle strength, tone, reflex development, motor planning, vestibular function, and proprioceptive function (Frank & Wing, 2004).

Tall Kneel: The purpose is to address the child’s core strength and balance development. Observation in short kneel, child resting on the heels of their feet, may also be looked at to determine the child’s current level of development.

Alligator Crawl: This activity is used to determine the child’s motor planning ability, tactile tolerance, reciprocal movement coordination, and trunk and limb strength.

Criss Cross: The purpose of this activity is to determine the child’s motor planning, midline crossing, separate limb use, reciprocal limb use, and eye-hand coordination abilities. Children 18 months-2 years can attempt with one arm to hit a target that you hold across their midline, place on a wall or to direct them to tap their opposite knee with their hand, (Oden, 2004).

Testing tips:
• For younger children, tall kneel may feel safer if done in front of a small table surface or in front of a wall. Short kneel may also be an alternative to tall kneeling.
• If a child struggles after several attempts in any of the requests, it is important to assist the child and ensure the child feels success.
• If home carry over is recommended, it is critical that the parents understand the actions and how to assist the child to achieve the correct motor sequence.

• Ensure that if a target is used, such as a sticker, that it is simple and large enough for the child to see.

• A child may be able to “alligator crawl” if they are told to swim through the water or some other imaginary play activity.

Observation tips:
• Observe if the child has missing components
• Note how many cues or demonstrations are needed
• Note any loss of balance
• Observe compensatory strategies
• Note if the child can understand the concepts
• Observe if the child has a noxious tactile response to the activities.

EYE COORDINATION
According to the Optometric Extension Program Foundation, 2003, vision involves the ability to move the eyes through the environment to locate, track, and focus for function.

Tracking: The ability to smoothly follow an object in any direction, changing directions, and not losing sight of the object.

Shift: The ability to move or shift the eyes together from one object to another.

Convergence: The ability to move the eyes inward together.

Divergence: The ability to move the eyes outward together.
Testing tips:
- Improved performance may occur if you allow them to move the object in and out for convergence and divergence.

- A swinging ball is a high skill of shift of gaze and should be used only with older children. Most children assessed should be asked to shift their gaze from one toy to another.

- Vertical tracking typically emerges sooner than horizontal.

- The younger child may not be able to hold their head still yet. Assist them and/or observe their tracking skills with head involvement. Eye movements separate from head movement may not emerge until age 5.

Observation tips:
- Observe for jerky eye movements.

- Observe for slow gaze.

- Observe which directions the child can track easiest.

- Note if the eyes are moving together or if only one eye is being used.

Hand Integrity

Observation tips:
General Appearance:
- Note if the hand appear soft looking, rigid, or tight.

- Note any abnormal scars, birthmarks, skin folds, creases, color, shape, and hand size.
Oblique Arch:
- This arch provides power to the hand from each fingertip to the thumb.
- Note if the child can touch their thumb to each finger, if so then the arch is intact.
- If they cannot, which finger can they not touch and note observable tightness in the muscle structure of the hand.

Longitudinal Arch:
- Defined as a long vertical crease that runs from the carpal bones to the fingertips.

Transverse Arch:
- One arch will run along the middle line of the hand and provides stability for the hand.
- A second arch runs horizontal across the palm side at the base of the MCP joints or "knuckles" providing mobility.

Thenar Prominence:
- If flat, the thumb or thenar eminence, may be underdeveloped, weak, or a nerve injury may be present.
- If round, it may be overdeveloped, have a tone imbalance, adhesions, or a birth diagnosis may exist.

Touch Sensation:
- Note the speed of processing to touch
- Note any hypo or hypersensitivity to touch
- Note if the child can localize where they are touched i.e.) on the front or backside of the hand.
UPPER EXTREMITY DEVELOPMENT

Voluntary Release: This is the first stage in the development of in-hand manipulation. It involves the controlled grasp and release of an object for purposeful placement on or off a supportive surface, (Pehoski, 1995).

Testing tips:

• For the younger child, it is helpful to provide a target such as a cup, outlined area on a table, or on top of another item.

• Release into a cup or onto a table will be easier than release onto another item.

• Have the child grasp and release an item that fits comfortably into their flexed palm. If the item is too big or too little, the difficulty of release will increase. This may be altered during treatment to increase or decrease the difficulty of the task.

• Do not make the item so interesting and colorful that the child does not want to release it.

Observation tips:

• 18 Months Observe if the child can pick up small items such as cheerios or fruit loops.

• Ensure the item is edible for young child as they may still attempt to place items in their mouth.

• Observe if the child places an item or if they push it down into the surface to release.

• 24 Months Can the child release the object in the air or does the child need surface support.

• Can the child adjust the object when placing it to adapt to its shape or size.

Supination: Develops by age 2. It is the ability to turn or hold the hand so the palm is facing up (Bridgeman, 2002 p 23).
Testing tips:
- It is often easier to get the child to rotate into supination if you hand the item, held vertically, to the child versus having the child pick the item up off a surface.
- Use of songs or games such as give me "5" may also trigger the child to rotate into full supination.
- Use of items such as holding a baby doll, pouring from a container, carrying towels or a tray, or rotating a plastic circle like a driver's wheel, can spontaneously facilitate the skill.

Observation tips:
- Observe if the child can do both arms together
- Observe approximate degree of supination present, at least 30 degrees is needed for any level of functional supination use.
- Document why it appears limited i.e. tone, joint alignment, developmental delay.

Wrist Extension: Develops between 18mo-2years when the child begins to explore items in their hand. It is defined as a slight upward bend of the wrist creating slight flexion of the fingers and natural arches within the hand (Bridgeman, 2002).

Testing tips:
- Lying on their stomach, look at a book, draw, color, write, roll a ball, or hit a balloon to spontaneously present the skill.
- Table push-ups will demonstrate the supported range of each wrist.
- If it is difficult to observe the skill in each hand, have the child hold onto something in the hand you have observed. This will force the child to use their other hand.
• Rocking forward on all fours will not only demonstrate the development but can be used to improve range of the upper extremities and upper body strength if it is an area of need.

Observation tips:
• Observe if a wrist bend is present. The optimal range of wrist extension is 40 degrees.
• Observe if the child fatigues, note the time the child can hold wrist extension.
• Observe if the child compensates with their body for giving the appearance of wrist extension. i.e.) bends down or forward over hand.

Arm Skills: Emerges at four months and involves the following skills:

Unilateral: Reach of one hand toward a desired object

Bilateral: One hand holds an object while other hand acts on the object.

Two Hand Hold: Both hands hold onto one object.

Bimanual Hand Use: Each hand acts on a different object at the same time using each object in a different way.

Grip Gradation: The ability to control the amount of force needed to hold an object to avoid crushing or dropping it.

Testing tips:
• Ensure the item is the right size for the task requested.
• A child is more likely to use 2 hands together if they pick up the item versus you handing it to them.
• Younger children may hold a cup of cereal and retrieve one item at a time. This is more likely if the child does not have a surface to set the cup on.
- A child may demonstrate grip gradation with a pompom, cotton ball, or any other item that will squish if held too tight. Always use an edible item with young children.

**Observation tips:**
- Note if the child can use each arm successfully
- Observe for compensatory use of self or surfaces
- Observe how long the child can hold an item and if they can transfer it successfully from one hand to the other hand.

**In-HAND MANIPULATION SKILLS**

In-hand manipulation skills are defined as the process of using one hand to adjust or replace an object within the hand for more efficient use, placement, or release of that object (Exner, 1992).

**Finger to Palm:** Finger-to-palm translation occurs when an object is held by the distal finger and thumb for movement toward the palmar surface of the hand.

**Palm to Finger:** During palm-to-finger translation, objects are moved from the palm of the hand to the distal tip of the finger surface.

**Testing tips:**
- Pick up erasers, coins, jacks, dice, rocks, beads, paper clips, pom poms, cereal, or beans.
- Start with use of a surface area to help the child understand the activity then request the task without surface support.
- Bring a functional outcome to the activity by having the child place the items into a container or pulling the item from a container that only allows room for 2 fingers.
Observation tips:
- Observe each hand and note which side has greater skill
- Observe if the child uses their body or a surface area to complete the task.
- Note the size of the item transitioned and if the child uses gravity to assist.

Rotation: During rotation, the object is moved between isolated fingers and the thumb ranging between 180 and 360 degrees.

Simple: One item is rotated between the fingers with or without a surface or use of the body.

Complex: One item is rotated while at least one item is held in the ulnar or ring and little finger of the hand.

Testing tips:
- Use eating utensils to shift or rotate in a functional task if you are unable to observe otherwise.
- Opening a lid can present rotation.
- Children younger than 3 can typically only rotate an item once.
- Children under age 3 may still need a surface to help them. By the age of 5 children typically should be able to rotate an item up to 10 consecutive turns.

Observation tips:
- Note number of items, directions, and smoothness of motor skill.
- Observe each hand and note which side has greater skill
- Note if the child uses their body or a surface area to assist.
• Document if the child is able to rotate the item multiple times and the size of the item.

**Shift:** Shift is a linear movement and is used in order to adjust an object between or among the fingers placed at the pads of the fingers for use.

**Testing tips:**
- Turning pages in a book can present shift.
- Shift emerges on the ulnar side of the hand first and then develops in the radial aspect of the hand.

**Observation tips:**
- Observe the child for use of their body or other surfaces.
- Note if a skill is emerging or mastered
- Observe each hand and note which side has greater skill

**HANDWRITING GRASPS**

Handwriting is a complex task that involves moving a pencil in specific directions to achieve a desired outcome. Grasps progress in order of primitive, transitional, and finally a mature grasp (Thompson, 2003).

Definitions are provided by Edwards, Buckland, & McCoy-Powlen from the text Developmental & Functional Hand Grasps, (2002).

**Radial Cross Palmar Grasp:** The writing tool is positioned in a fisted hand with the tip projecting out from the thumb and index finger. The thumb is positioned on the radial side of the index finger and the arm is fully pronated. Full arm movements are used.

**Palmar Supinate:** The writing tool is held in a fisted hand with the tip of the tool extended from the ulnar side. The thumb is positioned on the radial side of the index finger and the wrist is slightly flexed and the arm is supinated away from the center. Full arm movements are used.
**Digital Pronate Grasp:** The writing tool extends past the ulnar aspect of the palm. The index finger is extended along the shaft toward the tip of the tool while the other fingers are curled around the upper portion of the tool. Full arm movement is used.

**Static Tripod Grasp:** The tool is stabilized against the radial side of the distal joint of the middle finger supported additionally by the pad of the thumb and index finger. The base joints are flexed and the distal joint of the index finger is extended, a web space is present. The tool is controlled by the movements of the entire arm not within the hand.

**Dynamic Tripod Grasp:** The tool is stabilized against the radial side of the distal joint of the middle finger supported additionally by the pad of the thumb and index finger. The base joints are flexed and the distal joint of the index finger is extended. The tool rests in the web space. The dynamic hold is moved by intrinsic muscles of the hand.

**Testing tips:**
- Some children may have already had poor experiences with writing tools.
- Place the tool on the writing surface at the child’s midline with the tip of the tool facing away from the child.
- Ensure the tool fits the hand of the child. Break a crayon, cut pencils, or use smaller markers.
- Try changing the surface to a slanted or vertical one and observe if grasp maturity changes.
- In children 18mo-2 yrs, use of the tools for stirring or exploring in media such as cool whip, sand, or finger paints, may motivate tool use and make the experience successful.

**Observation tips:**
- For children 2 and above, demonstrate stroke formations and note if the child can make _, |, O, +, or \ lines.
• Observe and note any differences in the direction of the strokes, pressure used, spacing, and quality of the outcome.

• Difficulty drawing or writing may indicate the child has eye hand coordination deficits, motor planning impairments, perceptual deficits, developmental delays, or that the child may be developing inefficient compensatory strategies as their hands are not developed fully yet for writing.

• Note if the child uses a grasp not listed and include a full description.

• Observe the grip gradation on the tool

• Observe if the child has an open web space.

• Observe how long the child can use the tool and if they switch hands during use.

• Offer the tool in the center of the seated child or to their dominant side as this has proven to improve performance.

• Note if the child has wrist extension, hand separation, and if they are able to use the intrinsic muscles of the hand.

**SCISSOR SKILLS**

Cutting is a complex bimanual task that requires separation of the two sides of the hand, eye hand coordination, motor planning, hand and finger dexterity, and problem solving (Schneck & Battaglia, 1992).

**Testing tips:**

• Try snipping straws, felt, paper, foil, and index cards and eventually advance to paper. This is particularly helpful with the child not interested in cutting.

• Use alternative scissors such as loop or spring scissors, or right or left handed scissors.
• Children 18mo-2yrs can trial use of a tongs or strawberry picker to demonstrate hand separation development.

**Observation tips:**

- Document the type of scissors used

- Note performance changes with or without visual cues.

- Observe how the scissors is held and if needed what type of help is given to hold the scissors correctly.

- Note if help is needed to hold the cutting surface.

- Observe if the child fatigues which may be seen in changing of hands, tearing the paper, or modifying the scissor grasp.

- Note if cutting was smooth, choppy, or a strength for the child.

**POWER GRIP**

Defined as a static grasp that applies force to an object held in the hand (Bridgeman, 2002). Information is for baseline data and comparative data.

**Observation tips:**

- Observe for time child can hold grip

- Observe any compensatory patterns

- Note if you assist child to hold the position of their arm
Early Childhood
Fine Motor Assessment
Test Booklet

Developed by
Naomi Kapaun, MOTS
Gail Bass, Ph.D., OTR/L, Advisor
University of North Dakota
Occupational Therapy
NAME ________________________________
Examiner ________________________________
Sessions to Complete ______ Total Time ______
Adaptations during Test ________________________________

<table>
<thead>
<tr>
<th>Hand Dominance (18mo – 3 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Choose any or all to complete</strong></td>
</tr>
<tr>
<td>Kick stationary ball</td>
</tr>
<tr>
<td>Use playground size ball</td>
</tr>
<tr>
<td>Observe which leg initiates</td>
</tr>
<tr>
<td>Pick up cereal</td>
</tr>
<tr>
<td>Place 3 pieces in front of the child in a vertical line</td>
</tr>
<tr>
<td>Observe which hand is used to pick up the cereal</td>
</tr>
<tr>
<td>Open box</td>
</tr>
<tr>
<td>Present a small jewelry sized box to the child</td>
</tr>
<tr>
<td>Observe which hand is used to open the box</td>
</tr>
<tr>
<td>Comments</td>
</tr>
</tbody>
</table>

(Murray, 1995)

<table>
<thead>
<tr>
<th>Body Symmetry</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tone</strong></td>
</tr>
<tr>
<td>Head Alignment</td>
</tr>
<tr>
<td>Sitting Posture</td>
</tr>
<tr>
<td>Standing Posture</td>
</tr>
<tr>
<td>Comments:</td>
</tr>
</tbody>
</table>

(Smith-Zuzovsky & Exner, 2004)
## REFLEXES and POSTURAL STABILITY

<table>
<thead>
<tr>
<th>REFLEX</th>
<th>METHOD</th>
<th>OBSERVATION</th>
</tr>
</thead>
</table>
| **ATNR**| *Start on all fours*  
*Arms extended, legs flexed*  
*Rotate head so chin touches shoulder and the head and back stay at same level.*  
*Rock back and forth so shoulders move in front of hands*  
*Repeat with head rotated toward the other shoulder*          |*(Do arms, knees, and hips remain extended and toes remain on the floor)*  
*Do not spread legs, bend elbows, or sit on ankles)* |
| Integrate  
4-6m |                                                                        |                                                                            |
| **STNR**| *Start on all fours*  
*Child lifts head so chin is up*  
*Chin is in air and back is level child leans forward placing shoulders past hands*  
*Rock back and forth*                                                                 |*(Do not lift feet, sit on ankles.)*  
*Keep hands flat and fingers forward)*                                    |
| Integrate  
6-12m |                                                                        |                                                                            |
| “Superman”|                                                                        |                                                                            |
| **TLR- Prone**| *Lye flat on stomach*  
*Raise chin off surface*  
*Arms extended overhead by ears*  
*Legs lifted straight off floor*                                                                 |*(Are the arms and legs fully extended, thighs and elbows should not touch the floor)*|
| Integrate  
6-12m  
“Superman” |                                                                        |                                                                            |
| **TLR- SUPINE**| *Lye flat on back*  
*Bring knees to chest*  
*Wrap arms around knees*  
*Bring chin toward knees*                                                                 |*(Do not flex the neck, sit on hips, or roll back onto shoulders)* |
| Integrate  
6-12m  
“Popcorn” |                                                                        |                                                                            |
<table>
<thead>
<tr>
<th>REFLEX</th>
<th>METHOD</th>
<th>OBSERVATION</th>
</tr>
</thead>
</table>
| Tall Kneeel 18 mo | *Count seconds child can hold the position  
*Have child reach to tap a balloon on a string | (Can the child hold the position then move out of midline and return)      |
| Alligator Crawl 2 years | *Demo for child  
*18m-2yr- Child should attempt a belly crawl or 4 point crawl | *(Is movement reciprocal, assisted, smooth, jerky)*                        |
| Criss Cross 3 years | *18m-2yr-hit a target with one hand  
*3y-5.6y: Sit or stand  
*Demo for child | *(Child completes just arms, one side, # cycles)*                         |

Comments:

(Goddard, 2002 & Oden, 2004)
## Eye Coordination

<table>
<thead>
<tr>
<th>Skill</th>
<th>Method</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tracking</td>
<td>*Move toy vertical, horizontal, circular, diagonal</td>
<td>(Does child move eyes with head)</td>
</tr>
<tr>
<td>Shift</td>
<td>*Ask child to look from one toy to another</td>
<td></td>
</tr>
<tr>
<td>Convergence</td>
<td>*Ask child to focus on toy, move toy toward bridge of nose</td>
<td>(Distance from bridge and direction eyes shift from toy)</td>
</tr>
<tr>
<td>Divergence</td>
<td>*Move toy from bridge of nose out</td>
<td>(Can child hold gaze, do eyes shift from gaze)</td>
</tr>
</tbody>
</table>

**Comments:**

(Optometric Extension Program Foundation, 2003)

## Hand Integrity

<table>
<thead>
<tr>
<th>General Appearance</th>
<th>Method</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>*Observe palm and back of hand</td>
<td>(Note scars, tone, color)</td>
</tr>
<tr>
<td>Longitudinal Arch</td>
<td>*Look on palm side from index finger to wrist with hand relaxed</td>
<td></td>
</tr>
<tr>
<td>Transverse Arch</td>
<td>*Observe on palm side along wrist and knuckles</td>
<td></td>
</tr>
<tr>
<td>Thenar Prominence</td>
<td>*On palm side note muscle at base of thumb</td>
<td>(Muscle is flat, tight, or overdeveloped)</td>
</tr>
<tr>
<td>Sensory: Touch</td>
<td>*Touch hand various areas with finger, cotton ball, pencil</td>
<td>(Note if child can identify where they are touched and how they respond to the touch)</td>
</tr>
</tbody>
</table>

**Comments:**

(Edwards, Buckland, & McCoy-Powlen, 2002; Ayres, 1974)
## UPPER EXTREMITY DEVELOPMENT

<table>
<thead>
<tr>
<th>Function</th>
<th>Method</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Voluntary Release</strong></td>
<td>*18mo- Observe child place one object</td>
<td></td>
</tr>
<tr>
<td><strong>(18mo-2yo)</strong></td>
<td>*2yo-5yo- Observe child place different size objects</td>
<td></td>
</tr>
<tr>
<td><strong>Supination</strong></td>
<td>* Hold vertical rod or string for child to grab</td>
<td></td>
</tr>
<tr>
<td><strong>(2yo)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Wrist Extension</strong></td>
<td>*Place magnets or make drawing stokes on floor or wall</td>
<td></td>
</tr>
<tr>
<td><strong>(18mo-2yo)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Arms Skills</strong></td>
<td>* Unilateral reach each arm</td>
<td></td>
</tr>
<tr>
<td><strong>(4mo-18mo)</strong></td>
<td>* Bilateral hand use</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* 2 hand hold</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* Bimanual hand use</td>
<td></td>
</tr>
<tr>
<td><strong>Grip Gradation</strong></td>
<td>*Hold cracker without breaking it</td>
<td></td>
</tr>
<tr>
<td><strong>(18mo)</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comments:**

(Pehoski, 1995)

## IN-HAND MANIPULATION SKILLS

<table>
<thead>
<tr>
<th>SKILL</th>
<th>Method</th>
<th>Right/Left Hand Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finger to palm</td>
<td>*Pick up cereal or crumple paper</td>
<td></td>
</tr>
<tr>
<td><strong>(1.5-2yo)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palm to finger</td>
<td>*Place cereal in a jar</td>
<td></td>
</tr>
<tr>
<td><strong>(2-2.5yo)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple Rotation</td>
<td>*Twist ties, wind up a toy, turn dial, or roll peg in hand</td>
<td></td>
</tr>
<tr>
<td><strong>(2-2.4yo)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex Rotation</td>
<td>* Hold at least one item in palm during rotation activities</td>
<td></td>
</tr>
<tr>
<td><strong>(4-5-5.6)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shift</td>
<td>*Rotating paper, sliding pencil up or down, turning pages, separate playing cards, stringing beads</td>
<td></td>
</tr>
<tr>
<td><strong>(3yo)</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comments:**

(Bridgeman, 2002)
## Handwriting Grasps

<table>
<thead>
<tr>
<th>Grip (Age)</th>
<th>Method</th>
<th>Right/Left Hand Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radial Cross</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palmar Grasp (3yr)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palmar Supinate (3yr)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital Pronate (3-4yr)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Static Tripod (4yr)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic Tripod (5yr-6yr)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comments:**

(Thompson, 2003)

## Scissors Skills

<table>
<thead>
<tr>
<th>Skill</th>
<th>Method</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snip (2-3)</td>
<td>*Ensure scissor fits size of hand. May use modified style scissor such as loop or spring</td>
<td>(Type of scissor used, assist to hold paper or scissor)</td>
</tr>
<tr>
<td>Straight Line (3-4yr)</td>
<td>*Provide 3 inch line on index card</td>
<td></td>
</tr>
<tr>
<td>Curved Line (4-5)</td>
<td>*Provide 3 inch circle on index card</td>
<td></td>
</tr>
<tr>
<td>Complex (5+)</td>
<td>*Provide 3 inch square on index card</td>
<td></td>
</tr>
</tbody>
</table>

**Comments:**

(Schneck & Battaglia, 1992)
Optional Strength Test:
POWER GRIP
Use a vigorimeter: 4cm bulb
Place arm to side, elbow at 90 degrees, and forearm in neutral.
Rest 15 seconds between measures

<table>
<thead>
<tr>
<th></th>
<th>Right</th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial 3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Bush, Link, & Lukens, 1995)

Additional Comments and Observations:
EARLY CHILDHOOD FINE MOTOR ASSESSMENT SUMMARY

Summary Descriptor

The purpose of the summary form is to provide a clear picture of the child’s current functional and developmental level. It is intended that part of the form be completed by the screener and the remainder with the team members. A copy of the summary should be given to the parent or caregiver and any other requesting team members.

Demographics:

- Provide only the information pertinent for the meeting
- Provide age of the child at the time of the assessment.

Findings:

- Determine strengths and areas of need for the child.
- Include information such as disposition, strengths, skills, quality of movements, compensatory strategies, functional vision, level of development, coordination, and any other information found relevant

OT Goal Progression:

- Include goal progression from the OT treatment plan that pertains to the assessment administered
- It is not necessary to include all the goals if they do not all pertain to the results
- It is also acceptable to attach a second goal sheet if there are several goals.

New Goal Recommendation(s):

- Discuss any new goal ideas, new concerns, or progression of the child.
- List at least one new goal idea. This will not only ensure a unified effort from everyone, but it will also maintain a positive outlook regarding the child’s potential.

Recommendations:

- Not all recommendations can be carried out in both the academic or clinic setting and the home or daycare setting.
- The daycare setting has been included because of the growing placement of children in these care settings.
- Additional forms can be attached to this section to clarify recommendations. The additions could include visual aides and detailed descriptions of the recommended activities.
Early Childhood Fine Motor Assessment
Summary Form

Name of Child: ________________________________

Date of Assessment: ___________________ CA: ___________________

Examiner: ________________________________

Findings

<table>
<thead>
<tr>
<th>Strengths:</th>
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<table>
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<th>Areas of Need:</th>
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<table>
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<th>Current OT Goal Progression:</th>
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<tr>
<td>New Goal Recommendation(s)</td>
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<tr>
<td>-----------------------------</td>
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<table>
<thead>
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<th>Occupational Therapy Recommendations:</th>
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<tr>
<td>Academic Setting</td>
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<table>
<thead>
<tr>
<th>Home or Daycare Setting</th>
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</table>
References


CHAPTER V
SUMMARY

Based on the literature reviewed in Chapter II, school readiness skill development needs to begin as early as eighteen months and encompasses cognitive, motor, language, social-emotional, and adaptive behavior development. The involvement of a child in an early childhood intervention program has shown to be directly related to language development, cognitive development, and school readiness skills (NICHD, 2000).

McHale and Cermak, 1992, found handwriting and fine motor activities encompass up to 61% of a child’s academic day and consequentially, handwriting skills have proven to impact a child’s academic scores. Occupational therapists in early intervention settings are essential contributors during this time of opportunity and development in a child’s life.

The purpose of this scholarly project was to develop an early childhood fine motor assessment tool that will address developmentally appropriate fine motor skills in children age 18 months to five and a half years old. The intention of developing an early childhood fine motor assessment tool is to accomplish a global, efficient, and effective system to analyze this populations’ fine motor and ancillary systems development. Several areas impact fine motor development to include; sensory, vision, strength, reflex integration, posture, and hand integrity. In addition to these areas, functional development, grasp and manipulation skills, and pre-academic skill development are included within the context of the assessment. The assessment was specifically
developed for the early childhood setting and the tool ensures easy administration, convenient use of data, and an isolated look at a preschoolers developing skills.

The assessment tool is recommended for use in all early childhood intervention settings. Information gathered from administration of the assessment tool could also be beneficial in practices following the medical model. The assessment tool is intended to be used by occupational therapists, early childhood special education teachers, and other related professionals working with children 18 months to five and one half years of age. It is intended that the assessment tool be used for initial evaluation, reevaluation, or to screen identified students or populations not currently receiving services. The tool could also be used as an educational component for providing feedback to families or other professionals about the child’s present level of performance or the child’s progression. It can serve as an easy reference to see the progress of a child throughout their early childhood experience. It can also be referenced when establishing a list of recommended activities for parents or teachers to use for continued work on developing the child’s skills. An additional summary form has been included for the intent of education with the child’s team and caregivers. It is recommended that the information found within the assessment be summarized and reviewed with the child’s team including most importantly the child’s caregiver or parent.

The limitation of the assessment tool is that it is new and there has been no research to establish the reliability and validity of the assessment. An additional limitation is that the ease of administration and usefulness of the content has not yet been supported through extensive administration trails.
It is recommended that ongoing administration trials continue in the early childhood setting and the medical model completed by occupational therapists and early childhood special education teachers. The assessment tool is currently being trialed by an occupational therapist in the medical model, an occupational therapist in a consultative school model, an occupational therapist in an early childhood intervention setting, and by a special education teacher in an early childhood setting. Ongoing feedback and revisions to the assessment tool, user's manual, and summary worksheet is recommended.

Research is needed to establish validity and reliability for the product. Based on literature review findings, further evidence based research is needed on the effectiveness of teaching fine motor skills at the preschool level and its impact on school readiness performance. Further evidence based research is also needed to determine if the assessment tool is biased toward gender, hand dominance, or a child's diagnosis. There have been numerous studies on the effectiveness of early intervention and occupational therapy services on motor development and school readiness. Ongoing studies are needed to refine how fine motor skills affect academic performance, to identify which skills are the most critical to develop, and how each ancillary system impacts handwriting and academic success. Therapists and professionals choosing to utilize this product as part of their intervention process should document the usefulness of the assessment and summary form. Further implementation trials are needed in order to confirm the effectiveness of the assessment's format, content, and if the information attained proves to be beneficial. More research is needed to determine if a child's outcomes improve from identification of their needs through the use of this assessment.
tool. Changes are continuous in society, it is essential to implement evidence based practice in order to stay current in clinical practice and to support professional competency.
Glossary of Terminology

**Apraxia:** A dysfunction of awareness involving one’s position in space.

**Bilateral Integration:** The ability to coordinate and use both sides of the body to carry out a task. One hand holds the object while the other hand acts on the object.

**Bimanual Use:** Each hand acts on a different object at the same time using each object in a different way.

**Binocular Vision/Eye Teaming:** The use of both eyes together smoothly, equally, and accurately to fuse or focus on a specific targeted area.

**Central Nervous System:** Consists of the brain and the spinal cord and controls all the activity of the whole nervous system.

**Convergence:** The ability to clearly see, inspect, identify and understand objects at near distances.

**Depth Perception:** The ability to judge relative distances of objects and to see and move accurately in three-dimensional space.

**Dexterity:** Skill and ease in using the hands with expertise.

**Divergence:** The ability to clearly see, inspect, and identify and understand objects at a distance.

**Eye-Hand Coordination:** The use of the eyes with the hands in a successful manner.

**Fixation:** The ability to quickly and accurately locate and inspect with both eyes a series of stationary objects, one after another.

**Grasp:** The act of taking securely and holding firmly.

**In-Hand Manipulation:** The process of using one hand to adjust or replace an object within the hand for more efficient use, placement, or release of that object.

**Nonprehensile patterns:** The grasp is defined as hand movement without grip involved typically resulting in pushing or pulling of an object.

**Peripheral Vision:** The ability to monitor and interpret what is happening around you while you are attending to a specific central visual task.

**Pronation:** The act of turning the palm downward.

**Proprioceptive System:** Gathers information through muscles and joints.
**Praxis:** The ability to figure out, organize, and carry out non-habitual motor tasks.

**Prehension:** The grasp of an object with the finger and thumb used in a manner to allow the object to be moved.

**Reach:** To extend out toward something with a limb.

**Release:** It involves the controlled grasp and release of an object for purposeful or non-purposeful placement on or off a supportive surface.

**Rotation:** May be simple or complex and involves movement of an object around its axis.

**Sensory Integration:** The organization of sensory input for use.

**Sensory Integration Dysfunction:** Inefficient processing of neurological information received from senses causing problems with learning, development, and behavior.

**Shift:** Linear movement used in order to adjust an object between or among the fingers placed at the pads of the fingers for use.

**Somatosensory Processing:** Processing of tactile and proprioceptive input.

**Supination:** It is the ability to turn or hold the hand so the palm is facing up.

**Tactile Defensiveness:** A negative reaction of emotions and behaviors to tactile sensations resulting from a sensory integration dysfunction.

**Tactile Discrimination:** The ability to distinguish between different stimuli through the skin receptors.

**Tracking:** The ability to follow a moving object smoothly and accurately with both eyes.

**Translation:** A linear direction of movement to include finger-to-palm or palm-to-finger relocation of an object.

**Unilateral:** Reach of one hand toward a desired object.

**Vestibular System:** Informs the body as to whether it is moving or standing still.

**Visual Closure:** The ability to identify a form or object although incomplete, what it would look like as a complete item.

**Visual Discrimination:** The ability to identify same characteristics between objects or forms.
**Visual Figure-ground:** The ability to locate a form or object within a three dimensional presentation.

**Visual Form-constancy:** The ability to identify a form or object that may appear different than the example but still have the key characteristics.

**Visual Memory:** The ability to recall characteristics of an object or form.

**Visual Perception:** It involves the recognition, discrimination, and processing of sensory integration through the eyes and the central nervous system.

**Visual Spatial-relationships:** The ability to identify the different components of an object or form from several objects or forms.

**Visual System:** The engagement of the eyes for acuity and perceptual interpretation of what is seen.

Definitions have been adapted from the works of Kranowitz (1998), Ayres (1979), Erhardt (1992), Bridgeman (2002), and Thompson (2004).
Appendix B
Fine Motor Developmental Milestones
Fine Motor Developmental Milestones

Based on the work of Edwards, Buckland, & McCoy-Powlen, 2002, & Erhardt’s, 1974, diagram of grasp prehension development from 12 weeks to 52 weeks.

<table>
<thead>
<tr>
<th>AGE</th>
<th>DESCRIPTION</th>
<th>STIMULATION</th>
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<tbody>
<tr>
<td>12w</td>
<td>Reflex Squeeze</td>
<td>Place objects in hand</td>
</tr>
<tr>
<td></td>
<td>Reflexive</td>
<td>Provide visual tracking stimulation</td>
</tr>
<tr>
<td></td>
<td>Ulnar side strongest</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Eye contact dependent</td>
<td></td>
</tr>
<tr>
<td>16w</td>
<td>Crude Palmar</td>
<td>Hang toys to reach and swipe</td>
</tr>
<tr>
<td></td>
<td>Mouthing of hands</td>
<td>Place toys within reach</td>
</tr>
<tr>
<td></td>
<td>Retains object placed in hand- ulnar side</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unilateral and bilateral hold present</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not dependent on vision</td>
<td></td>
</tr>
<tr>
<td>20w</td>
<td>Palmar Grasp</td>
<td>Vary toy texture, color, size, shape, and weight</td>
</tr>
<tr>
<td></td>
<td>Primitive squeeze</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Raking</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No thumb control</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Approach and grasp on sight</td>
<td></td>
</tr>
<tr>
<td>24w</td>
<td>Radial Palmar Grasp</td>
<td>Place toys near and far</td>
</tr>
<tr>
<td></td>
<td>Squeeze grasp</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No thumb control</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Eyes and hands work together</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power Grasp still dominates</td>
<td></td>
</tr>
<tr>
<td>28w</td>
<td>Raking</td>
<td>Provide smaller objects for hand transfer</td>
</tr>
<tr>
<td></td>
<td>Radial-palmar grasp continues</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Radial side stronger</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thumb adduction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transfer of objects</td>
<td></td>
</tr>
<tr>
<td>32w</td>
<td>Radial Digital Grasp</td>
<td>Provide toys that are thinner and smaller for thumb adduction</td>
</tr>
<tr>
<td></td>
<td>Inferior scissors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thumb can adduct not yet oppose</td>
<td></td>
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<tr>
<td>36w</td>
<td>Scissors Grasp</td>
<td>Finger foods</td>
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<td></td>
<td>Radial-digital grasp</td>
<td>Pliable materials</td>
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<tr>
<td></td>
<td>Thumb begins to oppose</td>
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<tr>
<td></td>
<td>Digit movement more refined</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controlled release emerges</td>
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</tr>
<tr>
<td>40w</td>
<td>Inferior Pincer Grasp</td>
<td>Small objects to palpate and explore</td>
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<tr>
<td></td>
<td>Neat pincer</td>
<td>Provide toys with holes</td>
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<tr>
<td></td>
<td>Wrist extension</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Individual finger poking</td>
<td></td>
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<tr>
<td></td>
<td>Voluntary release</td>
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</tr>
<tr>
<td>44w</td>
<td>Three Jaw Chuck</td>
<td>Provide tiny objects to pick up and drop i.e.) cereal</td>
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<tr>
<td></td>
<td>Neat pincer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wrist extension</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Superior forefinger grasp</td>
<td>Provide cause-effect toys of various sizes</td>
</tr>
<tr>
<td>52w</td>
<td>Neat Pincer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Superior forefinger grasp</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wrist extension and ulnar deviation</td>
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<tr>
<td></td>
<td>Smooth release on large objects</td>
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<td>Emerging release on small objects</td>
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Appendix C
Developmental Assessments in Practice
Developmental Assessments in Practice

Battelle Developmental Inventory: second edition:
The Battelle is a standardized and individually administered assessment battery of key developmental skills in children birth to seven years of age. It is intended to be utilized in school settings by speech pathologists, psychologists, adaptive physical education specialists, clinical diagnosticians, and health care professionals. The tool consists of 450 items sectioned as adaptive, personal-social, communication, motor, and cognition. Assessment, interview, and observations are utilized in data gathering of the assessment.

Bayley Scales of Infant and Toddler Development-3rd edition:
“The Bayley Scales of Infant and Toddler Development, third edition is an individually administered instrument that assesses the developmental functioning of infants and young children one month to 42 months of age. The primary purpose of the Bayley-III is to identify children with developmental delay and to provide information for intervention planning” (Bayley, 2006 p.1). The assessment consists of a cognitive, language, and a motor scale. In addition, the third edition includes a social-emotional and adaptive-behavior questionnaire that is completed by the parent or caregiver.

Brigance Early Preschool Screen:
This is designed for quick administration of approximately 15 minutes. It can be utilized with children age one year nine months to six years six months. The screener provides a pictorial view of a broad range of areas to include fine motor, body awareness, general knowledge, language, and gross motor. A point value is assigned to skills performed and later compiled into a mean score for the child. It is a criterion-referenced and curriculum referenced assessment providing data that can be transferred into instructional objectives.

Developmental Assessment of Young Children (DAYC):
Use of the DAYC is intended for identification of possible delays in the areas of cognition, communication, social-emotional development, physical development, and adaptive behavior. It is intended for use with children birth to six years of age.

Early Screening Inventory- Revised (ESI-R):
The ESI-R is a developmental screening tool for children age three to six years of age. It is used to identify areas of need for successful school readiness skills. The screen is divided into a preschool version for use with children three to four and a half and a kindergarten version which is intended for children four years five months sixteen days to six years of age. The inventory also includes a parent questionnaire, hearing and vision screening, and a generalized physical exam. The screener provides a quick overview of a child’s visual-motor, language, cognition, and gross motor skills.
**Hawaii Early Learning Profile:**
The Hawaii Early Learning Profile (HELP) is a curriculum based assessment and reference guide. It provides guidelines for interpreting the child's skills and behaviors in their home environment with caregiver or parental recognition. The HELP is designed to be particularly useful in early intervention programs by a variety of professionals that are family-centered. The tool is designed to measure development of cognition, language, gross motor, fine motor, social-emotional, and self help skills in children birth to three and three to six years of age. 

**Peabody Developmental Motor Scales- 2nd edition:**
The Peabody Developmental Motor Scales- Second edition (PDMS-2) is a motor assessment tool designed to provide a test of motor development and a series of activities for remediation. It is set up to measure the motor skills of children age birth through five years of age. The gross motor component includes 170 test items to include reflexes, balance, receipt and propulsion, locomotion and non-locomotion. The fine motor component contains 112 test items and includes grasp, hand use, eye-hand coordination, and manual dexterity. Additionally, scoring includes raw scores, standard scores, and percentiles of each subtest and fine motor quotient and gross motor quotient performance scores.

**Schoodles: Pediatric Fine Motor Assessment (PFMA) second edition:**
This is a tool designed for administration time of approximately 30 minutes. It is intended for use with children in preschool to grade school levels. The tool includes fine motor skills, vision skills, gross motor skills, body parts, manual muscle testing, self care, and general observations.

**T.I.M.E Toddler and Infant Motor Evaluation:**
A diagnostic assessment for measurement of children age birth to three and a half years old. It is designed to evaluate the overall quality of infant and toddler movements within an eight subtest design. Subtests include mobility, stability, motor organization, functional performance, and social-emotional abilities. The evaluation requires approximately 15-45 minutes to complete. The structure involves observation of a child’s sequential motor movements coupling a score to the motor performance and functional level observed. The test can be administered in increments or its entirety.
Appendix D
Handwriting Programs
Handwriting Programs

**Fine Motor Dysfunction: Therapeutic Strategies in the Classroom:**
These strategies adapt the regular classroom program and materials for preschool and school-age children. Illustrated sheets help to understand why a child is having difficulty with fine motor tasks. The activities and strategies give examples of ways to improve the child's performance. Activities are arranged in 15 skill areas, including central nervous system states, muscle tone, postural control, arm and hand strength, grip and pinch strength, shoulder stability and control, forearm, hand, and finger control.


**Fine Motor Olympics:**
This program was developed by Marcia P. Bridgeman, an occupational therapist. The program includes a guide to hand function, in-service training program guidelines, a checklist and screening format, and an activity completion and progression record form. In addition, a second manual is included with sixty five activities designed to promote hand and upper extremity strength, structure, and writing readiness.


**Fingermania:**
Fingermania is comprehensive hand skills program for age 5 and up which includes a screening tool and seventy-two activities for children preschool through third grade exhibiting mild to moderate hand skill deficits. Each activity includes detailed instructions, target skills, challenges and specific observations to watch.


**Handwriting without Tears (HWT):**
The goal of HWT is to make legible and fluent handwriting an easy and automatic skill for students. The curriculum uses multi-sensory techniques and consistent habits for letter formation to teach handwriting to all students—Pre-K through Cursive. In addition, HWT provides parents and teachers the instructional techniques and activities to help improve a child's self-confidence, pencil grip, body awareness, and posture.


**Handy Learning:**
This program was developed by Susan Thompson, licensed occupational therapist and includes activities for hand development and curriculum enhancement. The program provides an overview of current school readiness criteria, and environmental challenges for children. The program is intended for use on a daily basis and emphasizes hand structure, sensory processing, and visual processing components. The manual provides information for intervention in the classroom or home environment. Twenty four activity suggestions are described to include targeted areas, learning goals, supplies and positioning recommendations.

References


