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Handwriting from A-Z

Connie Lillejord
University of North Dakota

HANDWRITING FROM A-Z

by

Connie Lillejord, OTR/L

Advisor: Janet Jedlicka, PhD, OTR/L

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This Scholarly Project Paper, submitted by Connie Lillejord 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.

Faculty Advisor

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ABSTRACT

Prevalence for the number of students with poor handwriting skills has been estimated to range from 12% to 21% depending on grade, selection criteria, and instruments used (Graham & Weintraub, 1996; Hamstra-Bletz & Blöte, 1993; Smits-Engelsman & Van Galen, 1997). During late elementary and middle school years there is an increasing demand for efficient work output, particularly in written requirements. Greater numbers of required reports, math assignments, and writing assignments tap into a child's capacity to develop ideas quickly and put them down on paper (Levine, Oberklaid, & Meltzer, 1981). Children who have not developed automatic, fluent handwriting will find completing written work more of a struggle as demand for written output increases throughout their school years.

In surveys given to elementary teachers regarding handwriting, 64%-88% responded that they did not feel they had received adequate training in how to teach handwriting in their undergraduate courses (Graham, et al. 2008; Graham &Weintraub, 1996). It is not surprising to find that the strategies, techniques and programs used by these teachers varies a great deal, even within the same school district.

An extensive literature review was conducted and pertinent information gathered in order to gain an understanding of the underlying components needed for handwriting, as well as, which components research has found to be significant factors in learning how to write. Unique differences in teaching left-hand writers was explored through the

literature review in order to identify how to correctly teach to this minority 10% of the population and to be able to answer questions teachers frequently ask (Coren, 1993).

It was determined through the literature review that there is a need for training adults who work with children, or who will be working with children in the future in the area of handwriting. This teaching unit has been designed to educate professionals, college students majoring in elementary education and other childcare providers. It is intended to give them a background in the development of fine motor skills in young children, an overview of the components needed when learning to write and how to set up the writing area. The unit covers hand development in terms of attaining the correct pencil grasp, how to work with a child who is left-handed and when to bring in an occupational therapist. Additional activities are included to give learners' ideas that they can utilize in their classrooms. The training unit incorporates the visual, auditory, kinesthetic and tactile modes of learning throughout the 4 ½ hour presentation.

CHAPTER I

INTRODUCTION

Problems with handwriting are one of the primary reasons for referral to occupational therapy in elementary school (Reisman, 1991; Schneck & Henderson, 1990). It is a critical skill used by the student throughout every school day. A child dealing with handwriting difficulties may not be able to finish required written work on time, or may try to finish an assignment in as few words as possible, because it is a struggle for them to get the words down on paper. When a child is focused on the mechanical aspects of forming the letters or how to join the letters together when writing cursive, they may not fully attend to the content of the assignment (McHale & Cermak, 1992). Many children struggle with handwriting on a daily basis. The number of students with poor handwriting skills has been estimated to range from 12% to 21% depending on grade, selection criteria, and instruments used (Graham & Weintraub, 1996; Hamstra-Bletz & Blöte, 1993; Smits-Engelsman & Van Galen, 1997).

During late elementary and middle school years there is an increasing demand for efficient work output. A large amount of required written work in the form of reports, taking notes in class, math assignments, and writing assignments tap into a child's capacity to develop ideas quickly and put them down on paper (Levine, Oberklaid, & Meltzer, 1981). Children who have not developed automatic and fluent handwriting will find completing written work more of a struggle as demand for written output increases throughout their school years. This is frustrating for the child, as well as, the teacher.

In surveys given to elementary teachers regarding handwriting, 64%-88% responded that they did not feel they had received adequate training in how to teach handwriting in their undergraduate courses (Graham, et al. 2008; Graham &Weintraub, 1996). It is not surprising to find that the strategies, techniques and programs used by these teachers varies a great deal, even within the same school district. Thus the problem of struggling students is complicated by the fact that many teachers aren't sure how to help the situation or how to set up the classroom. Informal activities that may work on improving fine motor skills are missed. Resources for the teachers are needed to help them in assisting their students who struggle with handwriting.

The Occupational Adaptation theory was used to guide the development of this project (Schakde & Schultz, 2003). This theory views the learners as agents of change. The occupational therapist, in presenting the teaching unit, sets the stage for the learning environment. This teaching unit is seen as an activity that is particularly relevant to the learner in their current or future occupational roles. It is the learner who will decide how they will best utilize the information being presented to them and how they will adapt what they learn and implement it in the classroom.

This scholarly project is divided into 5 chapters. This chapter has provided an overview of the project and the intent behind the design of the teaching unit. The second chapter is a review of the current research and literature that helped to address the importance of handwriting, fine motor skills as they relate to handwriting, teacher's beliefs and teaching methods in this area, the components of handwriting and how occupational therapy fits in this realm. The literature review reinforces the need that

individuals who work with pre-school and elementary children would benefit from further education as they work with these children on developing their handwriting skills. Chapter III provides a description of the process used in designing this product. An overview of the product can be found in Chapter IV with the complete project, PowerPoint presentation, notes, learning activities and program evaluation found in the appendices. Chapter V contains the summary of the scholarly project, recommendations for handwriting in the classroom, implementation recommendations for the product and limitations of the project.

CHAPTER II

REVIEW OF LITERATURE

Handwriting is an important life-long skill. How well a child learns to write is determined by the time a child has completed his elementary years. Knowing how to write well cannot be overemphasized and it is an important part of classroom learning. During late elementary and middle school years there is an increasing demand for efficient work output, particularly in written requirements. Greater numbers of required reports, math assignments, and writing assignments tap into a child's capacity to develop ideas quickly and put them down on paper (Levine, Oberklaid, & Meltzer, 1981). Difficulties with handwriting can constrain a child's development in becoming a writer. If a child has difficulty in mastering this critical skill, they may avoid writing and develop a mindset that they cannot write (Graham, Harris & Fink, 2000).

Writing is used throughout the day, at work and at home. Job applications are filled out, notes are left for family members, phone messages are written, worksheets are completed, spelling tests taken, names are signed, tax returns are sent in, packages are addressed and mailed at the post office, and the list goes on. Prevalence for the number of students with poor handwriting skills has been estimated to range from 12% to 21% depending on grade, selection criteria, and instruments used (Graham & Weintraub, 1996; Hamstra-Bletz & Blöte, 1993; Smits-Engelsman & Van Galen, 1997).

According to Pape and Ryba, (2004), the Writing Instrument Manufacturers Association claims that illegible handwriting and other handwriting-related issues are

expensive and cost the United States more than $200 billion dollars a year in lost time and money. One example of this is the $95 billion in tax refunds that cannot be delivered because of illegible addresses on the tax forms. At the 1994 American Medical Association conference, medical records and prescriptions were deemed potential health hazards; the health of at least one in 10 people are endangered by a physician's handwriting. This may improve with technology, as it becomes more common to have prescriptions printed out.

Groff's study (as cited in Pape & Ryba, 2004), documented that students may achieve, as much as, a full grade higher on written assignments if their writing is more legible than similar or identical work. In addition, the study documented that at least 1 of every 3 teachers writes so poorly that it affects a student's ability to be able to read assignments, read notes written on the board or the teacher's penned response to their written work.

Since 1994, the Cohoes (New York) post office has needed to use a special facility called a Remote Encoding Center. There are 10 such centers around the country and each are staffed full-time around the clock. Their job is to simply decipher the region's daily load of illegibly addressed mail (Gladstone, 2002).

The handwriting crisis even extends to the criminal world. In 2003, in Mishawaka, Indiana, two men failed to rob a convenience store after the clerk had trouble deciphering their hold-up note. Before they left the store, one of the thieves berated the other for his poor handwriting (Gladstone, 2002).

The following literature review section describes how an infant acquires fine motor skills through a combination of movement, play and weight-bearing activities in the first year of life.

Development of Fine Motor Skills

According to Benbow (1995), developmental experiences in the first year of life lay the groundwork as an infant develops fine motor skills. As a child begins to point, grasp and release objects, the hand muscles strengthen and the child develops their abilities to make increasingly refined hand and finger movements (Naus, 2000).

Newborns keep their arms and legs tucked up underneath their bodies when lying in the prone position. They take a significant amount of weight on their forearms, which results in a great deal of proprioception distributed on the arms and hands. This is the beginning of hand development (Benbow, 1995).

The 4-month old infant is involved in hand-to-hand, hand-to-mouth and hand-to-body contact during play and exploration. Most of an infant's upper extremity movements demonstrate increasing gross motor control. They are able to hold a rattle, but are not able to manipulate it. An ulnar grasp is used to hold onto objects placed in their hands (Bly, 1994).

At five months, the infant is able to push up on extended arms, which allows his weight to shift posteriorly. This movement causes more weight to move onto the palmar surface of the hand, under stable shoulders. Weight-bearing into an open hand with an extended wrist helps to develop a palmar grasp. That is, four fingers holding an object against the palm of the hand. The baby can now visually direct reaching in a variety of

positions, supine, prone and in supported sitting. Transferring toys from hand to hand is just beginning (Benbow, 1995; Bly, 1994).

At 6 months of age, the infant is able to move into a position where only their hands and feet have contact with the surface. This position places complete weight bearing on the palmar surface of the hand, particularly the thumb and radial palmar surface. The infant begins to use a radial-palmar grasp, securing objects by using second and third digits against the palm. As with previous developmental stages, where the infant bears weight, tone develops and then functional use emerges (Benbow, 1995).

At about 8 months, the infant begins to use a radial-digital grasp, securing objects using their thumb, index and middle fingers. This occurs at this stage because the child is frequently transitioning from sitting to crawling and from prone to sitting. Early hand separation begins as the infant bears weight in crawling while carrying a toy. The baby can manipulate, transfer, and release a toy at will (Benbow, 1995; Bly, 1994).

Between the ninth and twelfth months, the infant begins to pull to stand using his digits to help push and pull. Fine motor skills are refined and grasp and release, thumb opposition and an emerging pincer grasp begin to develop (Benbow, 1995; Bly, 1994). These early developmental experiences help to set the stage for the fine motor skills needed in pre-school and kindergarten.

Not all infants follow the above timelines. Case-Smith, Bigsby and Clutter (1998) concluded that the influence of the size, weight, contour, shape, consistency and texture of the toys/objects that infants' handle and their ages make a difference in the how grasping patterns are used. At times, the infants used several different grasp patterns

depending on whether the object is tiny, medium-sized or larger. The results of this study supported that there is variation during the early months of fine motor development.

A child refines his motor skills over the next several years. Activities, such as, building blocks, putting together Legos®, stringing beads, eating finger foods, crawling, climbing, pulling wagons and pushing toys help a child to develop in-hand manipulation skills, dexterity and grip. All of these activities are important as they contribute to fine motor development, as the child heads towards preschool and kindergarten.

Fine Motor Skills in School

In order to determine the impact that handwriting has during a typical school day, it is important to know how much of a child's day is involved in the process. The following literature review and research suggests that children spend a large amount of their school days involved in fine motor tasks and that the need for handwriting increases as a child moves out of kindergarten and into the upper grades.

Children in kindergarten spend 36%- 66% of their time engaged in fine motor activities (Marr, Cermak, Cohn, & Henderson, 2003). These authors further broke the fine motor areas into three broad categories: Self-care, manipulative and paper and pencil activities. Fourteen percent of time was spent in "self-care activities", such as, handwashing, donning and doffing a coat and toileting. The kindergarten students spent 44% of their time in a second category, labeled "manipulating objects", and included such activities as cutting, play dough, finger plays and puzzles. The final category, "paper and pencil activities" consumed 42% of the total fine motor time.

In a study of second, fourth and sixth graders, fine motor activities were investigated in six elementary classrooms and amount of time allocated to fine motor

activities during a typical school day was determined (McHale & Cermak, 1992). The findings indicate that 31% to 60% of the school days were allocated to fine motor activities, closely paralleling the study by Marr et al. (2003). All classrooms observed had a high level of fine motor demands on the children. The difference between the two studies is that older elementary students (grades 2, 4 and 6) spent 85% of their fine motor time on paper and pencil tasks, i.e. copying from a textbook, writing spelling words repeatedly, creative writing, taking notes and drawing while the kindergarten students spent approximately half that time (42%) on paper and pencil tasks and more time on manipulating objects.

Handwriting Instruction in Elementary Schools

A literature review was conducted in order to determine the amount of handwriting instruction that college students majoring in education have received. Beyond that it is important to gather information on the techniques being used across grades of how teachers in the field are currently teaching handwriting.

Handwriting instruction in elementary schools varies between grades and teacher by teacher. The differences in teacher instruction are not surprising. Zaner-Bloser (a company that produces handwriting materials) mailed a survey to 4,970 kindergarten through sixth grade teachers. Of the 2,584 respondents, only 36% indicated that they had received any form of handwriting elementary instruction in their undergraduate classes (Graham &Weintraub, 1996). In a smaller sampling of nine kindergarten teachers, all reported they had not had any training in handwriting instruction in their undergraduate courses or in workshops (Marr, Windsor & Cermak, 2001).

A recent survey of 169 primary grade teachers that teach handwriting shows that nine out of every ten teachers indicated that they taught handwriting, averaging 70 minutes of instruction a week (Graham, et al. 2008). Slightly more than one-half of the teachers (51%) taught handwriting daily. Another one-third (34%) taught handwriting several times a week. One in every ten teachers taught handwriting just once a week. These teachers estimated that 23% of their students experienced difficulty with writing. 61% of the teachers use a commercial handwriting program. Of this group of teachers, only 12% of the teachers indicated their preparation was adequate.

In a suburban school district, that had approximately 2,900 students, a survey was completed by 52% of teachers in grades 1 through 6. The teachers responded to questions regarding their handwriting strategies on how students were taught handwriting skills. Six of the teachers expected handwriting to be taught in first grade and seven teachers stated it should be taught beginning in kindergarten. As for the order of introducing the letters, four teachers used a developmental approach, learning letters with straight lines first, five of the teachers introduced letters in conjunction with classroom themes (i.e. introducing the letters "G" and "g" during Green week), three teachers reported that they introduced one new letter per week as part of language arts and one teacher waited for mastery of a letter formation before moving onto another one. Nine of the respondents used six different commercial handwriting programs for manuscript instruction. For cursive, four of the seven teachers taught lower case letters first, one teacher taught all of the upper case letters first, and another teacher preferred to teach both at the same time. Five of the seven teachers used the Zaner-Bloser handwriting

program to teach cursive and another teacher used the Orton-Gillingham program (Asher, 2006).

In another study completed in London, 82 teachers who taught 9- and 10-year olds responded that 33% taught a style of writing called Marion Richardson, 21% taught italic writing, 20% taught "other" and 8% had no specific style. The amount of time spent per week on class or group lessons varied: 2% spent less than 20 minutes a week, 61% spent between 20-60 minutes a week, 10% said that the time varied and 9% stated that there was no group or class lesson (Rubin & Henderson, 1982).

It is easy to see that even within the same school district significant differences exist in how and when handwriting is taught. This makes it difficult for the child who may not be taught handwriting in kindergarten and then he moves into first grade where the teacher's expectations are that he should already have learned how to write.

Putting the Pieces Together

The following sections will pull together a picture of the components that are needed for handwriting. The literature review suggests that ongoing research is needed to continue to study the underlying mechanisms responsible for this critical skill. The literature review, also, suggests that there is a foundation that should be in place before a child is ready to be taught handwriting.

Studies have indicated that a child is ready to learn to write when he is able to copy geometric forms (Benbow, Hanft & Marsh, 1992; Weil & Amundson, 1994). The ability to copy geometric forms closely parallels the "drawing" needed to complete each letter of the alphabet. These forms include: a vertical and horizontal line, a circle, cross, square, triangle, left and right diagonal lines and an "X". Children typically draw a circle

at 3 years, a cross at 4 years, and a triangle at approximately 5 years of age. According to Beery's normative sample, children are usually able to master the first nine forms on the Developmental Test of Visual-Motor Integration (VMI) by the time they are 5 years, 3 months (Beery & Buktenica, 1989).

In the Weil and Amundson (1994) study, 88% of the kindergarten children were able to copy the first nine forms of the VMI at the end of the first semester. The author's conclusion was that most children would be ready to begin handwriting instruction in the latter half of the kindergarten year.

In addition to copying the first nine shapes of the VMI, Benbow et al. (1992) listed three other areas: dominant hand use, midline crossing with the dominant hand and proper posture and pencil grip. These skills lay the foundation needed to begin to write.

Learning to write requires a combination of motor, sensory, cognitive and perceptual skills. It is a process that begins with recognizing and producing a specific shape (Benbow et al., 1992). Before a pencil is put to paper, a child needs to be prepared to write. The following components will address the importance how a child's desk and chair should be fitted. In addition, one literature review found an alternative for the standard chair that may work effectively for students as they write.

Proper Ergonomics: A child may have good postural control and stability and then be seated in an ill-fitting desk or chair and asked to write. This is similar to participating in a sport, such as, softball and not having the right equipment to play the game (i.e. the glove is too large or small, the bat is too heavy or the spiked shoes are too big). Any of these equipment flaws would cause a less than optimal outcome in a person's performance. A student's chair height should allow the student to be able to

place his feet comfortably on the floor. He can use this heel contact point to help counterbalance the weight shifting and postural adjustments he needs, as his writing hand moves across a sheet of paper. Knees and hips should be flexed to 90 degrees. The writing desk should be 2" inches above the student's bent elbow. This will allow him to easily rest his arms and support himself when writing. If the desk is too high, the student will spread his arms too widely for maximum control of his hands. If the desk is too low, the student will lean forward and use his non-dominant hand to prop his head up rather than hold onto the paper. Every handwriting session should begin with the student assuming a proper, functional position for writing (Benbow, 1990). The student should lean forward slightly. Each desk should directly face the chalkboard where the teacher will be standing as she demonstrates the letter formations for the students. This will eliminate directional and positional confusion for the students who may struggle (Benbow, 1995).

In a move from the traditional classroom chair, a study was conducted using therapy balls as a chair replacement to determine if they had an impact on in-seat behavior and what effect they would have on legible word productivity. The study was initially designed to look at a strategy that might benefit children with attention-deficit hyperactivity disorder (ADHD). The therapy balls were fitted to the students, so the optimal positioning of feet on the floor, with hips and knees at 90 degrees was followed. At the conclusion, the results indicated that both in-seat behavior and legible word productivity improved. In addition, 21 other students in the class reported that they believed the therapy balls were more comfortable, improved their writing, and increased

their ability to listen and finish class work (Schilling, Washington, Billingsley, & Deitz, 2003). This is another alternative to consider when seating children for classroom work.

Pencil Grip and Effect of Pencil Size and Shape: The following literature review looks at different types of pencil grips, what that indicates and whether legibility and speed is affected by the different grips that children use. It was determined that many people can write satisfactorily with poor or immature grips. However, there were no studies found indicating what the long-term effects of using poor grips (i.e. closed web space, use of power muscles rather than precision muscles) may be.

A study designed to investigate the developmental progression in pencil and crayon grips in 3- to 6- year olds was completed on 320 nondysfunctional children, with 20 boys and 20 girls at each 6-month age interval. The authors found that all of the grips observed could be categorized into one of 10 grips. Forty percent of the youngest children (age 3.0-3.5 years) were already using the dynamic tripod grasp. By the age of 6.6-6.11 years, 72.5% of the children were using the dynamic tripod grasp. The implication from this study shows that children, three years of age can be expected to use a variety of grips, from primitive to mature. By 4 ½ years, children can be expected to use transitional (cross thumb, static tripod or four fingers on the shaft) or mature grips and by 6 ½ years of age or older, children will typically use the lateral tripod or dynamic tripod grasp (Schneck & Henderson, 1990). The dynamic tripod grasp is described as the pencil stabilized against the radial side of the third digit by the thumb pulp with the index pulp on top of the shaft of the pencil. The thumb is in full opposition with the wrist slightly extended. The fourth and fifth digits are flexed to stabilize the metacarpophalangeal arch and third digit, the thumb, first two digits and wrist move as

the child draws tall and horizontal strokes and the forearm rests on the table (Rosenbloom & Horton as cited by Schneck, 1991).

Greer and Lockman (1998) compared the grips used by 3 year olds, 5-year olds and adults. The results indicated that between 3 and 5 years of age the number of different grips a child routinely uses is reduced. Three year olds tend to use a variety of multiple grip patterns. Five year olds were similar to adults in that they tended to use a consistent grip across all of the trials.

Many writers write satisfactorily with poor grips. Many of the grips used require the person to develop skilled use of the proximal joints. When proximal versus distal joints are used, a person loses out on precise control and speed when forming letters. If the writer does not demonstrate good stability to manipulate the writing tool in their hands, they may use the thumb adductor, a slow power muscle, to brace the pencil and close the web space in the hand (Benbow et al. 1992; Benbow 2006).

However, a study by Koziatek and Powell (2003) looked at the pencil grips, legibility and speed of fourth graders' writing in cursive. The 101 students used a variety of pencil grips: 38 used the dynamic tripod grasp, 18 used a dynamic quadropod pencil grip, 22 used a lateral tripod pencil grip, 21 used a lateral quadruped pencil grip, one used a four-finger grip and one used an interdigital grip. The findings of no significant legibility and speed differences among the first four pencil grips strengthens the argument that these grips may be equal in function to those of the dynamic tripod grasp. As only one student used the interdigital grasp and the four-finger grasp, further study is warranted with these two grips.

Providing writing tools with a variety of grips for preschool children who are just beginning to work on positioning their hands correctly on a pencil is the most sensible and effective use of these devices. If the correct grip is reinforced at an early age, this will eliminate the struggle to correct the inefficient grip after it has been used repeatedly and kinesthetically locked in (Benbow, 2006).

The discussion of what size of pencil should be used with young children comes up frequently when children are referred for handwriting problems. One study was designed to see if there were any differences in the pre-writing skills of kindergarten children when given a standard, primary or triangular-shaped pencil. 126 children, ages five and six, participated in the study. The writing tools used were a standard #2 round pencil, a primary #2 7/8 centimeter round pencil and a #2 7/8 centimeter triangular-shaped pencil. Grasp patterns were also recorded. 36-40% of the children used a dynamic tripod grasp when writing. The overall results of this study indicated that the children's performance did not differ when using the various sizes and shapes of pencils. One thing to keep in mind with this study is that children receiving OT services or having handwriting difficulties were not assessed in this study. It is possible that using an alternative grip may benefit them (Oehler et al., 2000).

Components of a Working Hand: The hand is a complex structure. It contains 19 bones, 17 joints, and 19 muscles and is equipped for delicate manipulation, power grip, tactile discrimination and precision work (Tubiana as cited by Benbow et al. 1992). Good hand function is dependent on interplay of intrinsic and extrinsic muscles working together. The extrinsic, large muscles help to stabilize the wrist and provide gross flexion and extension of the fingers and thumb when holding objects. The lateral wrist

movements by the extrinsics help to move the writing tool across the paper. The smaller, intrinsic muscles in the hand grade the movements needed to manipulate and rotate objects within the hand. Flexion and extension movement of the digits, by these muscles are used to draw the vertical lines needed in writing and drawing. The ability to transfer thought to paper has less to do with how a person holds the writing utensil and more to do with the ability to combine and sequence finger and wrist movements. (Benbow et al. 1992; Boehme, 1988).

A study by Cornhill and Case-Smith (1996), suggests that enhancing a toddler and preschool child's in-hand manipulation skills, before the introduction of writing implements, may improve the child's intrinsic muscle function. This would decrease the probability of acquiring an inefficient pencil-grasp pattern.

Arches: The hand consists of four oblique, four longitudinal and two transverse arches. When arches are well developed, they will form a deep hollow in the palm at the base of the middle finger. They are an important component in shaping the hand when holding the pencil and allow skilled movement of the fingers. Examples of this include: unscrewing the cap off a tube of toothpaste or turning a pencil over to use the eraser (Benbow et al. 1992).

Separation of the sides of the hand: The hand has a midline that separates out its two important functions: skill and power. The ulnar (little finger) side is used for power, while the radial (thumb) side is used for more skilled movements. When a student writes, the ring and little finger should be flexed and remain "quiet" to stabilize the arch, while the radial side (thumb, index and third finger) manipulates the pencil. The motoric separation of the hand can be seen when a student is cutting with a scissors. One side of

the hand stabilizes the object and the other side of the hand is in motion. Shoe tying, removing a pen cap with one hand and holding a pump water bottle and squirting it are other examples of motoric separation (Benbow et al. 1992; Boehm, 1988).

Wrist position: The wrist is the key joint of the hand (Bunnell as cited in Benbow, 2006). The fingers of the hand operate most efficiently when they work from a point of stabilization. The wrist is that stabilization point. The wrist joint should be straight or slightly extended during fine motor activities. Activities used to facilitate wrist stabilization in an extended position with precision finger skills can best be done on vertical surfaces above the child's eye level. Using this position automatically places the wrist into its optimal posture and assists the thumb in working distally with the fingertips. Another advantage of this position is that the weight of the arms will strengthen the muscles and stabilize the joints of the scapula and the shoulder (Benbow, 2006).

Manipulation skills of the hand: In-hand manipulation involves the adjustment of an object within one hand while it is being held. Simple rotation within the hand involves rolling an object 90 degrees or less while complex rotation involves turning an object 90 to 360 degrees while isolating thumb and finger movements. An example of this is turning a pencil over to use the eraser. A shift is an in-hand manipulation movement where there is a slight adjustment of the object being held by the fingertips. Translation is a form of manipulation where an object is moved in a linear direction between the palm and the fingertips. Both of these movements are used in writing to help adjust the pencil in the hand, once it is initially grasped. The intrinsic muscles of the hand are responsible for these in-hand manipulation skills (Benbow, 1990 as cited in Benbow, et al. 1992; Exner, 2006).

In a study by Cornhill and Case-Smith (1996), evidence of a strong association between handwriting performance and in-hand manipulation skills was shown. The results of the study support the contention that precise control of fingers and thumb, needed to move objects in and out of the hand, is highly associated with letter formation in writing. This is an area that should be assessed when a student is identified as having handwriting problems.

In children with low academic work output, 72% of the 26 children had difficulty with fine motor tasks (Levine et al. 1981). The authors further suggested that the children's uncoordinated finger movements and diminished pencil control accounted for their "illegible and/or laborious, hesitant, and slow" handwriting (pg. 20).

The following components have their base in the sensorimotor arena. Students who are referred to occupational therapy for messy or poor handwriting may have problems in one of the following areas: Postural control and balance, proprioceptive/kinesthetic, bilateral integration, tactile system or motor planning.

Postural Control and Balance: Use of the hands begins at the shoulders. Control throughout the shoulder girdle (proximal stability) is necessary to provide a stable base of support from which the arms and hands can function. Children must be sensitive to how their bodies are positioned and be able to make minute adjustments. The muscles in the front and the back of the trunk are needed to maintain the trunk in erect alignment with gravity. Students who have difficulty with postural control and balance may be observed to hold their head propped up with their hand, put their heads on the desk while they are writing or may fall out of their chair. If a student is unable to maintain an erect upright posture, there is a disadvantage for the shoulder, eyes and hands to work together

efficiently for handwriting (Benbow, 1990; Benbow et al., 1992; Vreeland as cited in Pape & Ryba, 2004).

A study by Smith-Zuzovsky and Exner (2004), observed that children with poor positioning moved frequently in their seats in an attempt to find a better or more comfortable seating position. It was suggested that this not only affects the quality of the child's performance but that their attention to tasks may have been negatively influenced.

Proprioceptive/Kinesthetic: Proprioception information gives the student an unconscious sense of arm, body movement, weight and where the body, hand, and arm are positioned in relation to the writing surface. Awareness of when a movement feels right, such as, learning to ride a bike or handwriting will reduce the need for visual monitoring of a body part in space while helping build motor confidence and speed (Benbow et al., 1992; Benbow, 1995). The word "kinesthesia" has been used interchangeably with the term "proprioception", in recent years (Fisher, Murray & Bundy, 1991). This kinesthetic/proprioceptive feedback allows the student to sense where the point of the pencil is on the page. Students who have difficulty with this sense may use increased pressure on the pencil to provide themselves with adequate feedback or use excessive force when pressing down on the writing surface. Habituation is quick and the pressure will continually need to be increased. Fatigue, pain and avoidance may be noted (Benbow et al., 1992; Levine et al., 1981).

In a study by Schneck (1991), 60 first- grade children, without physical, learning or behavioral problems, from elementary schools in Philadelphia were studied. Thirty of the children had handwriting difficulties and 30 of the children did not. One part of the study was to determine if children with poor grips had decreased proprioceptive-

kinesthetic finger awareness and this hypothesis was supported. These same students also had less mature pencil grips. Children that have decreased tactile and proprioceptive/kinesthetic feedback from their hands continue to need visual monitoring in order to make sure that they are writing letters correctly. They do not develop the automatic skill needed to put words down on paper.

Several authors have concluded that automatic letter writing plays a critical role in allowing the student to move forward with higher-level cognitive processes. The ability to access letter forms rapidly from memory, and to produce them automatically frees up the student's attention to plan content, generate text and transcribe written composition (Christensen, 2005; Graham, Berninger, Abbott, Abbott & Whitaker, 1997; Marr et al. 2001).

Bilateral Coordination and Crossing Midline: A child needs to have good bilateral coordination when writing. One hand is used for manipulating the writing implement and the other hand is needed to stabilize the paper. As the child writes across the paper, he will cross midline. Children who struggle within this area may write with their left hand when they are writing on the left side of the page and when they get to midline they will switch hands and use their right hand to finish the line.

By the time most peers are doing well in the graphic motor area, a child with bilateral integration dysfunction is still using their hands interchangeably to do far less complex activities. The child is unable to change stroke direction in a continuous flow pattern. When writing the following letters in cursive (h, k, b, f, and l), it is almost impossible for the child to make the transition (Benbow, 2006).

Orientation to Print/Spatial Organization: An assumption is made that by the time a student enters kindergarten, he/she is able to understand basic spatial directions. The directions needed to teach children handwriting include several spatial concepts. Terms, such as, "on top of the line", "below the line", "between the line" and "above the line" are used in handwriting curriculum (Benbow, 2006). One suggestion that the author makes is that writing instructors could use different descriptions of the lines on the writing paper. The descriptions of top line, writing line, and dotted middle marker, will help the students to distinguish where to place the letter. Boehm (1986) indicates that 98% of kindergarten children understand the word "top," 90% understand the word "between," and 85% understand the word, "above".

Visual-Motor Control and Visual Perception: Use of vision is an essential piece as children learn to plan, execute and monitor their handwriting attempts. The reliance on the visual system generally diminishes as the child becomes more skilled in handwriting and feedback from the somatosensory system provides greater feedback (Cornhill & Case-Smith, 1996). A number of researchers have documented a significant relationship between handwriting skills and visual motor control. One study investigated some of the mechanisms needed for writing (Volman, van Schendel & Jongmans, 2006). Twenty-nine children with handwriting problems and 20 of the children without handwriting problems were studied. The aim of the study was to investigate the role of lower level processes, such as, visual perception, visual-motor integration, and fine motor coordination and higher level processes (cognitive planning) involved in a handwriting task. The children with handwriting difficulties were less proficient in fine motor coordination, visual-motor integration, visual perception, and cognitive planning abilities.

However, in looking at the quality of handwriting, visual-motor integration was the best and only significant predictor in the group of those with handwriting problems.

Tseng and Chow (2000) investigated the differences in perceptual-motor measures and sustained attention between children with slow and normal handwriting speed and the relationship between these factors. 110 children from grades 2 through 6 participated in the study. Using the Chinese Handwriting Speed Test (CHAST), 71 of the children were evaluated as slow handwriters and the other 39 had normal handwriting speed. Several different tests assessing perceptual/motor, vigilance and upper limb speed and dexterity were given. The normal speed group scored higher than the slow handwriting group on all measures. However, the differences were not statistically different on the visual discrimination and visual closure test. Fine motor skill was an important predictor for the normal handwriting speed group. It was found that the slow handwriters performed poorly in a laboratory measure of attention and this supported the teacher's ratings of inattention with the students.

In another study, 48 children with good and poor handwriting as identified by teacher report and the Minnesota Handwriting Test (Reisman 1995), were studied for differences on certain components: eye-hand coordination, visuomotor integration, and in-hand manipulation. The results suggest that eye-hand coordination and visuomotor integration are fundamental components of handwriting and should be evaluated when a child demonstrates handwriting problems. The authors found that visuomotor scores on the VMI was a significant predictor of handwriting performance (Cornhill & Case-Smith, 1996).

In yet another study, Marr et al. (2001) concluded a moderate relationship exists between visual motor and graphomotor skills. This would suggest that evaluating visual motor skills may help to pinpoint children who need close monitoring or interventions to prevent the development of handwriting problems.

Hand Dominance: Between the ages of four to six years, a young child typically begins to show a hand preference when playing with toys, using tools and performing fine motor tasks. Hand dominance develops as a result of the ability to coordinate the two sides of the body (Pape & Ryba, 2004). This preference encourages the child to become skilled in the use of one hand through repeated use of the dominant hand. Unilateral hand function initially takes place only on the same body side and at midline. It is only later that this extends to the opposite side of the body (Kraus, 2006). As a precursor to developing hand dominance, Knickerbocker (1980) suggests that nursery school and kindergarten children should be exposed to many activities that encourage wide, random arm movements of both arms.

An established dominance is a strong indication of maturation and differentiation of the two cerebral hemispheres. Both sides of the brain need to be working together when producing words in written form (Benbow, et al. 1992).

Left Handers

Ten percent of the present population represents a neglected minority group that has been subject to discrimination and humiliation over the years – this group are people who use their left hands for writing, among other things (Coren, 1993). There are a number of theories within literature as to handedness although the determining factors for handedness remain inconclusive. The theories that have been looked at are:

a) sociocultural influences, b) genetic theories, c) pathological influences, and d) neuroanatomical and neurophysiological foundations (Kraus, 2006).

Several decades ago, many children were forced to switch from their left hand to their right hand. It happened to this author's mother in the 1940's, at the age of six. The teacher was adamant that she switch from being a "leftie" to using her right hand. She is strongly left hand dominant and developed a distinct stutter as a result. Her father intervened with the school and insisted that she be allowed to remain left-handed, to which they reluctantly agreed. People who went to elementary school in the 50's, 60's, even the 1970's, have been forced to switch from their left hand to their right hand by their teachers and/or strong influences from the family.

There is a strong hereditary disposition toward a child developing a particular hand preference. A child with two left-handed parents has a 42% chance of being left-handed; when only one parent is left-handed this percentage drops to 17%. If both parents are right-handed there is only a 2% chance that their child will be left-handed (Marsh & Hanft, 1992).

There are more "pathological" left handers than there are pathological right-handers. This means that more left-handed children are naturally right-hand dominant children who choose to use their left hand because, for some reason, the right hand is clumsy. Interference with development or damage to one side of the brain can lead a child to use the non-dominant hand as the dominant hand, because it works better (Levine, 1991). Coren (1993) has done several studies and has come to the conclusion that left-handedness appears to be associated with the presence of certain abnormal or pathological conditions, such as birth or pregnancy difficulties. Although not all left-

handers fall into this category. One typical study involving premature children found that they were nearly twice as likely to be left-handed or mixed-handed when compared to children delivered after a full-term pregnancy (Ross, Lipper & Auld as cited in Coren, 1993).

This does not mean that most of the left-handed children will have learning disabilities or motor problems. Left-handed children are a mixed group – some are strongly left-dominant from an early age, some have a family history of left-handedness, some of the children will take a long time to develop their left hand preference (Levine, 1991). Ayres (1975) stated that although a child may show a preference for one hand early in life, many may not establish a dominant hand until they reach school-age, and it may not be stabilized until age 7.

Hemispheric integration and callosal maturation have been linked to many higher cognitive activities, one of them being handedness development (Rourke as cited in Kraus, 2006). There is neuroanatomical evidence that the corpus callosum differs with handedness. Studies have shown that it is approximately 11% larger in left-handed and ambidextrous individuals than in right-handed individuals (Witelson, 1985).

Handedness appears to have many causal factors that are influenced by a variety of mechanisms, both genetic and non-genetic. Origins aside, it is still important to remember that a left-handed writer will always be in the minority in any classroom and how they learn to write is not simply opposite of a right-handed individual. Right-handers move the arm away from the body in an arc, using their elbow as a pivot point. They are able to see each of the words that are written across the page. If a left-hander were to position the paper the same way, they would have to push across the page and the

words would not be visible as they went along. The words would smear and children would not be able to see what they had just written. Because of this it is important to work with left-handers before they automatically develop awkward grips in order to see the words they are writing as they move across the page.

Occupational Therapy and Handwriting

Problems with handwriting are frequent reasons why children in public school are referred to occupational therapy (Reisman, 1991; Schneck & Henderson, 1990). The following literature review looks how occupational therapy intervention in handwriting may make a difference to the student.

The demands of handwriting fit into the realm of both the occupational therapist and the teacher. It is the teacher's role to teach handwriting. It is the occupational therapist's role to determine underlying postural, motor, sensory integrative, or perceptual deficits that might interfere with the development of legible handwriting (Stephens, 1989).

Reisman (1991) conducted a study and compared scores from the Minnesota Handwriting Test (pilot version) to the teacher's judgment on which children had poor handwriting skills. Children in 27 second grade classes (N = 265) participated. The children were split into four groups. Group I were students in regular education and had the highest mean test score (95.8%). The Group IV students spent part of their day in special education and were receiving occupational therapy services. They received the lowest mean score (76.0%). Group II (89.4%) and Group III (80.5%) fell in between and were not receiving occupational therapy services. Overall, it appeared that the teachers were making appropriate referrals for handwriting issues to occupational therapy.

A few studies have been conducted to look at the benefits of occupational therapy and its effectiveness. Peterson and Nelson (2003) examined whether or not intervention for a group of economically disadvantaged first graders would improve academic output. The Minnesota Handwriting Assessment (MHT) was used both pre-test and post-test to evaluate letter and word spacing, legibility, speed, placement and letter size and form. Occupational therapy intervention was given twice a week for 30 minutes for 10 weeks for one group; the other group received academic instruction only. Post-test scores indicated a substantially greater increase in the scores of the MHT in the test group receiving occupational therapy than in the "academic instruction only" group.

A study conducted by Case-Smith (2002) investigated the effects of school-based occupational therapy services to see if intervention was effective. The study examined a control group of students with poor handwriting who did not receive occupational therapy services with a group of students with poor handwriting who did receive occupational therapy services. Handwriting legibility, speed and other associated handwriting components were examined. Forty-four elementary students in 2nd through 4th grades were recruited for this study. 31 were receiving occupational therapy intervention and 13 were not. Students who received services improved in overall letter legibility but did not improve in numeral legibility and handwriting speed. The handwriting legibility of those students not receiving services remained unchanged over the course of the school year. In addition, students receiving intervention showed significant increases in in-hand manipulation and position-in-space scores.

The above information provides information one of the roles that an occupational therapist can provide. As a member of the school team, the occupational therapist can

provide a variety of resources, techniques and strategies for the teacher to try with the students. It is important that the occupational therapist work with individual teachers because of the wide variety in how handwriting is taught across districts.

Summary

The skills necessary for handwriting are many and complex and need to be understood in order to assist those kids who struggle with this daily task. The above literature review has discussed many of the components associated with skilled handwriting. There will always be variation in the skills and abilities of each child due to the history of their early years. Handwriting needs to be taught with this in mind. Not every child is ready to sit down and begin writing when they enter school.

Students could benefit from a structured handwriting program coordinated from kindergarten through subsequent grade levels. It would benefit the children if the education system could agree on common handwriting strategies and methods. School-based occupational therapists can help educators develop effective methods and guidelines for consistency of handwriting instruction ensuring that all students receive proper instruction.

The ultimate goal for improving a child's handwriting should be that the handwriting will become fluid and automatic, so that he will not need to think about specific letter formation while he is producing written output in an expected period of time, without undue fatigue (Tseng & Cermak, 1993). Keeping this goal in mind, this scholarly project seeks to develop an educational presentation about hand function and handwriting. It is intended to be used by those individuals who have contact with children, or will have contact with children, beginning in the early childhood years and

continuing through the elementary years. This could include college students in early childhood development or education, early childhood education staff, daycare providers and elementary teachers. It will also serve as an introduction to occupational therapy, to those who are not aware of the benefits of having an occupational therapist on the team.

It is clear from the review of the existing information that there is still more research that needs to be done in several areas. In regards to pencil grasp, it appears that the grips used by children in the United States have subtly changed in the last 20 years, with more closed web space grips being employed. Although research proposes that poor grips do not affect handwriting, the long-term effects of using such grips need to be studied. Other areas for continued research would be to continue to investigate what the best programs for handwriting are, how much weekly practice is needed to help the student develop automatic, fluid handwriting and whether handwriting should continue to be taught until the middle school years.

Windsor (2000) stated:

> We should be pounding on the doors of agencies concerned with well children, maternal and child health, parent information, and early childhood education in order to share our information about hand functions and handwriting. Only through education and program implementation can we be assured that young children will participate in developmentally appropriate play and activities that will form solid foundations for producing proficient handwriting in school (p. 19).

CHAPTER III

METHODOLOGY

In reviewing the literature, it was determined that there was a need for a teaching unit that would inform elementary teachers, college students majoring in elementary education and others working with young children on the basics of handwriting. The following information illustrates how the literature review helped to guide the process in building the teaching unit.

An extensive review of literature was conducted and relevant information gathered from clinically based textbooks and professional journals from the fields of occupational therapy, science, psychology and education. Some discussion with classroom teachers was also helpful. The information gathered was used to develop five main areas in designing the final product: The first area discusses the development of fine motor skills in the infant and segues into how fine motor skills are utilized by children once they enter school. This section underscores the importance of development of these skills before formal writing begins. The second area will discuss handwriting instruction in elementary schools, which includes teachers' training, current methods and beliefs about how to teach handwriting. The literature review for this section helped to define the many differences in today's schools utilized by teachers. The third area will discuss the research that studied the relationships among several underlying mechanisms of handwriting, including a discussion on different pencil grips used and what they mean. Information from the literature review was used to include a section on how to help left-

handers as they learn to write. The final area is included to help the learner understand the role of the occupational therapist and how they can partner with teachers in this process.

An attempt was made to ascertain the reading level of the teaching unit itself. Although the presentation does not use complete sentences, an estimate of the reading level was attempted using both the SMOG and the Fog formulas (Bastable, 2006). It is estimated that the reading level is between the 9-10th grade reading levels. Given that the teaching unit would be presented primarily to professionals or college students, the reading level of the presentation was felt to be adequate.

The teaching unit was designed with the adult learner in mind. According to Bastable, 2006 the prime motivator for an adult learner is to be able to apply knowledge and skills for the solution of immediate problems. The teaching unit will use discussion, hands-on activities and handouts to give the learners activities that can be incorporated into any classroom situation.

CHAPTER IV

PRODUCT

Handwriting from A-Z is a teaching unit that is designed to cover all aspects of handwriting. The intended audience is college students majoring in education and elementary teachers. In addition, it would benefit others who work with young children in pre-school settings. It is best presented by an occupational therapist. The presentation can be divided up and taught in smaller units of time, but will take an estimated 4 ½ hours. Activities throughout the teaching unit are interspersed along the way to allow the learner to be an active participant. Handouts will give the learner ideas to bring back to the classroom and use with students.

The intended goal of this product is to inform and educate those who are responsible for developing handwriting skills in young children, regarding the impact of writing and the complexities of learning to write. It is intended to give parameters and answer questions that learners may have in regards to how to teach this skill.

Following the introduction, the sections of the presentation consist of: Teaching how fine motor skills develop in infants, a look at the amount of fine motor skills used and needed in a typical school day, information gleamed from teachers' surveys on how they currently teach handwriting, the basic mechanics of the hand, the underlying mechanisms needed for handwriting, including establishing hand dominance, teaching left handers and how occupational therapy fits in the educational picture.

The Model of Occupational Adaptation by Schultz and Schkade (2003), was used as a guide for the development of this project. This model views the learners as agents of change. The occupational therapist, in presenting the teaching unit, sets the stage for the learning environment. This teaching unit is seen as an activity that is particularly relevant to the learner in their current or future occupational roles. It is the learner who will decide how they will best utilize the information being presented to them and how they will integrate and adapt what they learn and implement it in the classroom or their future classrooms.

CHAPTER V

SUMMARY

The purpose of this scholarly project was to design a handwriting-teaching unit that would educate teachers and students majoring in education on the basics and the complexities of handwriting. It was the author's intent that given a clearer understanding of what is needed to assist students in learning this skill that the learners would take the information learned and adapt it for their classrooms or future classrooms.

Limitations: The literature review for the most part was limited to research articles based on the needs of children who did not carry motor impairments or other significant impairments beyond those who struggled with difficulties in handwriting, learning disabilities and attention deficit disorders. Recognizing this as a limitation, it was felt that this teaching unit was designed to benefit the majority of students in regular education classrooms who may or may not qualify for related services.

Although the literature review identified some of the possible underlying mechanisms responsible for good handwriting, there continues to be a need for more research in this area. The vast amount of information gleamed from the literature review made it difficult to cover all of the components in great detail. Therefore, the author chose to focus more of the teaching unit on the elementary student instead of the preschool child. Although much of the information is pertinent to those who teach at the preschool level, all of the information will benefit those teaching at the elementary level.

There should be an emphasis on teaching those involved in early childhood education why implementing developmentally appropriate play and activities is vitally important for forming solid foundations for producing proficient handwriting in school (Windsor, 2000), but this teaching unit is focused more on the elementary arena. However, this presentation could be altered to include only those slides that are pertinent for the younger children.

Implementation of this teaching unit: The information contained in this teaching unit is informative and relevant to education students, occupational therapy students, elementary teachers and those who teach in the early childhood areas. Parents would find this interesting as well. It could be presented in parts over several days or as a workshop in half a day. This presentation is suggested for education conferences or the classroom.

Recommendations: This handwriting–teaching unit should be presented by an occupational therapist. Given their knowledge base, an occupational therapist would be able to answer questions in regards to sensory-motor skills, positioning, working with left handed students and hand dominance, among other questions that may arise.

Utilizing the program evaluation contained in the Appendices, the occupational therapist could gather information from it to continue to improve the presentation in terms of adding more detailed information in areas or giving more suggestions for the learners. It is also recommended that the materials listed in the activities section be provided for all participants as listed. This will allow learners to be active participants.

It was not the intent of this project to explore the various commercial handwriting programs that are available. However, it would be possible to use this teaching unit to

pull out several helpful hints on what is important when teaching and come to a conclusion on which program might be more effective.

In terms of general recommendations to use in the classroom, the following is a brief list of items that were compiled. Information was pulled from the research studies and readings found primarily in the field of occupational therapy and education:

1. Begin to teach handwriting in the latter half of the kindergarten year. Children are more developmentally ready to work on forming letters at that time.
2. Spend the first half of the kindergarten year developing fine motor skills, providing games and activities that work on in-hand manipulation skills and learning geometric shapes and directional concepts.
3. Bring multiple fine motor activities into the classroom, providing multiple opportunities to develop the intrinsic and extrinsic muscles. These can be incorporated into other subjects. Math is a good example for allowing the students to handle manipulatives.
4. Provide multiple opportunities on vertical surfaces, including painting and drawing. This includes easels, as well as, the dry erase boards. Slanted boards at the desk would work well for this approach, also. This will help the child to stabilize the wrist while it performs fine motor tasks and helps to shape the hand.
5. Provide a multi-sensory approach. Handwriting lessons should begin with a warm-up period for the hands, fingers and arms. Chair push-ups, pressing hands together or interlacing fingers and trying to "pull" them apart are a few exercises that can be completed while the child is seated. Children need to "touch it, feel it,

see it and hear it" as they learn new things. Children need to be alert and ready to learn.

6. Use a repetition of the same words when describing how to draw the letters. When drawing the letter "a", you might say, "Begin at the dotted line, circle around, draw a straight line down". Whatever sequence of words you use, or whatever commercial program you use, be sure to use repetition so the students build a memory of what they are hearing and seeing.
7. Handwriting should be taught at regularly scheduled intervals throughout the week, this means how to shape the letters and how to hold the pencil. Smaller amounts of time on a regular basis, rather than one lengthy period one time a week appears to make more sense.
8. Provide the students appropriate height desks and chairs if possible. Use a box under their feet if they are short and cannot support their feet flat on the floor. If they are tall, adjust the desk height. Borrow a desk from another classroom if necessary. There can be height differences of 12"-18" inches among students in a classroom of students. Their work stations should be individualized to best meet their needs.

Conclusion: The components of handwriting are multi-faceted. One of the consistent findings is that visual-motor integration, as measured by the VMI, is strongly related to the students' ability to copy letters. In addition, in-hand manipulation skills has been found to correlate highly with good handwriters. These are just a few of the areas. Other areas, such as kinesthesia, visual perception and use of inefficient grips in prolonged writing could benefit from further research. Some research has studied effective means

of providing intervention, including occupational therapy to those students who are struggling with handwriting. More research is needed in this area, on specific interventions and approaches.

Handwriting is pivotal in helping elementary school students demonstrate their knowledge in all academic areas. If a strong foundation is built from the early grades on up, the student will be more successful throughout their school career.

References

Asher, A. V. (2006). Handwriting instruction in the elementary schools. *American Journal of Occupational Therapy*, 60, 461-471.

Ayres, A. J. (1975). *Sensory integration and learning disorders.* Los Angeles, CA: Western Psychological Services.

Bastable, S. B. (2006). Literacy in the adult patient population. In S. B. Bastable (Ed.), *Essentials of patient education* (pp. 165-208). Sudbury, MS: Jones and Bartlett.

Bastable, S. B., & Dart, M. (2006). Developmental stages of the learner. In S. B. Bastable (Ed.), *Essentials of patient education* (pp. 165-208). Sudbury, MS: Jones and Bartlett.

Beery, K. E., & Buktenica, N. (1989). *The Beery-Buktenica developmental test of visual-motor integration* (3rd ed.). Cleveland, OH: Modern Curriculum.

Benbow, M. (1990). *Loops and other groups*. Tucson, AZ: Therapy Skill Builders.

Benbow, M., (1995). Neurokinesthetic approach to hand function and handwriting. *Continuing education seminar series. Clinician's View.* Albuquerque, NM. (pp. 16-17).

Benbow, M. (2006). Principles and practices of teaching handwriting. In A. Henderson & C. Pehoski (Eds.), *Hand function in the child: Foundations for remediation* (pp. 319-342). St. Louis, MO: Mosby.

Benbow, M., Hanft, B. & Marsh, D. (1992). Handwriting in the classroom: Improving written communication. In Charlotte Royeen (Ed.), *AOTA self-study series:*

Classroom applications for school-based practice (pp. 6-60). Rockville, MD: American Occupational Therapy Association.

Bly, L., (1994). *Motor skills acquisition in the first year. An illustrated guide to normal development.* Tucson, AZ: Therapy Skill Builders.

Boehm, A., (1986). Boehm test of basic concepts revised. New York: Psychological Corporation.

Boehme, R. (1988). *Improving upper body control: An approach to assessment and treatment of tonal dysfunction.* Tucson, AZ: Therapy Skill Builders.

Case-Smith, J. (2002). Effectiveness of school-based occupational therapy intervention on handwriting. *American Journal of Occupational Therapy,* 56, 17-25.

Case-Smith, J., Bigsby, R., & Clutter, J. (1998). Perceptual-motor coupling in the development of grasp. *American Journal of Occupational Therapy,* 52, 102-110.

Christensen, C., (2005). The role of orthographic-motor integration in the production of creative and well-structured written text for students in secondary school. *Educational Psychology,* 25 (5), 441-453.

Coren, S., (1993). *The left-hander syndrome.* New York: Vintage Books.

Cornhill, H., & Case-Smith, J. (1996). Factors that relate to good and poor handwriting. *American Journal of Occupational Therapy, 50,* 732-739.

Exner, C., (2006). Intervention for children with hand skill problems. In A. Henderson & C. Pehoski (Eds.), *Hand function in the child: Foundations for remediation* (pp. 239-266). St. Louis, MO: Mosby.

Fisher, A., Murray, E., & Bundy, A. (1991). *Sensory integration: Theory and practice.* Philadelphia, PA: F. A. Davis.

Gladstone, K. (2002). Illegibility: Can America write? Retrieved February 29, 2008, from http://www.global2000.net/handwritingrepair/KateHwR.html.

Graham, S., Berninger, V. W., Abbott, R. D., Abbott, S. P., & Whitaker, D. (1997). Role of mechanics in composing of elementary school students: A new methodological approach. *Journal of Educational Psychology*, 89 (1), 170-182.

Graham, S., Harris, K. R., & Fink, B. (2000). Extra handwriting instruction: Prevent writing difficulties right from the start. *TEACHING Exceptional Children*, 33, 88-91.

Graham, S., Harris, K. R., Mason, L., Fink-Chorzempa, B., Moran, S., & Saddler, B. (2008). How do primary grade teachers teach handwriting? A national survey. *Reading and Writing*, 21, 49-69.

Graham, S., & Weintraub, N. (1996). A review of handwriting research: Progress and prospects from 1980 to 1994. *Educational Psychology Review*, 1(8), 7-87.

Greer, T., & Lockman, J. (1998). Using writing instruments: Invariances in young children and adults. *Child Development,* 69, 888-902.

Hamstra-Bletz, L., & Blöte, A. W. (1993). A longitudinal study on dysgraphic handwriting in primary school. *Journal of Learning Disabilities*, 26, 689-699.

Knickerbocker, B. M. (1980). *A holistic approach to learning disorders.* Thorofare NJ: Slack.

Koziatek, S. M., & Powell, N. J. (2003). Pencil grips, legibility, and speed of fourth-graders' writing in cursive. *American Journal of Occupational Therapy*, 57, 284-288.

Kraus, E. L. (2006). Handedness in children. In A. Henderson & C. Pehoski (Eds.), *Hand function in the child: Foundations for remediation* (pp. 161-191). St. Louis,

MO: Mosby.

Levine, M. D., Oberklaid, F., & Meltzer, L. (1981). Developmental output failure: A study of low productivity in school-aged children. *Pediatrics*, 67, 18- 25.

Levine, K. (1991). *Fine motor dysfunction: Therapeutic strategies in the classroom.* Tucson, AZ: Therapy Skill Builders.

Marr, D., Cermak, S., Cohn, E.S., & Henderson, A. (2003). Fine motor activities in Head Start and kindergarten classrooms. *American Journal of Occupational Therapy,* 57, 550-557.

Marr, D., Windsor, M., & Cermak, S. (2001). Handwriting readiness: Locatives and visuomotor skills in the kindergarten year. *Early Childhood Research and Practice,* Retrieved February 10, 2008, from http://ecrp.uiuc.edu/v3n1/marr.html.

Marsh, D., & Hanft, B. (Speakers). (1992). *Getting a grip on handwriting.* (Audioconference). American Occupational Therapy Association.

McHale, K., & Cermak, S. (1992). Fine motor activities in elementary school: Preliminary findings and provisional implications for children with fine motor problems. *American Journal of Occupational Therapy*, 46, 898-903.

Naus, J.M. (2000). Helping hands – A world of manipulatives to boost handwriting skills. *TEACHING Exceptional Children*, 32 (4), 64-70.

Oehler, E., DeKrey, H., Eadry, E., Fogo, J., Lewis, E., Maher, C. & Schilling, A. (2000). The effect of pencil size and shape on the pre-writing skills of kindergartners. *Physical and Occupational Therapy in Pediatrics*, 19, (3/4), 53-60.

Pape, L., & Ryba, K. (2004). *Practical considerations for school-based occupational therapists.* Bethesda, MD: American Occupational Therapy Association.

Peterson, C., & Nelson, D. (2003). Effect of an occupational intervention on printing in children with economic disadvantages. *American Journal of Occupational Therapy*, 57, 152-160.

Reisman, J. E. (1991). Poor handwriting: Who is referred? *American Journal of Occupational Therapy*, 45, 849-852.

Reisman, J. (1995). *The Minnesota Handwriting Test: Research edition.* Minneapolis: University of Minnesota.

Rubin, N., & Henderson, S.E. (1982). Two sides of the same coin: Variations in teaching methods and failure to learn to write. *Special Education: Forward Trends*, 9 (4), 17-24.

Schilling, D., Washington, K., Billingsley, F., & Deitz, J. (2003). Classroom seating for children with attention deficit hyperactivity disorder: Therapy balls versus chairs. *American Journal of Occupational Therapy*, 57, 534-541.

Schkade, J. K., & Schultz, S. (2003). Occupational adaptation. In P. Kramer, J. Hinojosa & C. B. Royeen (Eds.), *Perspectives in human occupation: Participation in life.* (pp. 181-221). Baltimore, MD: Lippincott Williams & Wilkins.

Schneck, C. M., (1991). Comparison of pencil-grip patterns in first graders with good and poor writing skills. *American Journal of Occupational Therapy*, 45, 701-706.

Schneck, C.M., & Henderson, A. (1990). Descriptive analysis of the developmental progression of grip position for pencil and crayon control in nondysfunctional children. *American Journal of Occupational Therapy*, 44, 893-900.

Smith-Zuzovsky, N., & Exner, C. E. (2004). The effect of seated position quality on typical 6- and 7-year old children's object manipulation skills. *American Journal of*

Occupational Therapy, 60, 380-388.

Smits-Engelsman, B. C. M. & Van Galen, G. P. (1997). Dysgraphia in children: Lasting psychomotor deficiency or transient developmental delay? Journal of Experimental Child Psychology, 67, 164-184.

Stephens, L. C. (1989). School work tasks and vocational readiness. In P. N. Pratt & A. S. Allen (Eds.), *Occupational Therapy for Children* (2nd ed., pp.311-334). St. Louis, MO: Mosby.

Tseng, M. H., & Cermak, S. A. (1993). The influence of ergonomic factors and perceptual-motor abilities on handwriting performance. *American Journal of Occupational Therapy*, 47, 919-926.

Tseng, M. H., & Chow, S. M. K. (2000). Perceptual-motor function of school-age children with slow handwriting speed. *American Journal of Occupational Therapy,* 54, 83-88.

Volman, M. J. M., van Schendel, B. M., & Jongmans, M. J. (2006). Handwriting difficulties in primary school children: A search for underlying mechanisms. *American Journal of Occupational Therapy*, 60, 451-460.

Weil, M., & Amundson, S. J. (1994). Relationship between visuomotor and handwriting skills of children in kindergarten. *American Journal of Occupational Therapy*, 48, 982-988.

Windsor, M., (2000). Clinical interpretation of "Grip form and graphomotor control in preschool children". *American Journal of Occupational Therapy*, 54, 18-19.

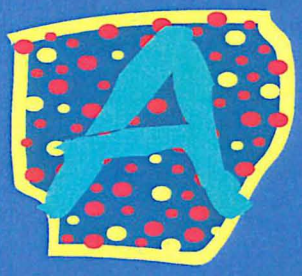
Witelson, S. F. (1985). The brain connection: The corpus callosum is larger in left handers. *Science*, 229, 665-668.

APPENDICES

Appendix A

Handwriting from A-Z
PowerPoint Teaching Unit

Handwriting from A-Z



By Connie Lillejord, OTR/L

OUTLINE

- Importance of Handwriting
- Development of Fine Motor Skills
- Strategies used by Teachers
- Pencil Grasp
- Handwriting Components
- Hand dominance and "Lefties"
- Occupational therapy and writing

Handwriting from A-Z

Goals: At the conclusion of the presentation, participants will:

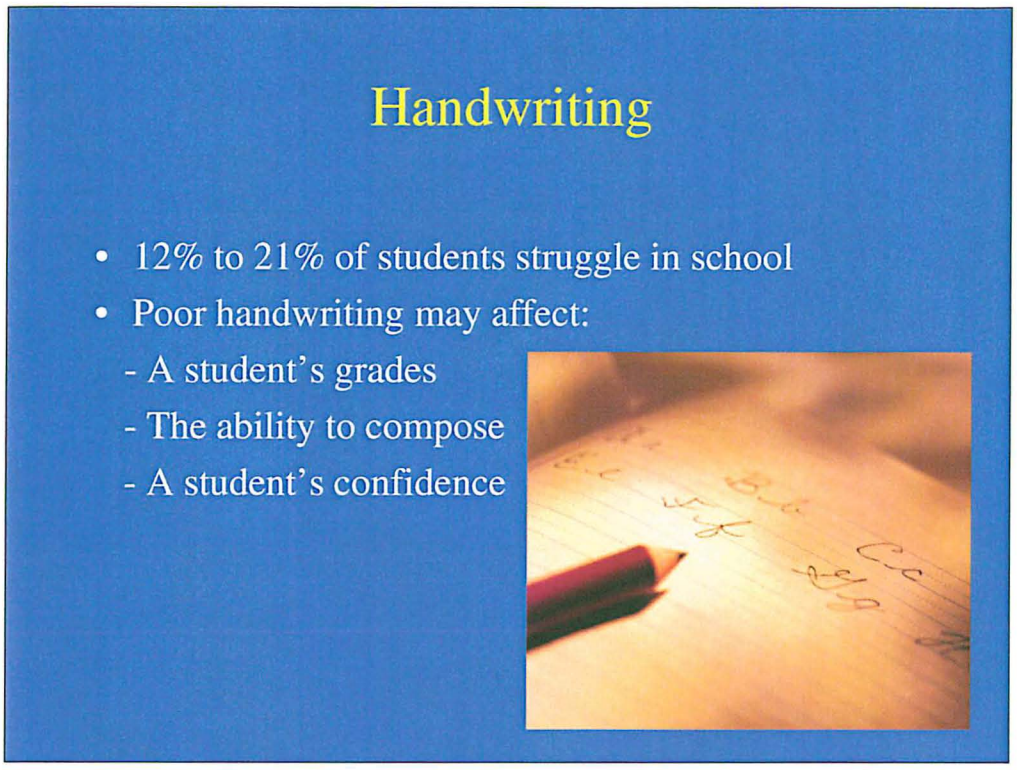
1. Increase their understanding of the importance of early developmental activities for a child and their impact on handwriting.
2. Understand the impact over time that poor handwriting may have on a student.
3. Gain an understanding of the differences in teaching handwriting among teachers.
4. Understand the complexities of the process and the underlying mechanisms needed to learn to write.
5. Understand the role of the occupational therapist on the team.

Handwriting from A-Z

Learning Objectives:

At the conclusion of the presentation, participants will:

1. Identify three important components in learning to write.
2. Participant will be able to identify a mature pencil grip.
3. Identify one important difference between teaching a left-handed versus a right-handed student.
4. Identify an occupational therapist's role in this area.



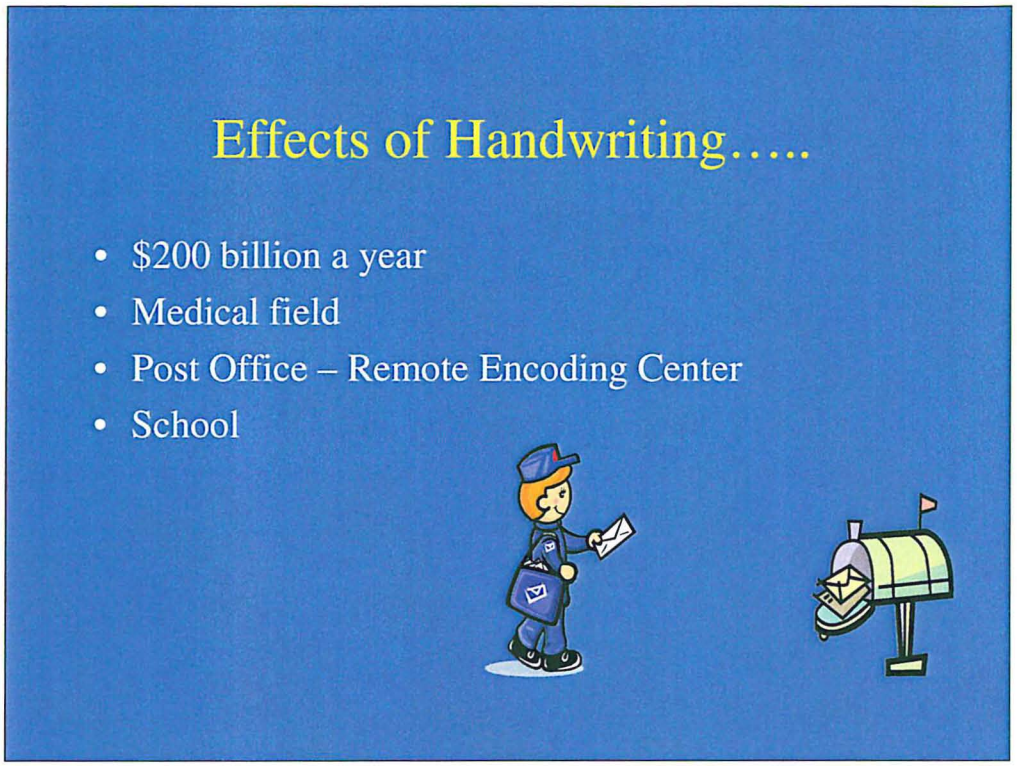
Handwriting is an important life-long skill.

Knowing how to write well cannot be overemphasized.

Statistics estimate that 12% to 21% of students struggle in school.

A study Groff documented that students may achieve as much as, a full grade higher on written assignments if their writing is more legible than similar or identical work.

Difficulties in writing can hamper a child's progress throughout their school career, they may avoid writing, develop a mindset that they cannot write. If a child continues to struggle with the formation of letters, writing will not become automatic and fluid.



The Writing Instrument Manufacturers Association claims that illegible handwriting and other handwriting-related issues are expensive and cost the United States more than $200 Billion dollars a year in lost time and money.

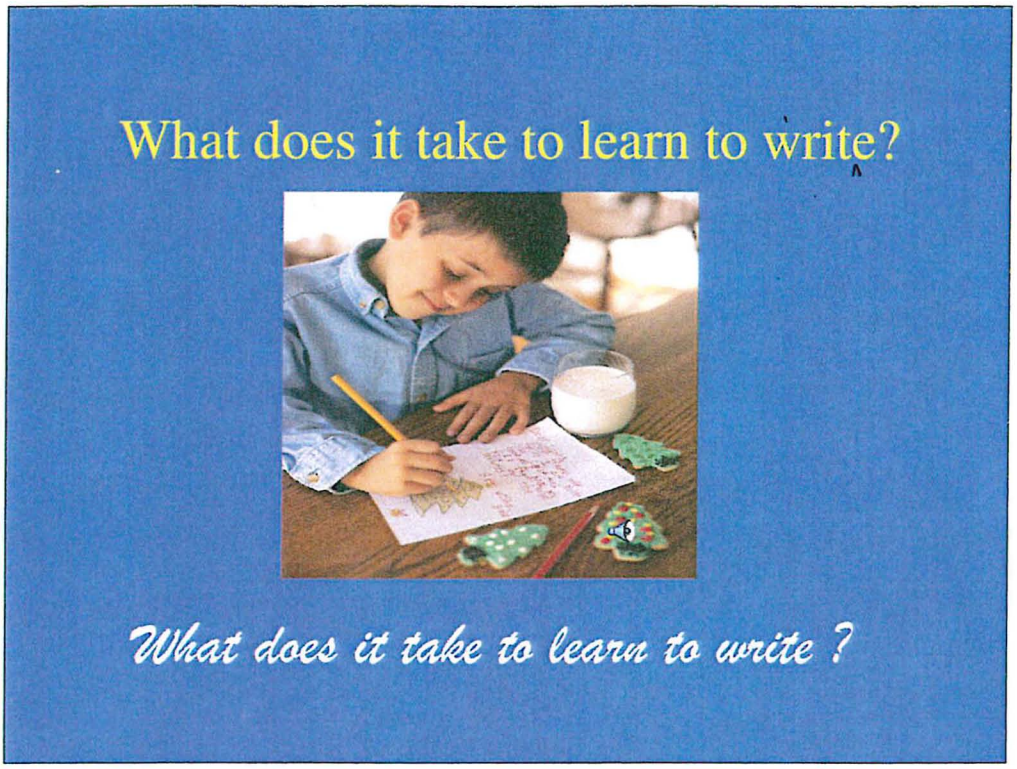
One example of this is the $95 billion in tax refunds that cannot be delivered because of illegible addresses on tax forms.

At the 1994 American Medical Association conference, medical records and prescriptions were deemed potential health hazards; the health of at least one in 10 people are endangered by a physician's handwriting. The use of more technology may reduce this problem.

Since 1994, the Cohoes (New York) post office has needed to use a special facility called a Remote Encoding Center. There are 10 such centers around the country and each are staffed full-time around the clock. Their job is to simply decipher the region's daily load of illegibly addressed mail (Gladstone, 2002).

In addition, the study documented that at least 1 of every 3 teachers writes so poorly that it affects a student's ability to be able to read assignments, read notes written on the board or the teacher's penned response to their written work.

The handwriting crisis even extends to the criminal world. There have been several documented foiled robbery attempts when the bank teller or the cashier puzzled over what the "note" said. In 2003, in Mishawaka, Indiana, two men failed to rob a convenience store after the clerk had trouble deciphering their hold-up note. Before they left the store, one of the thieves berated the other for his poor handwriting (Gladstone, 2002).



Learning to write is not as easy as placing a pencil in a child's hand and letting them go…..

There are many steps in learning how to write, just like there are steps in learning to talk or learning to walk, before the actual event takes place.

The first section of this unit is going to look at how an infant begins to build their fine motor skills. A prerequisite for writing, you might say that begins when a baby is born.

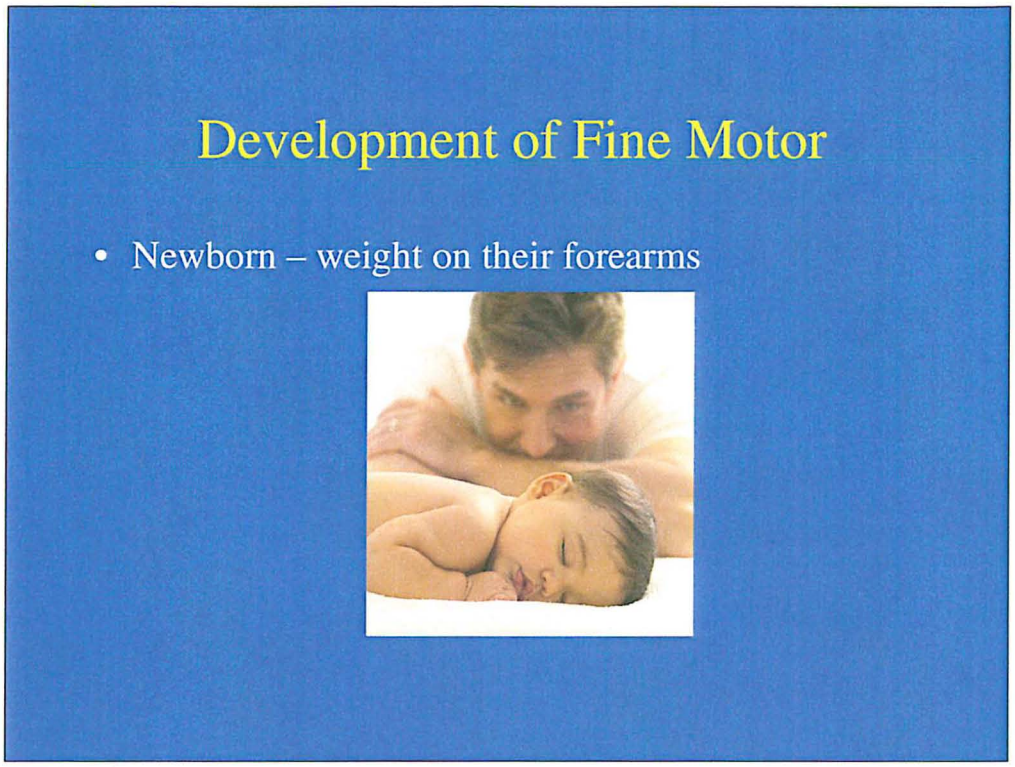
Development of Fine Motor

- Groundwork for fine motor begins as an infant
- Control of arm and hand movements develop from the trunk
- Development of reach and grasp in the first year

Motor development works from the trunk out to the arm and fingers. Babies do a lot of work to build and strengthen muscles, develop head control, trunk control through play activities. That is why it is important to have babies out of car seats and down on the floor!

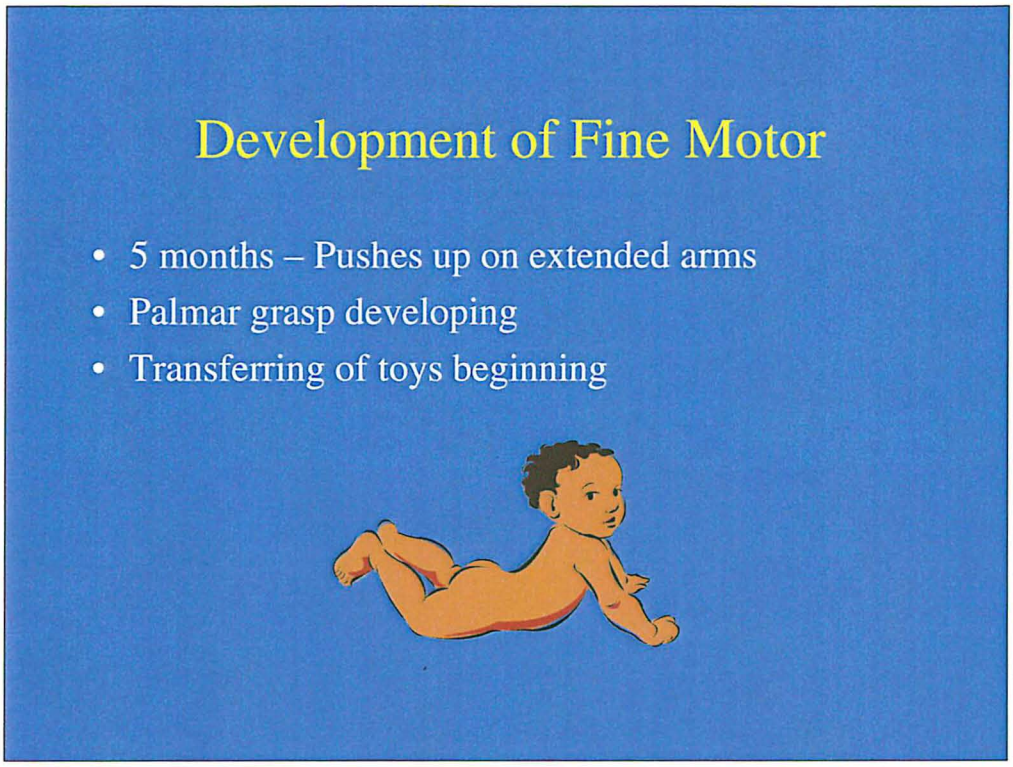
You will see why **tummy time** is very important to infants in terms of developing their fine motor skills.

Let's look at what a newborn does…..

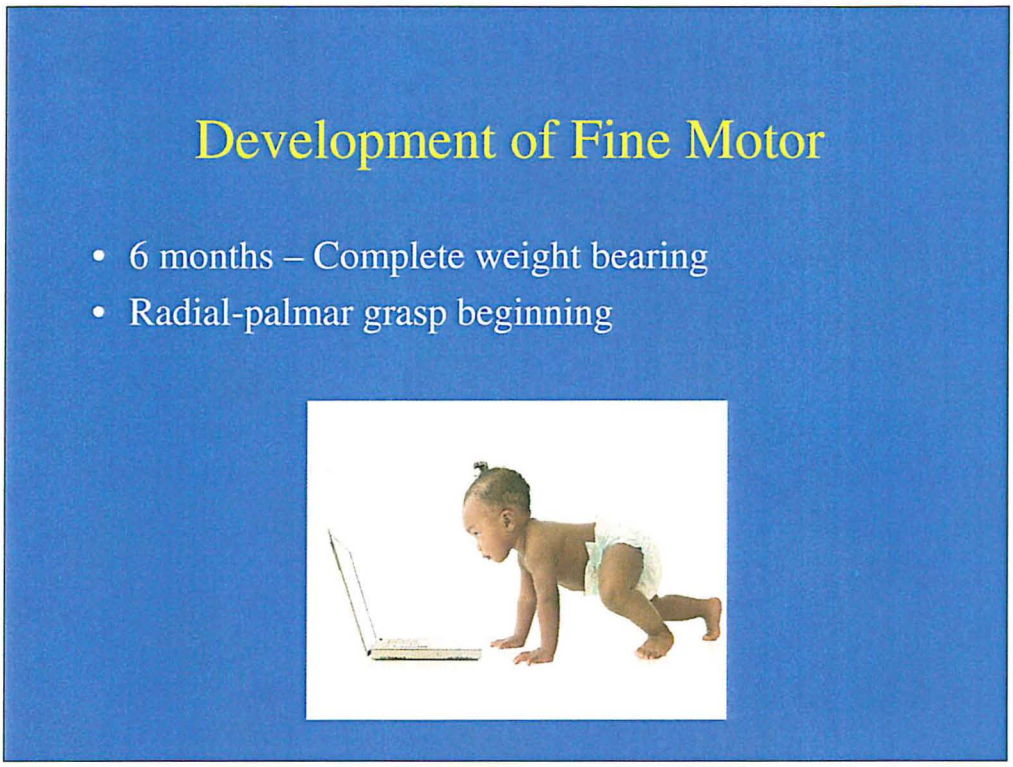


Newborns keep their arms and legs tucked up underneath their bodies when lying in the prone position. They take a significant amount of weight on their forearms, which results in a great deal of proprioception distributed on the arms and hands. This is the beginning of hand development (Benbow, 1995).

The 4 month old infant is involved in hand-to-hand, hand-to-mouth and hand-to-body contact during play and exploration – this is the age that babies begin to bring everything to midline. Babies can visually inspect their hands (together). Most of an infant's upper extremity movements demonstrate increasing gross motor control. They are able to hold a rattle, but are not able to manipulate it. An ulnar grasp is used to hold onto objects placed in their hands (Bly, 1994). This means that the fourth and fifth digits are used to press the toy into their hands. They begin to swipe at objects – beginning of eye-hand coordination



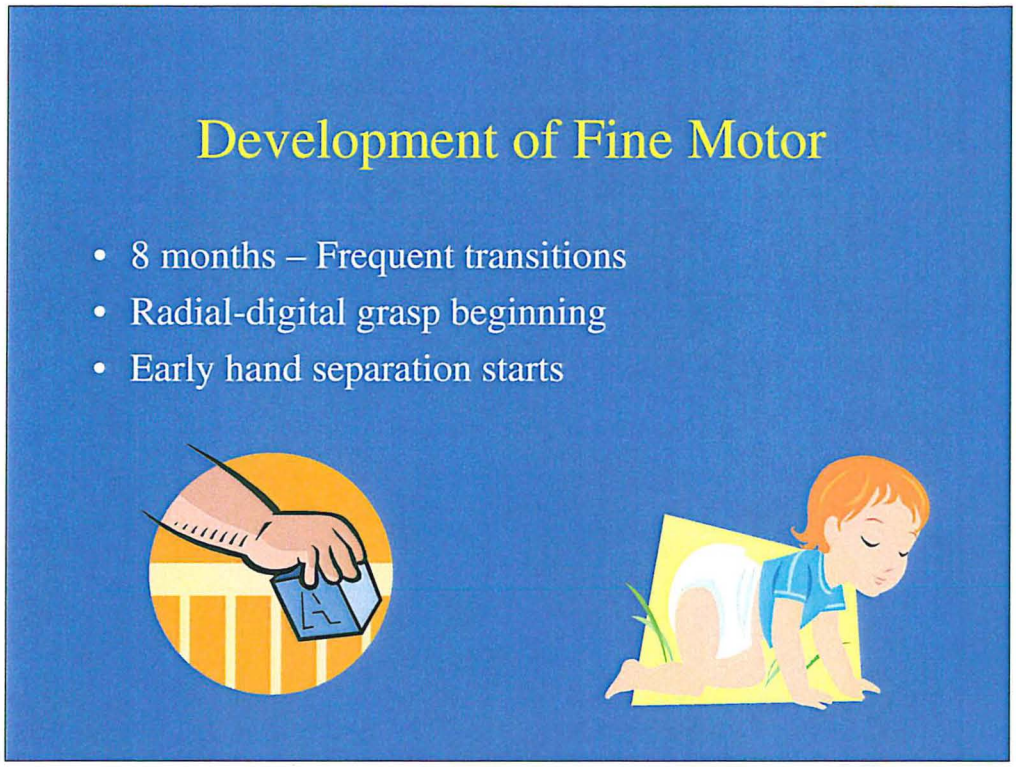
At five months, the infant is able to push up on extended arms, which allows his weight to shift posteriorly. This movement causes more weight to move onto the palmar surface of the hand, under stable shoulders. Weight-bearing into an open hand with an extended wrist helps to develop a palmar grasp. That is, four fingers holding an object against the palm of the hand. The baby can now visually direct reaching in a variety of positions, supine, prone and in supported sitting. Transferring toys from hand to hand is just beginning (Benbow, 1995; Bly, 1994).



The infant is able to move into a position where only their hands and feet have contact with the surface.

This position places complete weight bearing on the palmar surface of the hand, particularly the thumb and radial palmar surface. The infant is showing better postural control in this position. When they are on their elbows they can shift their weight to one side and reach for a toy. All of this play helps the infant to strengthen arm and hand musculature and provide tactile/proprioceptive information that appears important to hand development (Boehme, 1988, Case-Smith 2006)

The infant begins to use a radial-palmar grasp, securing objects by using second and third digits against the palm. **As with previous developmental stages, where the infant bears weight, tone develops and then functional use emerges (Benbow, 1995).**



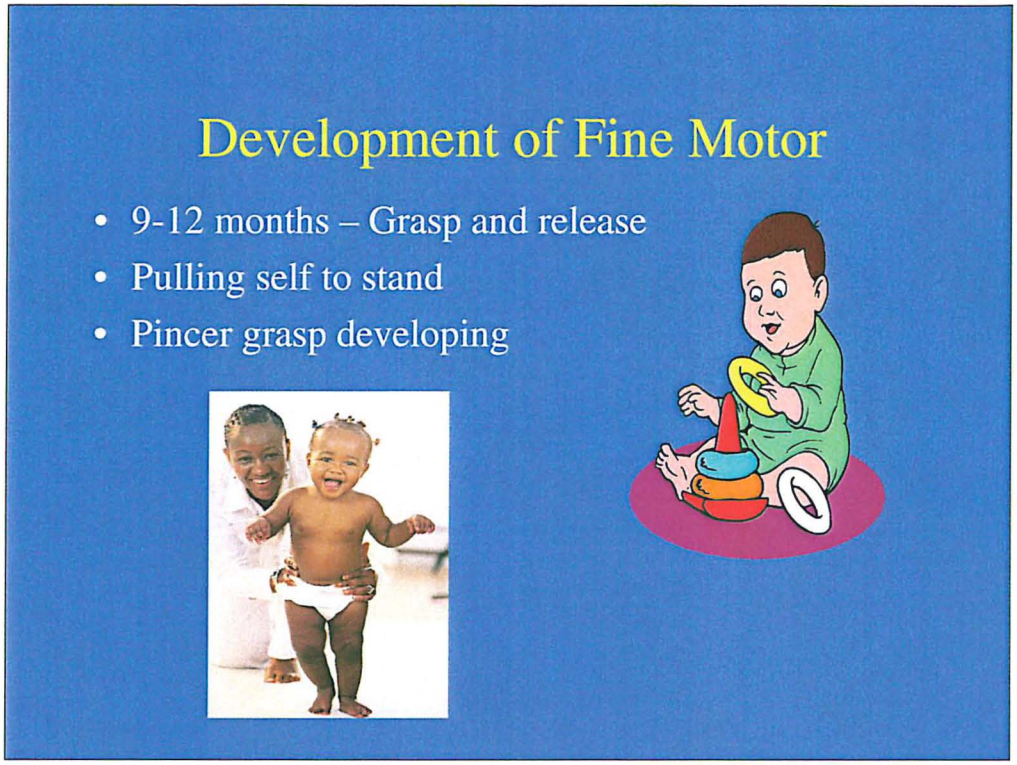
The infant is able to move into a position where only their hands and feet have contact with the surface.

Many infants move into a hands and knees (quadruped) position and begin to crawl. This position results in frequent weight bearing of the hands. - particularly the thumb and radial palmar surface.

Lots of movement from the floor to crawling to side-sitting and back to crawling results in a great deal of input into the hands. Weight shifts occur in a diagonal direction across the hand, as well

The infant begins to use a radial-palmar grasp, securing objects by using second and third digits against the palm.

As with previous developmental stages, where the infant bears weight, tone develops and then functional use emerges (Benbow, 1995).



Between the ninth and twelfth months, the infant begins to pull to stand using his digits to help push and pull. This strengthens the arms.

By 12 months, the infant has greater control of their arms in space when sitting. They are able to grasp a tiny object (i.e. cereal off of the tray) using a superior pincer grasp (arm not being stabilized on a surface).

Crawling at this age, provides lots of tactile and proprioceptive input to the hands.

Fine motor skills are refined and grasp and release, thumb opposition and an emerging pincer grasp begin to develop (Benbow, 1995; Bly, 1994).

A child refines his motor skills in leaps and bounds over the next couple of years, when compared to what an infant is able to do.

By 2 years, the toddler is able to use their hands with control in all positions and in all planes around the body, due to good postural control.

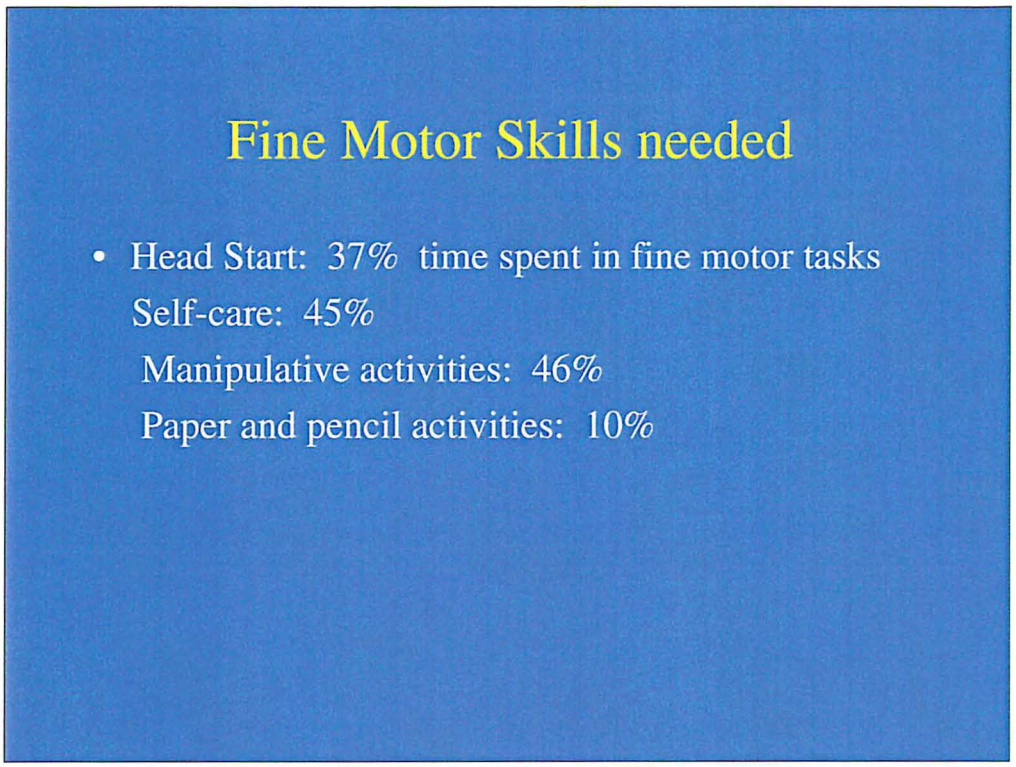
Activities, such as, building blocks, putting together Legos®, stringing beads, using a spoon, crawling, climbing, pulling wagons and pushing toys, beginning to dress themselves - help a child to develop in-hand manipulation skills, dexterity, and fine motor skills. All of these activities are important as they contribute to fine motor development, as the child heads towards preschool and kindergarten.

Play for toddlers/ pre-schoolers is critical for them to continue to develop their gross and their fine motor skills.

Manipulative activities and ball handling activities are important.

Passively sitting and watching TV or playing a computer game limits what a child's hands are doing.

Also, if a child has a physical condition, such as, cerebral palsy or a coordination disorder, that affects their postural stability – the kind of play needed to develop fine and gross motor skills will be limited.

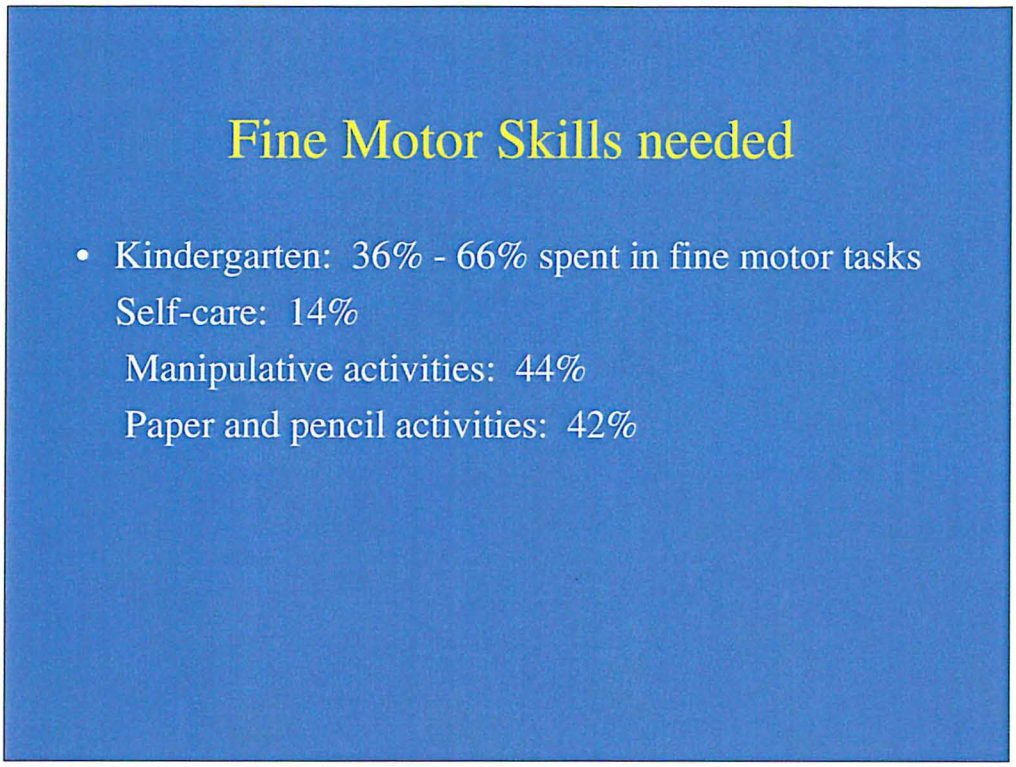


In this next section we will look at the amount of time that kids in Head Start (preschool), kindergarten and elementary grades spend using their fine motor skills – the ones they have just spent the past 3-4 years developing.

Head Start: 37% (range of 27-46%) spent in fine motor tasks

Self-care skills is considerable. Head Start generally provide breakfasts and/or lunches to kids and they spend a great deal of time in this area, using utensils, napkins, dishing up their food.

Manipulative activities include such things as putting together puzzles, building blocks or Legos, and beading.

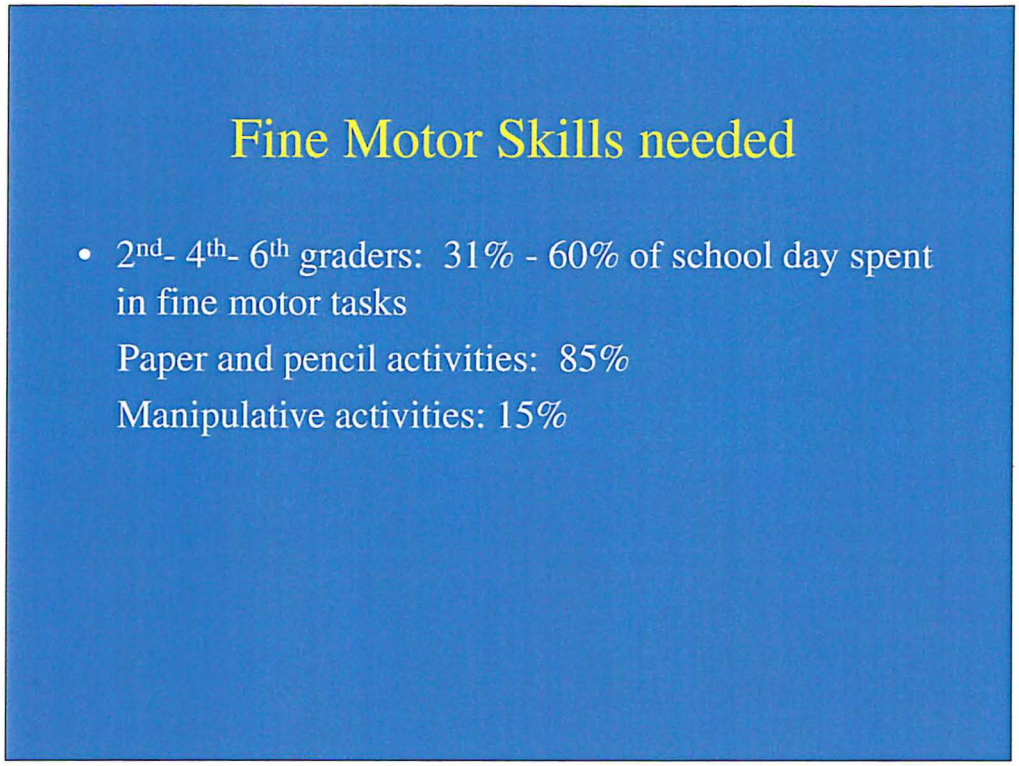


A study in 2003 found that children in kindergarten spend 36%- 66% of their time engaged in fine motor activities (Marr, Cermak, Cohn, & Henderson, 2003) on a daily basis. Three broad categories: **Self-care, manipulative and paper and pencil activities**.

14% of time was spent in "self-care activities", such as, handwashing, donning and doffing a coat and toileting.

44% of their time in a second category, labeled "manipulating objects", and included such activities as cutting, play dough, finger plays and puzzles.

The final category, "paper and pencil activities" consumed 42% of the total fine motor time.



(1992) McHale and Cermak. The difference between the two studies is that older elementary students (grades 2, 4 and 6) spent 85% of their fine motor time on paper and pencil tasks,

i.e. copying from a textbook or the board, writing from dictation, writing spelling words repeatedly, creative writing, taking notes and drawing while the kindergarten students spent approximately half that time (42%) on paper and pencil tasks and more time on manipulating objects.

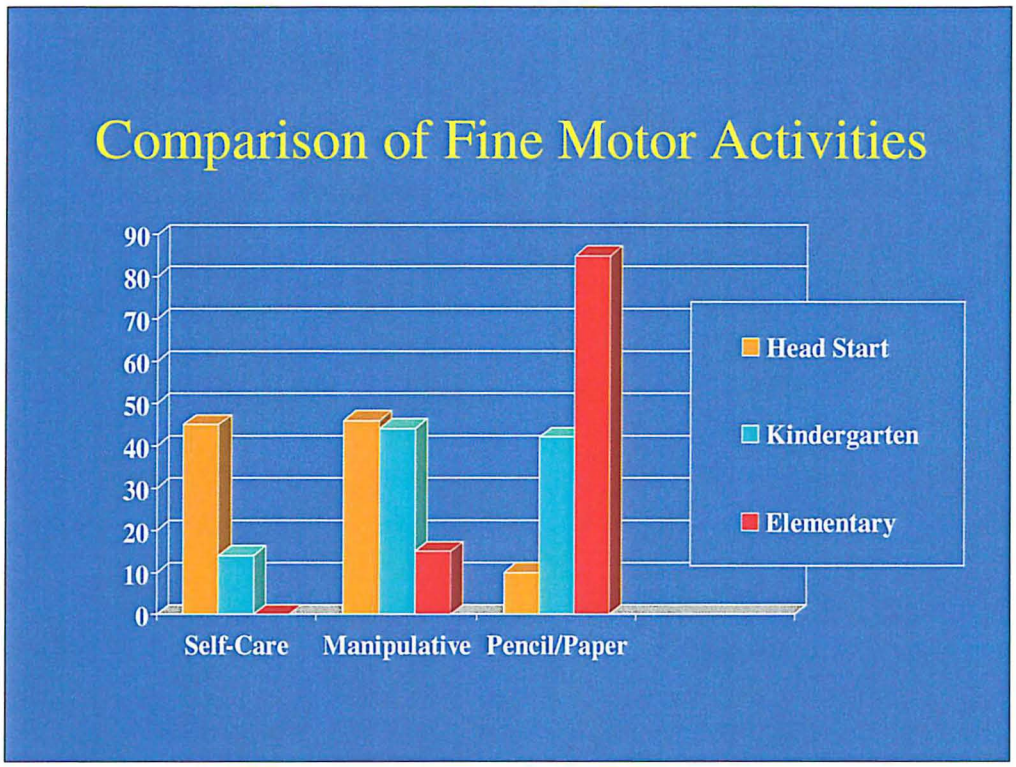
Manipulative activities (15%) consisted of:

Folding paper to make margins and dividing lines

Cutting or pasting or both

Using a computer

Manipulating objects, such as, seeds or plants.

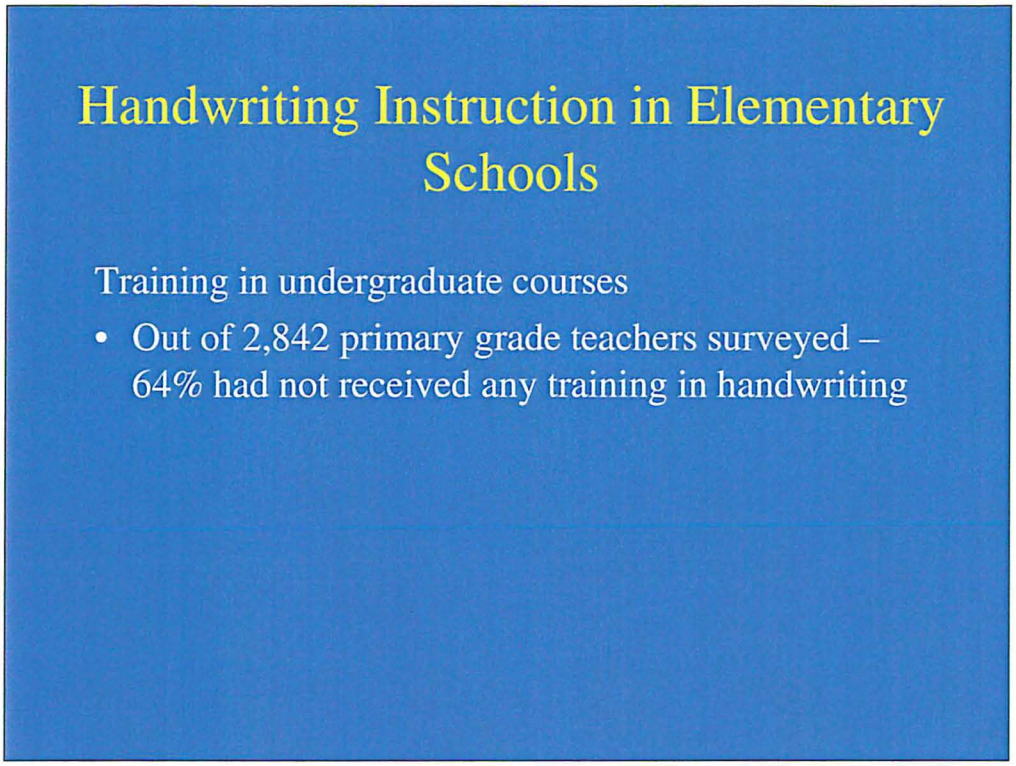


This is a graph depicting the information in regards to the amount of time that students in Head Start, kindergarten and 2nd, 4th and 6th (Elementary) spend on different fine motor activities.

In Head Start, a great deal of time is spent on self-care activities (they usually serve meals for the children). The amount of time that Head Start children and kids in kindergarten spend on manipulatives is almost identical.

In kindergarten, tasks are almost equally divided between manipulatives and pencil/paper activities 44% and 42% respectively (Marr, Cermak, Cohn, & Henderson, 2003).

In elementary grades, one study found students spent 85% of their time on paper/pencil activities (McHale and Cermak,1992). By 4th grade, writing should become an automatic function which is important. If the students are still needing to think about letter formation and how to join cursive letters, their work will be affected – I.e. work will get done more slowly.

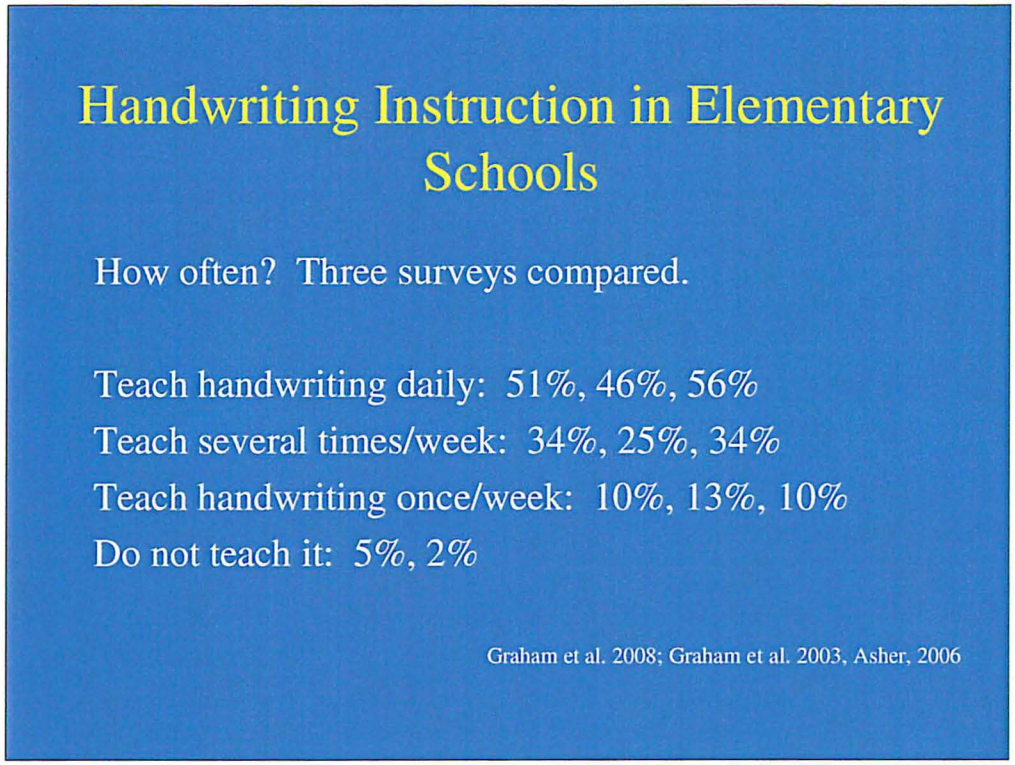


From two national surveys: One in 2008 (Graham et al. 2008) and one in 1993 (Graham and Weintraub, 1996). Also, another smaller research study in 2001 (Marr et al. 2001).

Interestingly the larger study in 1993 had 64% of people surveyed not receiving handwriting instruction.

The study in 2008 had 88% of people not receiving handwriting instruction (although a considerably smaller sampling of teachers – 249).

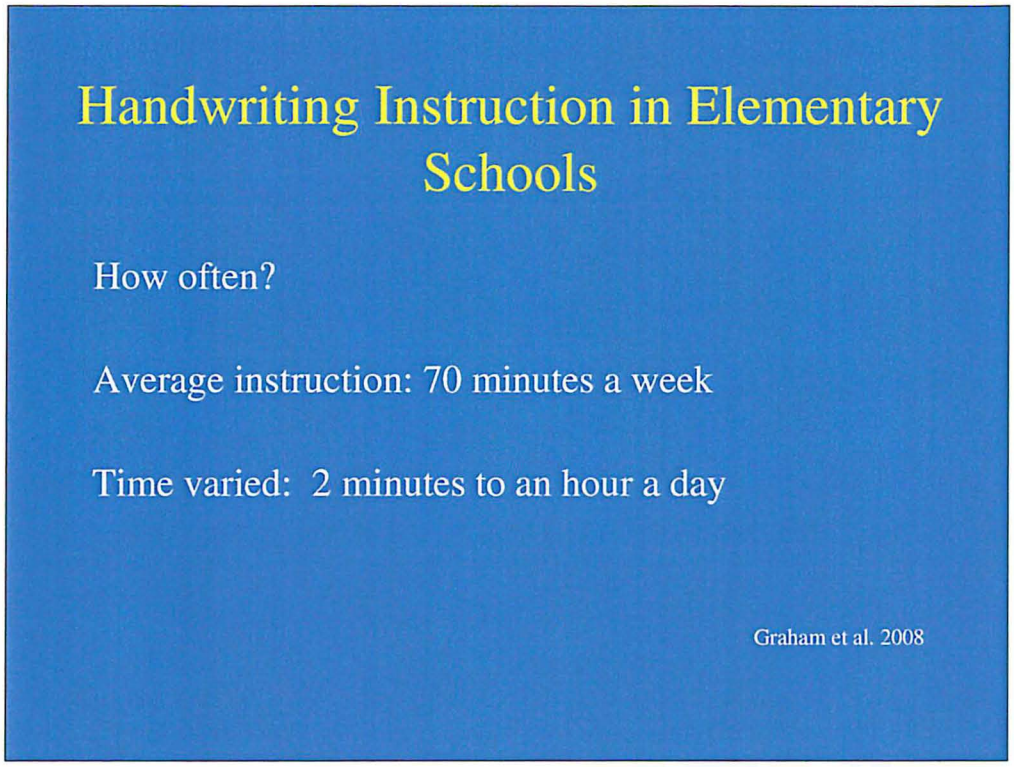
Learning Task: Show of hands on who received training on handwriting in undergrad classes?



A recent survey of 169 primary grade teachers that teach handwriting shows that nine out of every ten teachers indicated that they taught handwriting, averaging 70 minutes of instruction a week

A second survey, surveyed 86 teachers - nationally

A third survey, surveyed 47 teachers within one school district.



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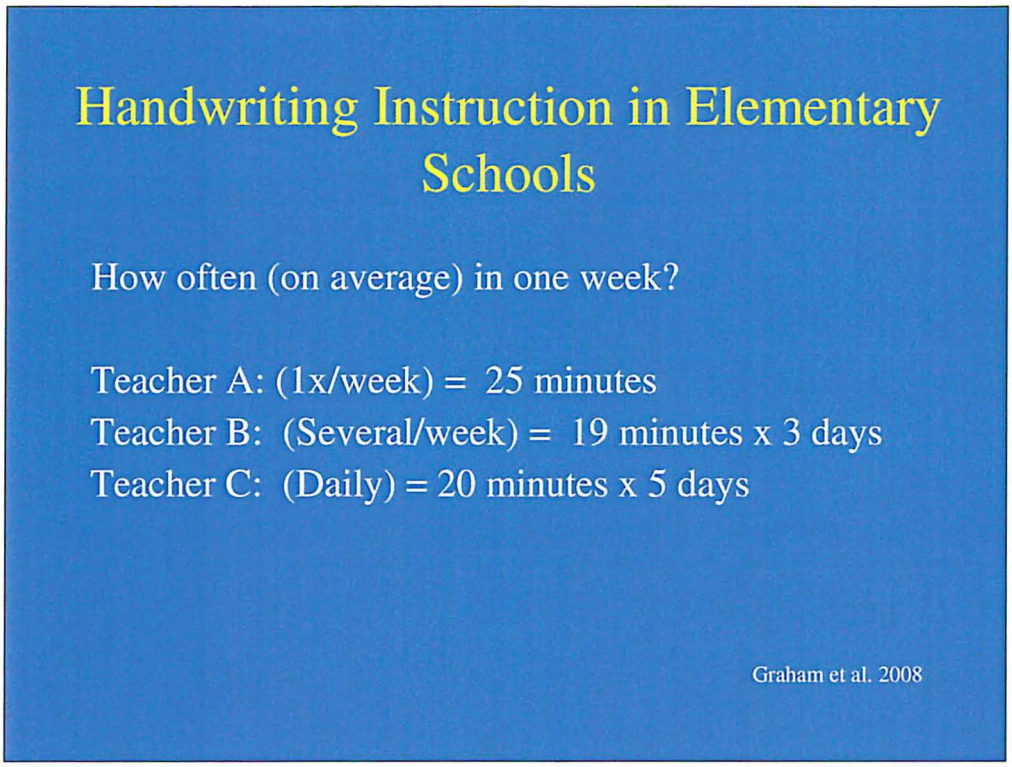
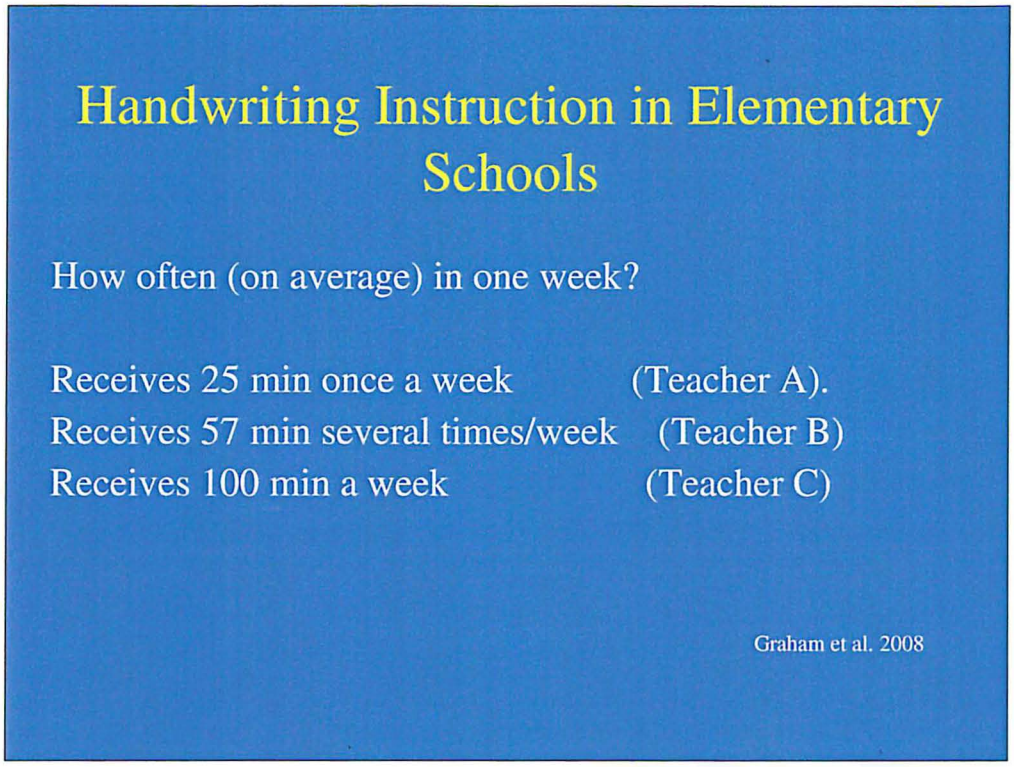


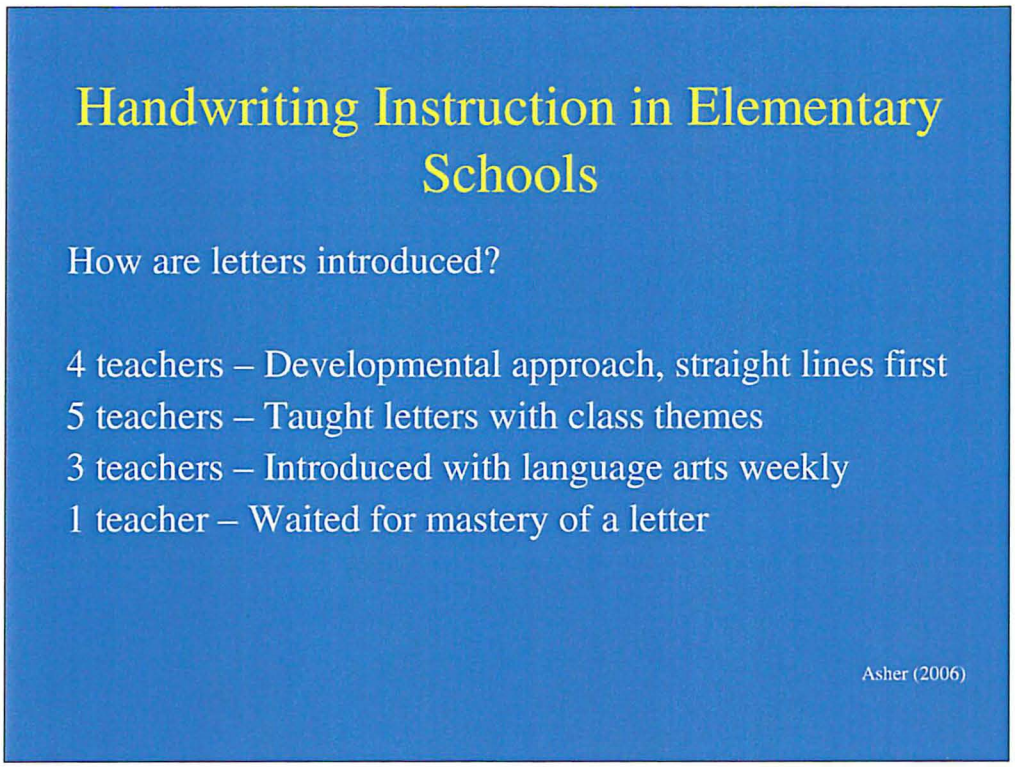
A recent survey of 169 primary grade teachers that teach handwriting shows that nine out of every ten teachers indicated that they taught handwriting, averaging 70 minutes of instruction a week.

The time varied significantly depending on how often during the week it was taught.



A recent survey of 169 primary grade teachers that teach handwriting shows that nine out of every ten teachers indicated that they taught handwriting, averaging 70 minutes of instruction a week .

There is a significant difference in instruction time, depending on the teacher's methods.



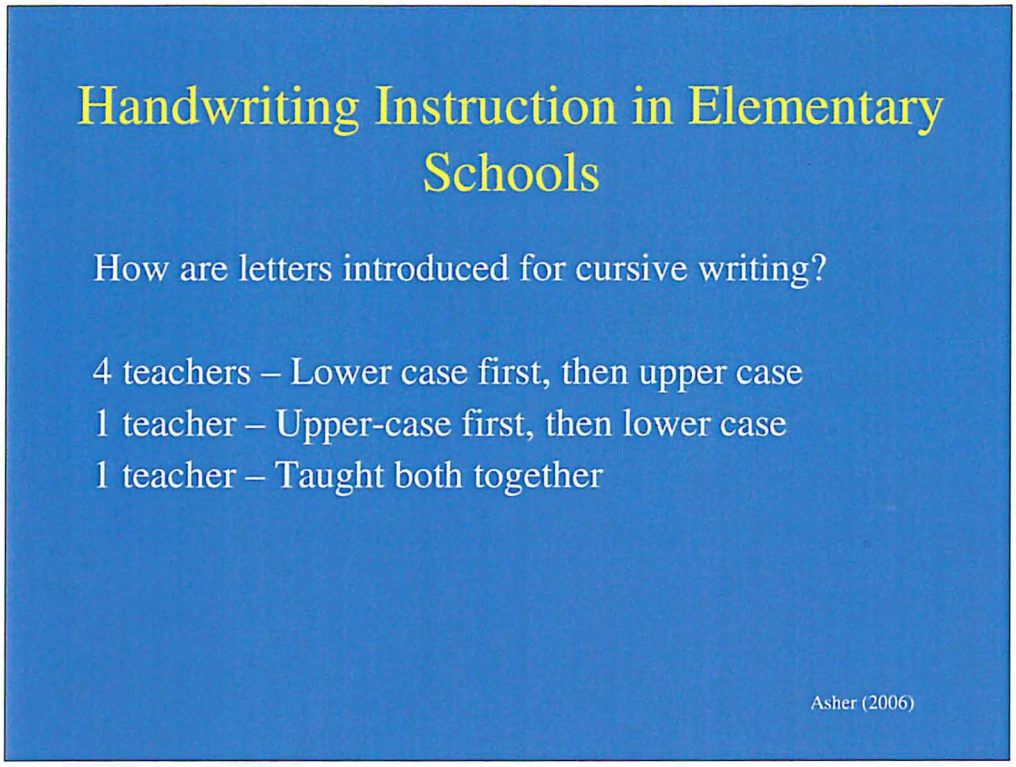
4 teachers used a developmental approach, learning letters with straight lines first,

5 of the teachers introduced letters in conjunction with classroom themes (i.e. introducing the letters "G" and "g" during Green week),

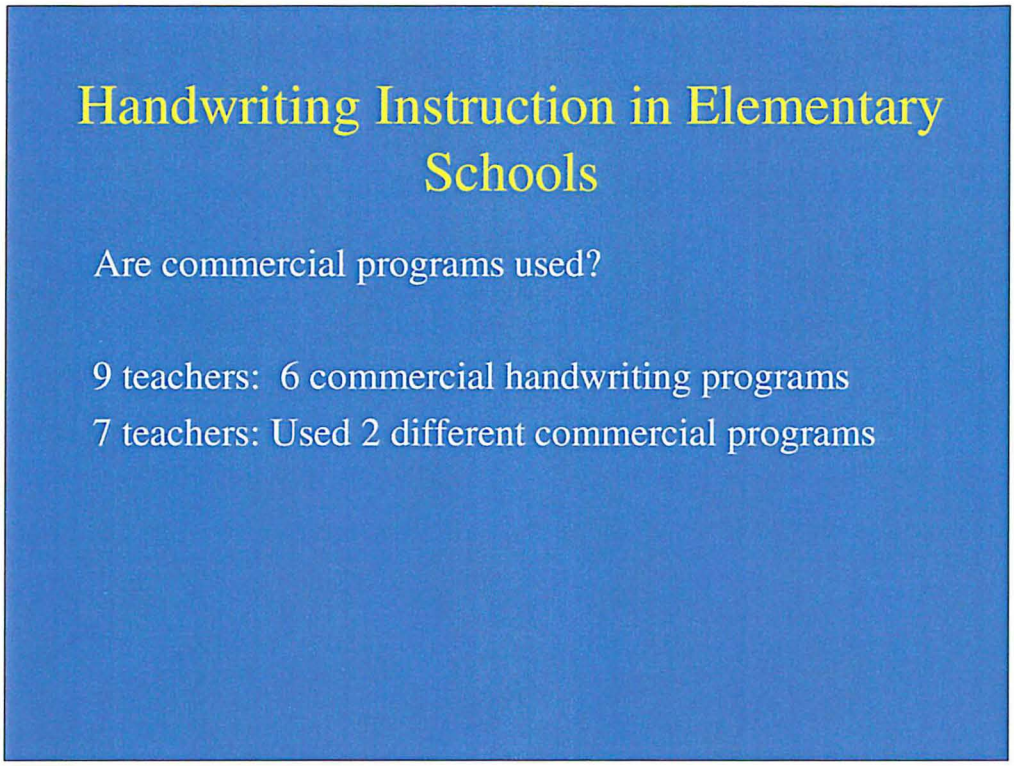
3 teachers reported that they introduced one new letter per week as part of language arts

1 teacher waited for mastery of a letter formation before moving onto another one

If you are in the group of kids (12%-21%) who are struggling with handwriting difficulties, the way a teacher introduces a letter may be difficult for you. Developmental approach would be easiest.



There were not specifics on whether or not they taught the easier letters first. For instance, all of the letters with the straight lines, saving diagonal letters N, M, R, V, W, X, Y, Z

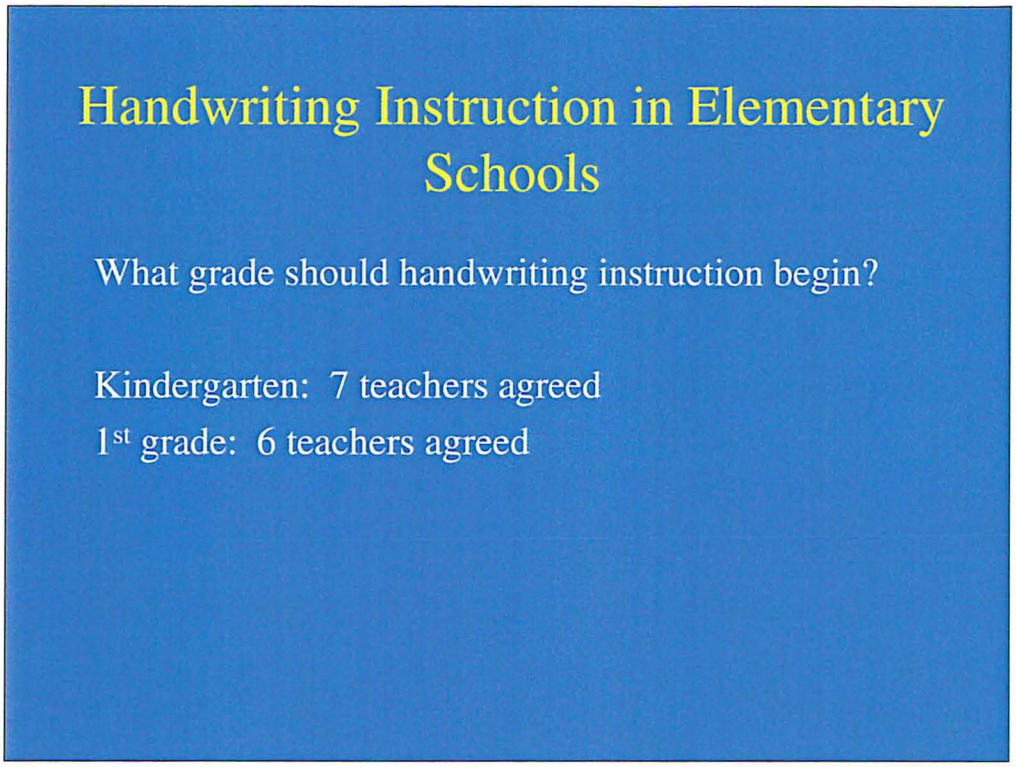


9 of the respondents used 6 different commercial handwriting programs for manuscript instruction.

This is within the same school district.

5 of 7 teachers used the Zaner-Bloser handwriting program to teach cursive and another teacher used the Orton-Gillingham program (Asher, 2006).

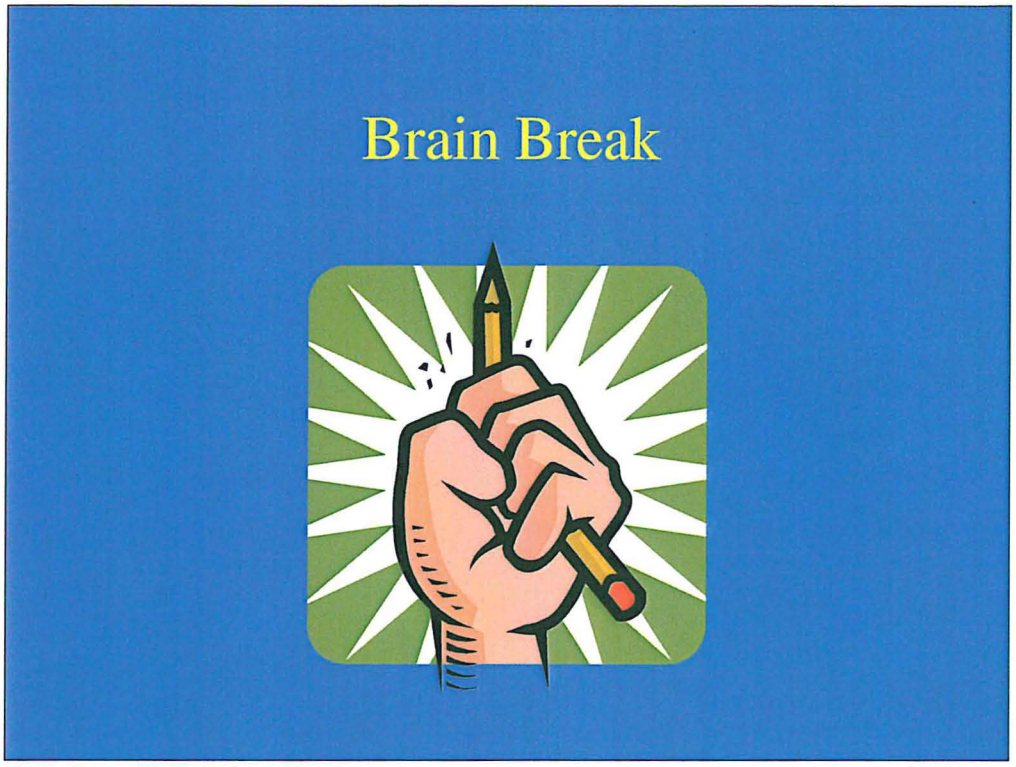
This school district had reported that not all students had learned fluent, automatic handwriting by the time the students were in 5-6th grades and the teachers needed to use instructional time to review handwriting again.

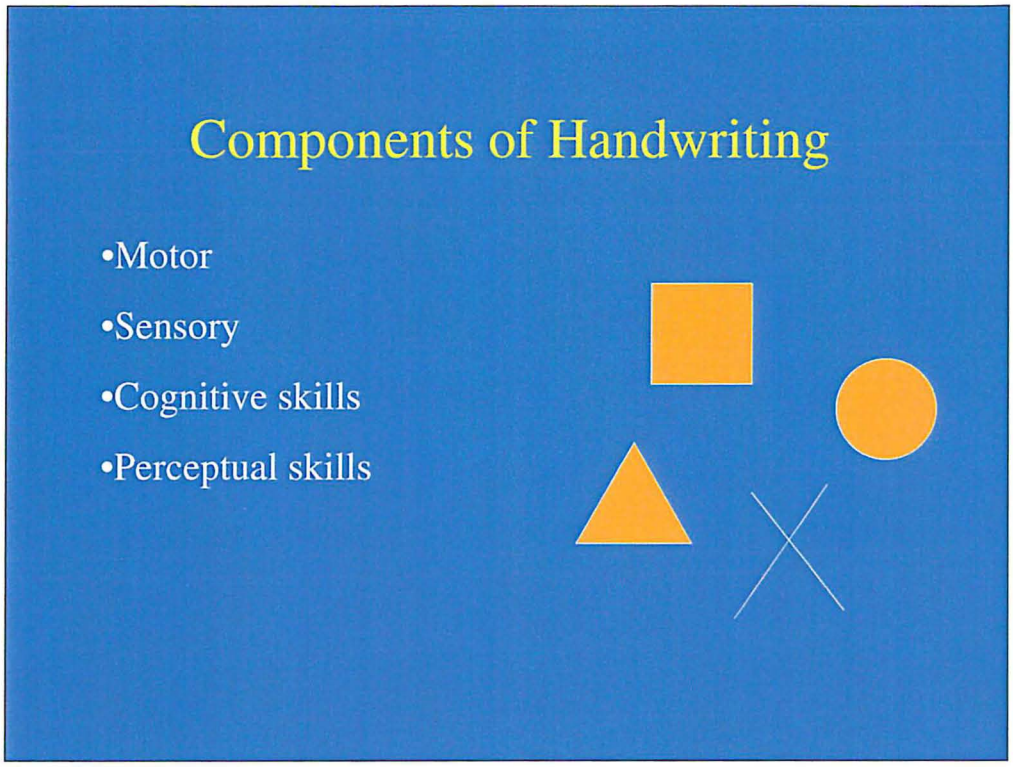


Six of the teachers expected handwriting to be taught in first grade and seven teachers stated it should be taught beginning in kindergarten. These teachers resided in the same school district.

It is easy to see that even within the same school district significant differences exist in how and when handwriting is taught. This makes it difficult for the child who may not be taught handwriting in kindergarten and then he moves into first grade where the teacher's expectations are that he should already have learned how to write.

As a result, he doesn't get actual instruction – and struggles to catch up, possibly learning how to form the letters incorrectly.

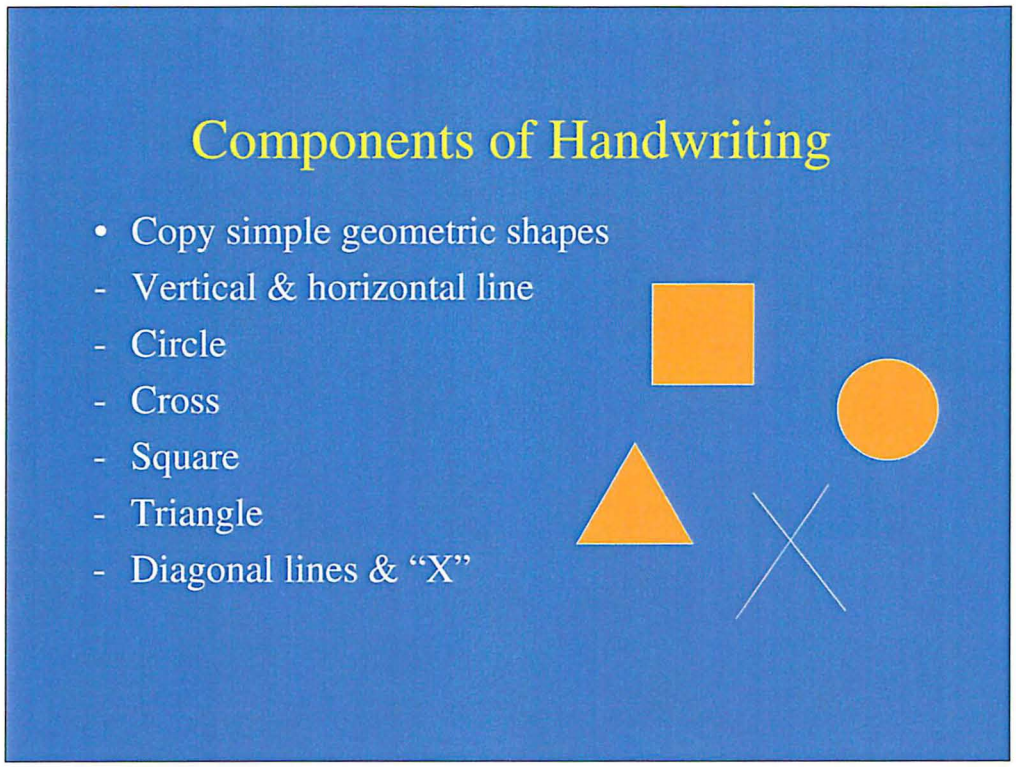

Brain Break



Learning to write requires a combination of motor, sensory, cognitive and perceptual skills.

It is a process that begins with recognizing and producing a specific shape (Benbow et al. 1992).

Before a pencil is put to paper, a child needs to be prepared to write.



Studies have indicated that a child is ready to learn to write when he is able to copy geometric forms (Benbow, Hanft & Marsh, 1992; Weil & Amundson, 1994).

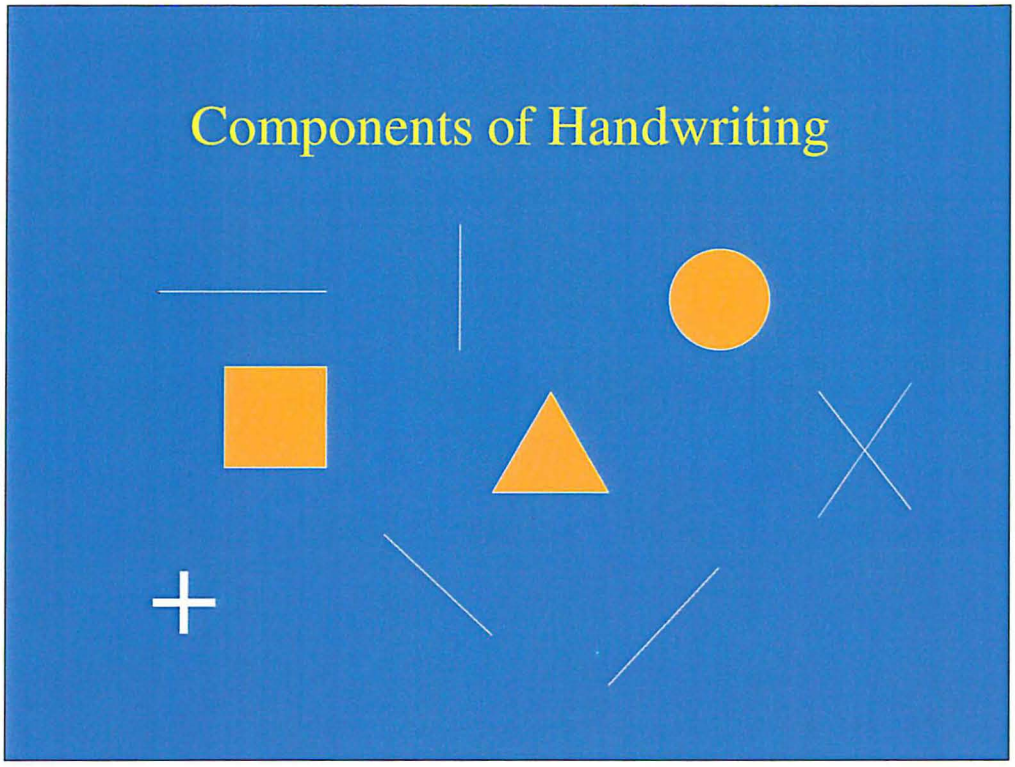
The ability to copy geometric forms closely parallels the "drawing" needed to complete each letter of the alphabet.

These forms include: a vertical and horizontal line, a circle, cross, square, triangle, left and right diagonal lines and an "X".

Children typically draw a circle at 3 years, a cross at 4 years, and a triangle at approximately 5 years of age.,

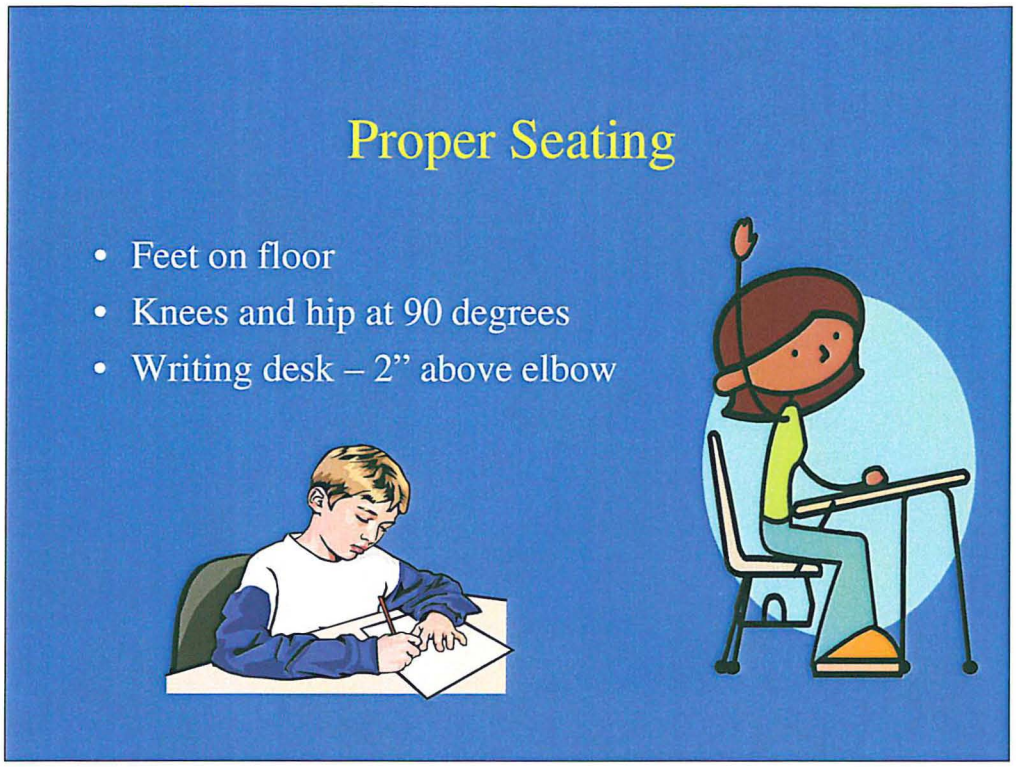
Children are usually able to master the first nine forms on the Developmental Test of Visual-Motor Integration (VMI) by the time they are 5 years, 3 months (Beery & Buktenica, 1989).

The last difficult letters to master would be K, V, W, X, Y, Z, Why? All diagonals.



In the Weil and Amundson study, 88% of the kindergarten children were able to copy the first nine forms of the VMI at the end of the first semester. The author's conclusion was that most children would be ready to begin handwriting instruction in the latter half of the kindergarten year.

There are a number of pre-writing activities that children can do in the beginning of their kindergarten year. It is better to start them later with the letters of the alphabet, so they have time to build their fine motor skills.



A child may have good postural control and stability and then be seated in an ill-fitting desk or chair and asked to write. This is similar to participating in a sport, such as, softball and not having the right equipment to play the game (i.e. the glove is too large or small, the bat is too heavy or the spiked shoes are too big). Any of these equipment flaws would cause a less than optimal outcome in a person's performance.

A student's chair height should allow the student to be able to place his feet comfortably on the floor. He can use this heel contact point to help counterbalance the weight shifting and postural adjustments he needs, as his writing hand moves across a sheet of paper.

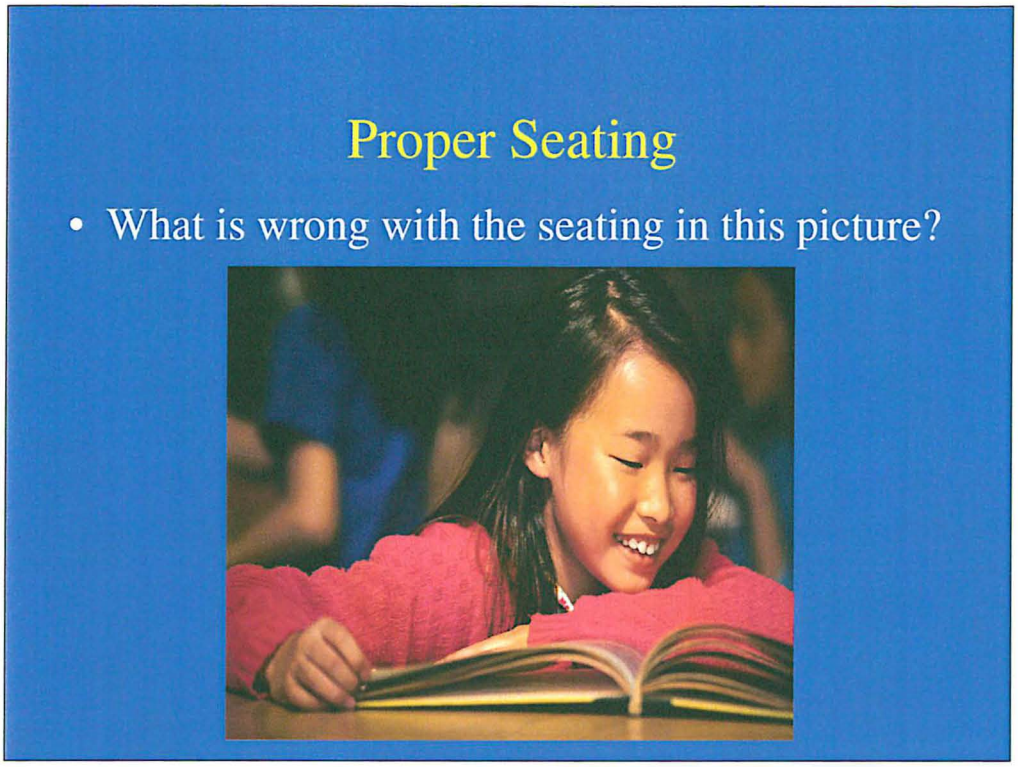
Knees and hips should be flexed to 90 degrees.

The writing desk should be 2" inches above the student's bent elbow. This will allow him to easily rest his arms and support himself when writing.

If the desk is too high, the student will spread his arms too widely for maximum control of his hands. If the desk is too low, the student will lean forward and use his non-dominant hand to prop his head up rather than hold onto the paper. Every handwriting session should begin with the student assuming a proper, functional position for writing (Benbow, 1990).

The student should lean forward slightly.

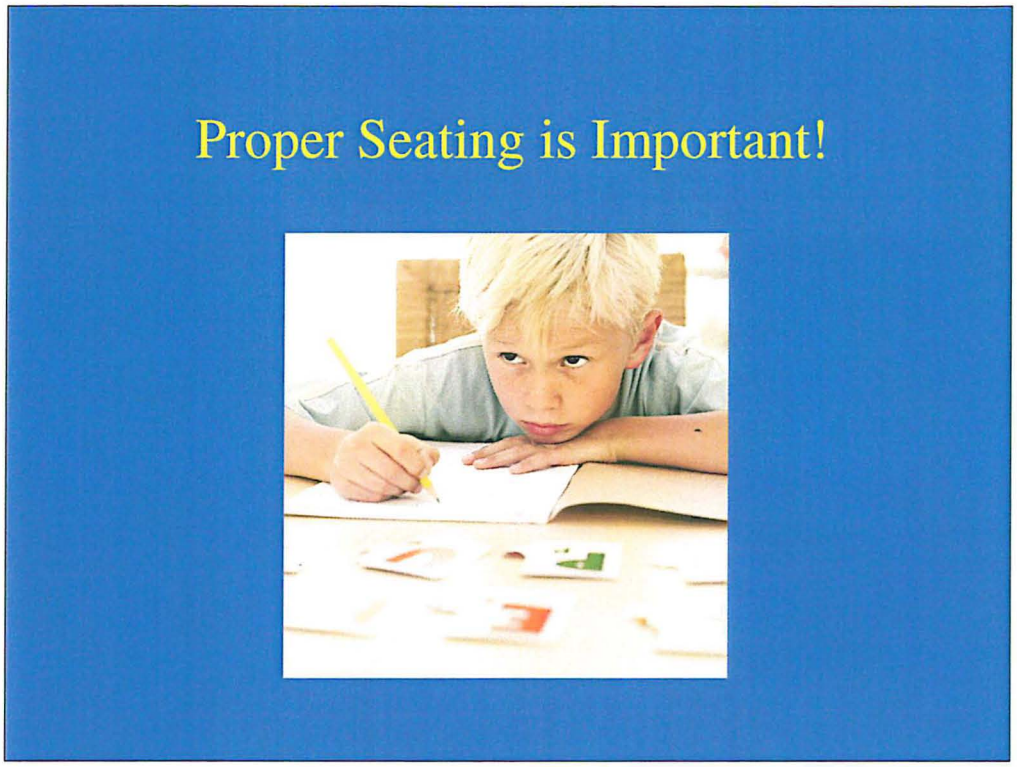
Each desk should directly face the chalkboard where the teacher will be standing as she demonstrates the letter formations for the students. This will eliminate directional and positional confusion for the students who may struggle



If this girl had a pencil in her hand, her arms would be spread too widely for best control of her hands.

Her chin would be practically on top of her paper making it difficult to look at.

What might happen if she were writing an assignment for class?



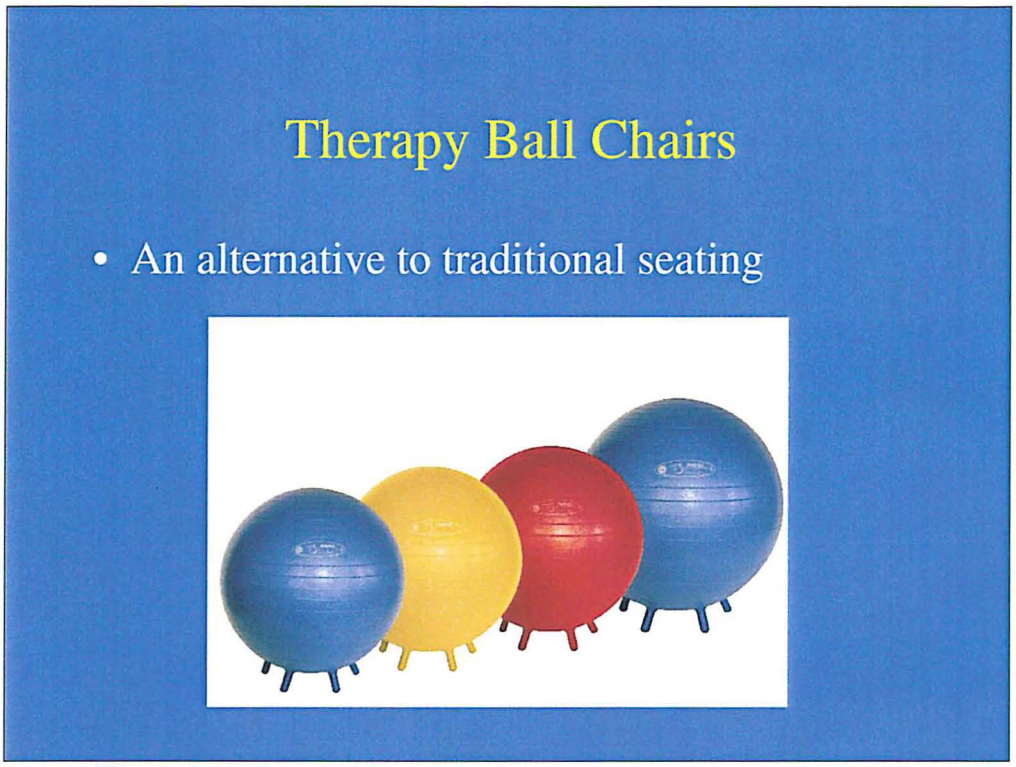
She might end up looking like this boy.

It doesn't take much and the child will be out of the optimal position to be doing his best work.

Make sure to check chair and desk height for each child, especially your smallest and biggest kids!

Add a foot stool, change desks with another classroom,

Can the janitor assist in raising a desk height?

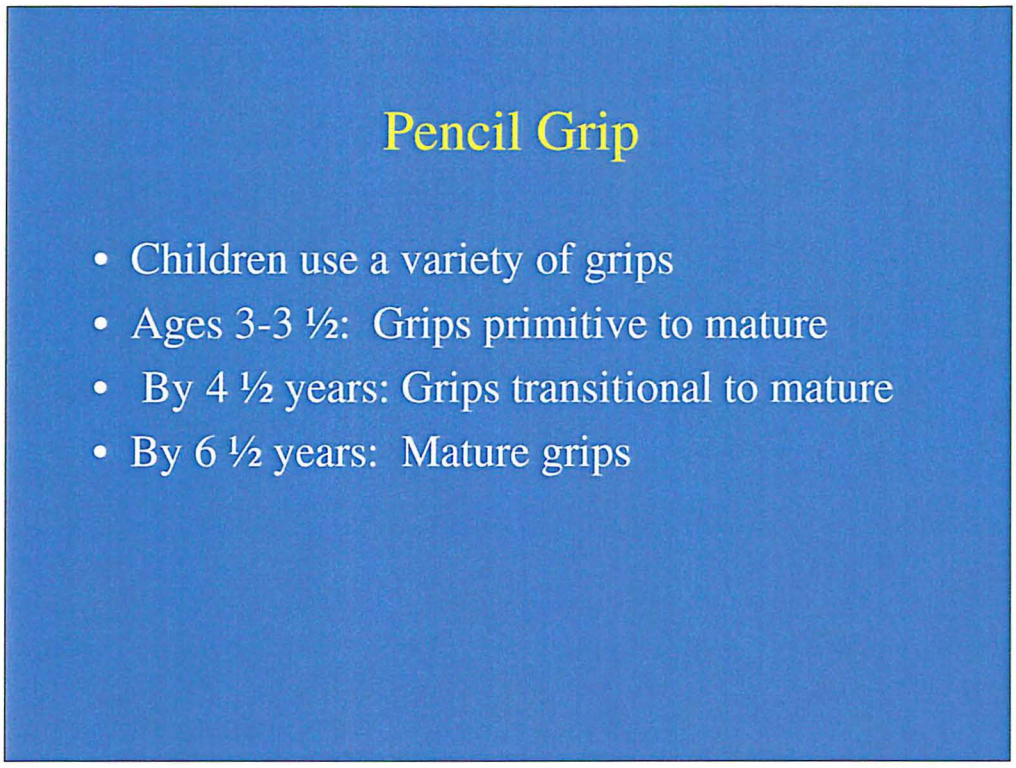


A study was conducted using therapy balls as a chair replacement to determine if they had an impact on in-seat behavior and what effect they would have on legible word productivity. The study was initially designed to look at a strategy that might benefit children with attention-deficit hyperactivity disorder (ADHD).

The therapy balls were fitted to the students, so the optimal positioning of feet on the floor, with hips and knees at 90 degrees was followed.

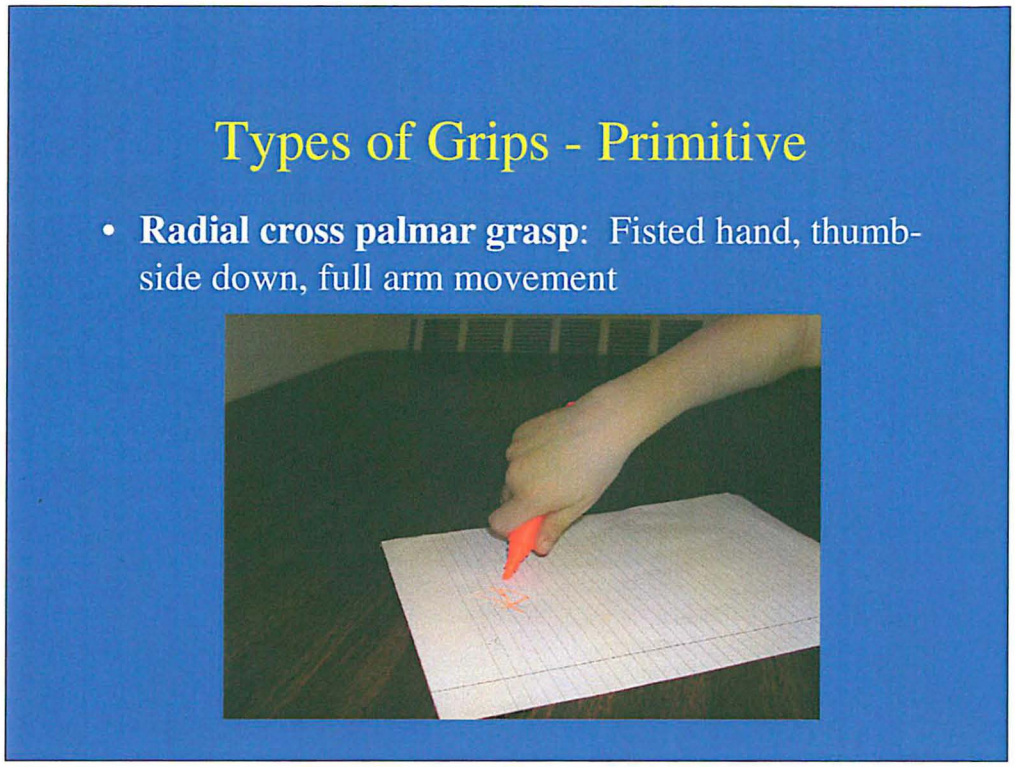
At the conclusion, the results indicated that both in-seat behavior and legible word productivity improved.

In addition, 21 other students in the class reported that they believed the therapy balls were more comfortable, improved their writing, and increased their ability to listen and finish class work (Schilling, Washington, Billingsley, & Deitz, 2003).

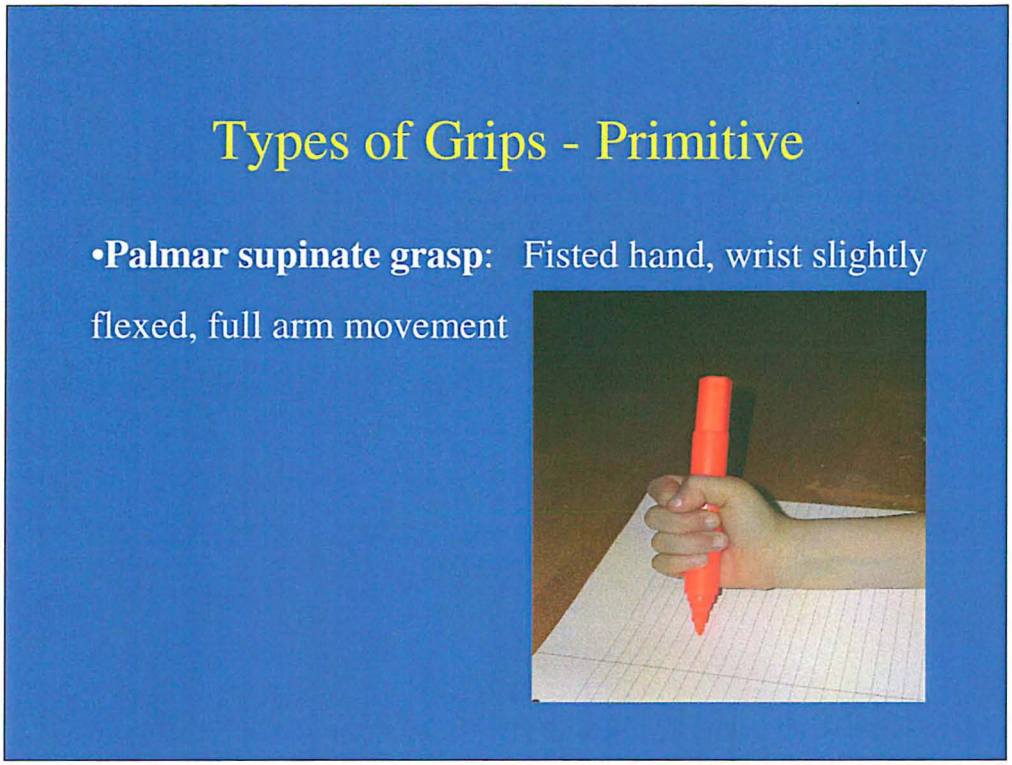


Pencil Grip and Effect of Pencil Size and Shape: The following literature looks at different types of pencil grips, what that indicates and whether legibility and speed is affected by the different grips that children use. It was determined that many people can write satisfactorily with poor or immature grips. However, there were no studies found indicating what the long term effects of using poor grips (i.e. closed web space, use of power muscles rather than precision muscles) may be.

A study designed to investigate the developmental progression in pencil and crayon grips in 3- to 6- year olds was completed on 320 nondysfunctional children, with 20 boys and 20 girls at each 6-month age interval. The authors found that all of the grips observed could be categorized into one of 10 grips. Forty percent of the youngest children (age 3.0-3.5 years) were already using the dynamic tripod grasp. By the age of 6.6-6.11 years, 72.5% of the children were using the dynamic tripod grasp. The implication from this study shows that children, three years of age can be expected to use a variety of grips, from primitive to mature. By 4 ½ years, children can be expected to use transitional (cross thumb, static tripod or four fingers on the shaft) or mature grips and by 6 ½ years of age or older, children will typically use the lateral tripod or dynamic tripod grasp (Schneck & Henderson, 1990).



Let's look at some of the grips that children will use. These first 5 grips are called primitive or immature grips, often times seen in younger kids. A child is able to draw using a fisted hand with the elbow off of the table.

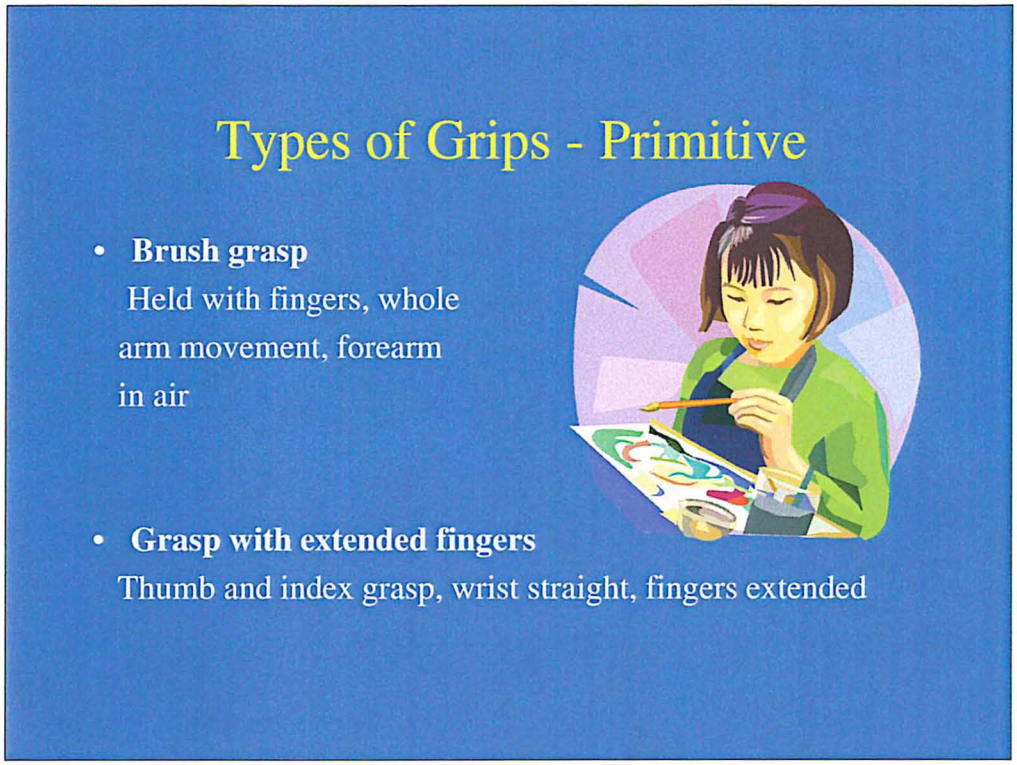


Note that with these primitive (more immature grasps), the fingers are not doing the work as much as the whole arm, forearm or wrist are doing all of the work.

Types of Grips - Primitive

- **Digital pronate grasp** – pencil held in palmar grasp with the index finger extended, arm not supported, full arm movement

The pencil is still held in a palmar grasp, only difference is that one finger is extended.



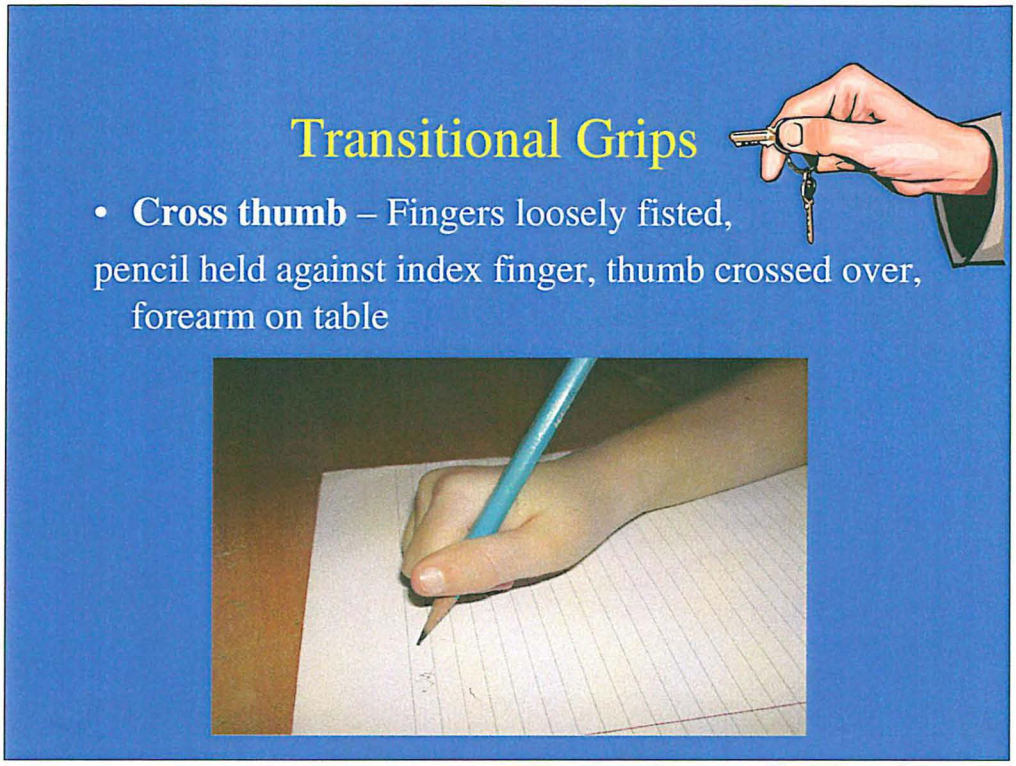
Brush grasp: Held with fingers, the eraser is pressed into the palm, hand is pronated (palm down) whole

arm movement, forearm positioned in the air.

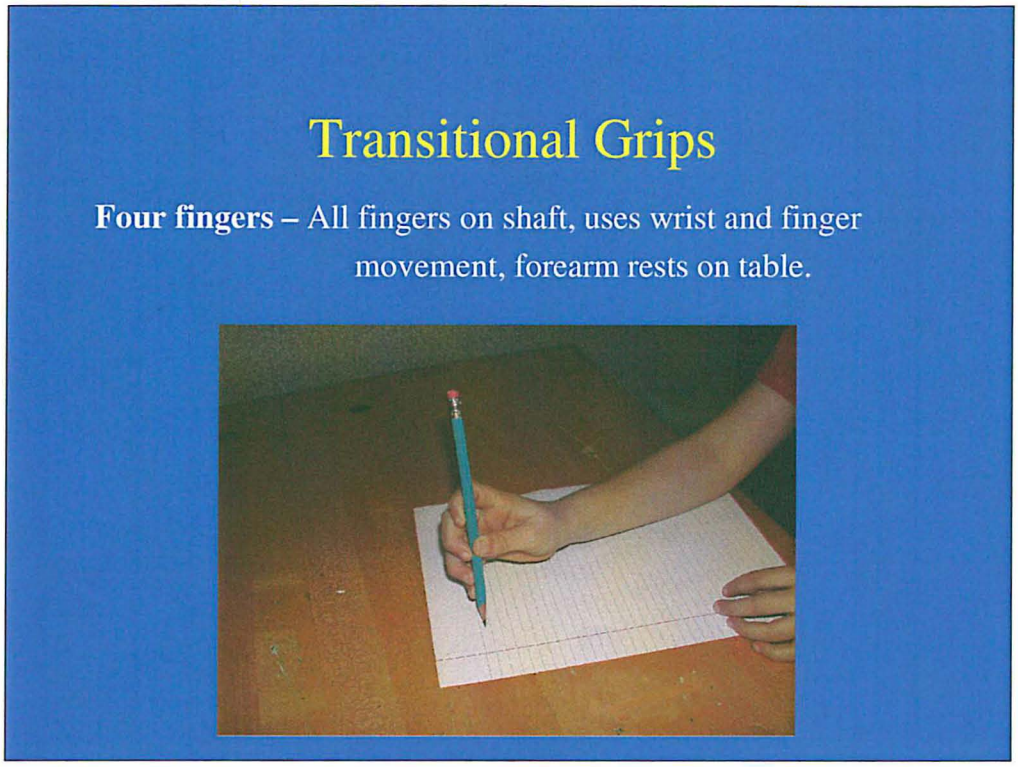
Grasp with extended fingers: Although the pencil is held with the fingers, the wrist is straight (not slightly extended),

Forearm moves as a unit, fingers do not do the moving.

Note that with these primitive (more immature grasps), the fingers are not doing the work as much as the whole arm, forearm or wrist are doing all of the work.



Cross thumb – (lateral or key grip- similar to holding onto keys to open a door) Fingers loosely fisted into the palm of the hand,pencil is held against the index finger, thumb crossed over the top of the pencil, there is finger and wrist movement, forearm resting on table

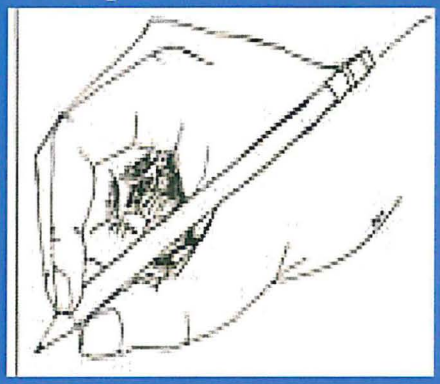


A little more control is coming into play. The child uses his fingers and wrist with the forearm resting on the table, giving him a bit more stability.

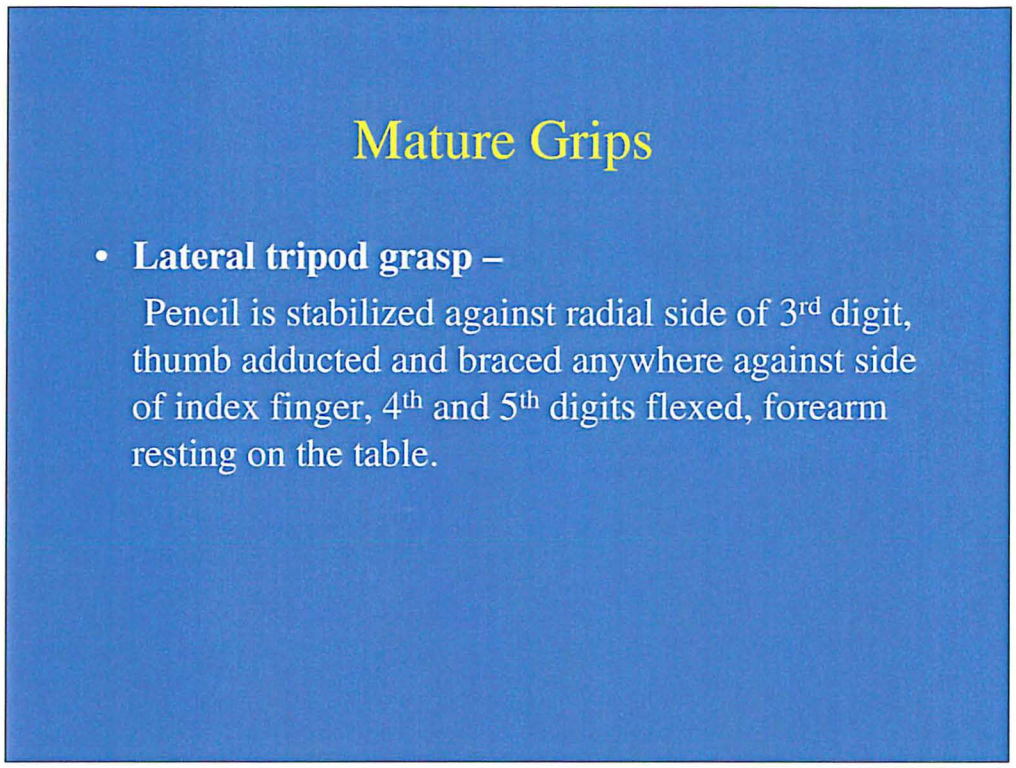
Transitional Grips

- **Static tripod grasp**

  Stabilized against side of third digit by thumb pulp, thumb in opposition; hand moving as a unit and pencil resting in open web space



Stabilized against radial side of third digit by thumb pulp, thumb in opposition; hand moving as a unit and pencil resting in open web space



Pencil is stabilized against radial side of 3rd digit, thumb adducted and braced anywhere against side of index finger, 4th and 5th digits **flexed to stabilize metacarpophalangeal arch and third digit**, forearm resting on the table.

Mature Grips

- **Dynamic tripod grasp –** Open web space, held with thumb, index finger, resting on the third digit, 4th and 5th digits are tucked under, wrist extended, localized movements of digits, forearm on table

Dynamic tripod grasp – Open web space, **pencil** held with thumb, pad of index finger on top of pencil, resting on the third digit (radial side), 4th and 5th digits are flexed to stabilize the metacarpophalangeal arch and third digit, wrist extended, localized movements of digits, wrist movements on tall and horizontal strokes, forearm supported on table. (Schneck & Henderson, 1990)

Does changing a particular pencil grip improve writing performance? Maybe.

It depends on the child and their unique difficulties.

The other point to consider is how long has the child been using an inefficient grip? "any grip, efficient or inefficient that has been used for a long period of time becomes kinesthetically locked in – Benbow

By 2nd grade, changing a child's grasp pattern may be so stressful that the effort should be abandoned

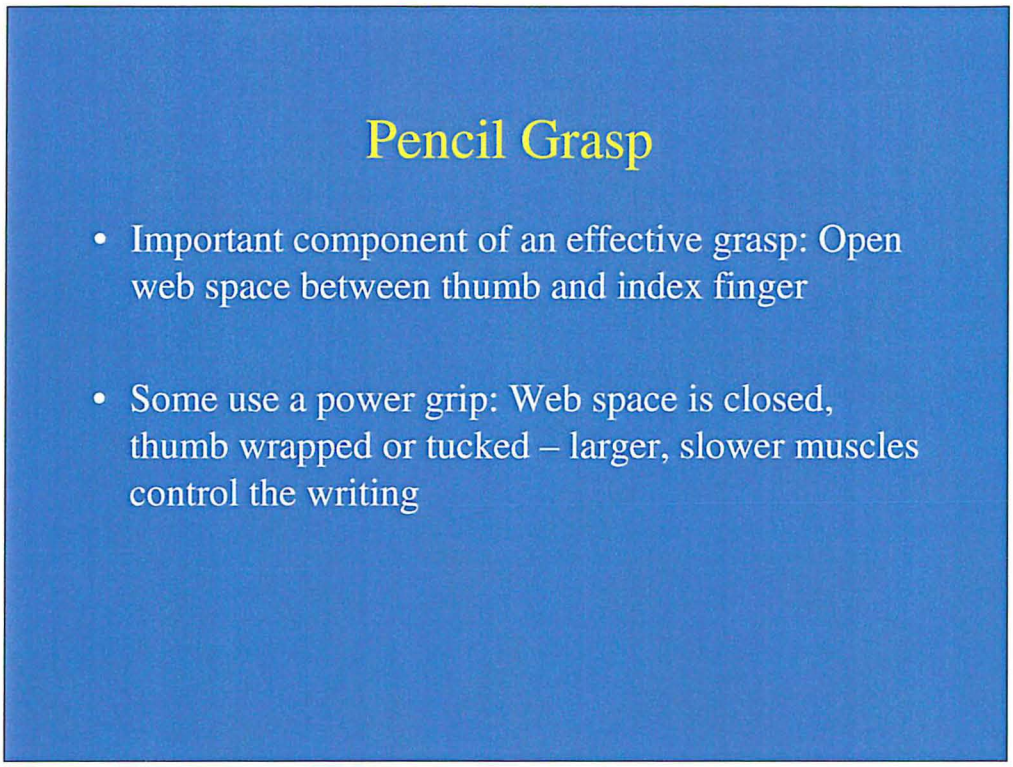
Variations on Pencil Grasps

- Hook grip (Lefties)-
May use dynamic tripod or four finger grasp but wrist is flexed.

- Alternate grasp – pencil between index and 2nd and 3rd digits. Helps to stabilize pencil

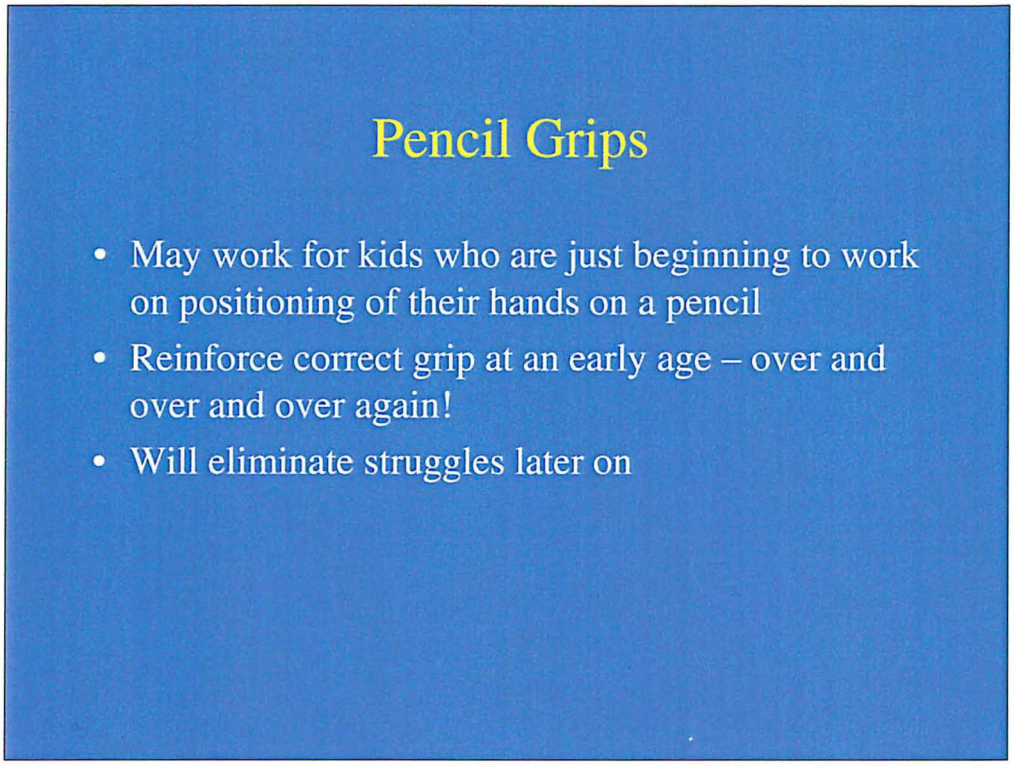
Will discuss the left-handed grip in more detail later. Often times this grip results from the paper not being at the correct angle for the child to be able to see the letters that they are writing.

If joints are loose, may need to adapt pencil posture – shift pencil between index and middle finger

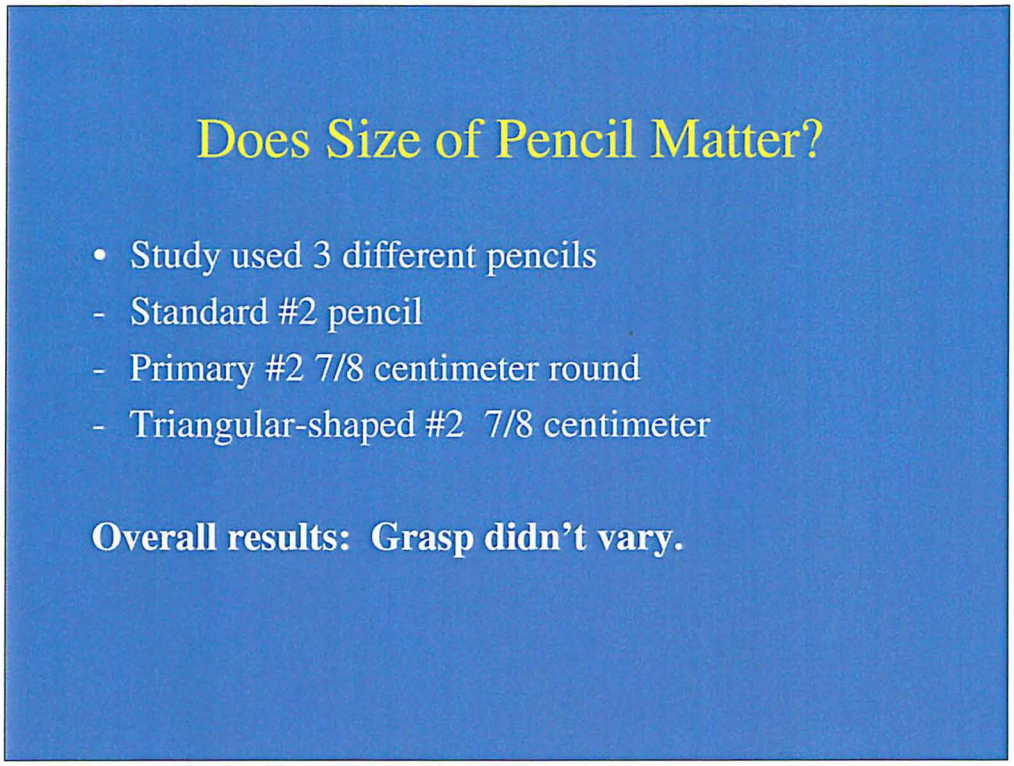


Many writers write satisfactorily with poor grips. Many of the grips used require the person to develop skilled use of the proximal joints. When proximal versus distal joints are used, a person loses out on precise control and speed when forming letters. If the writer does not demonstrate good stability to manipulate the writing tool in their hands, they may use the thumb adductor, a slow power muscle, to brace the pencil and close the web space in the hand (Benbow et al. 1992; Benbow 2006).

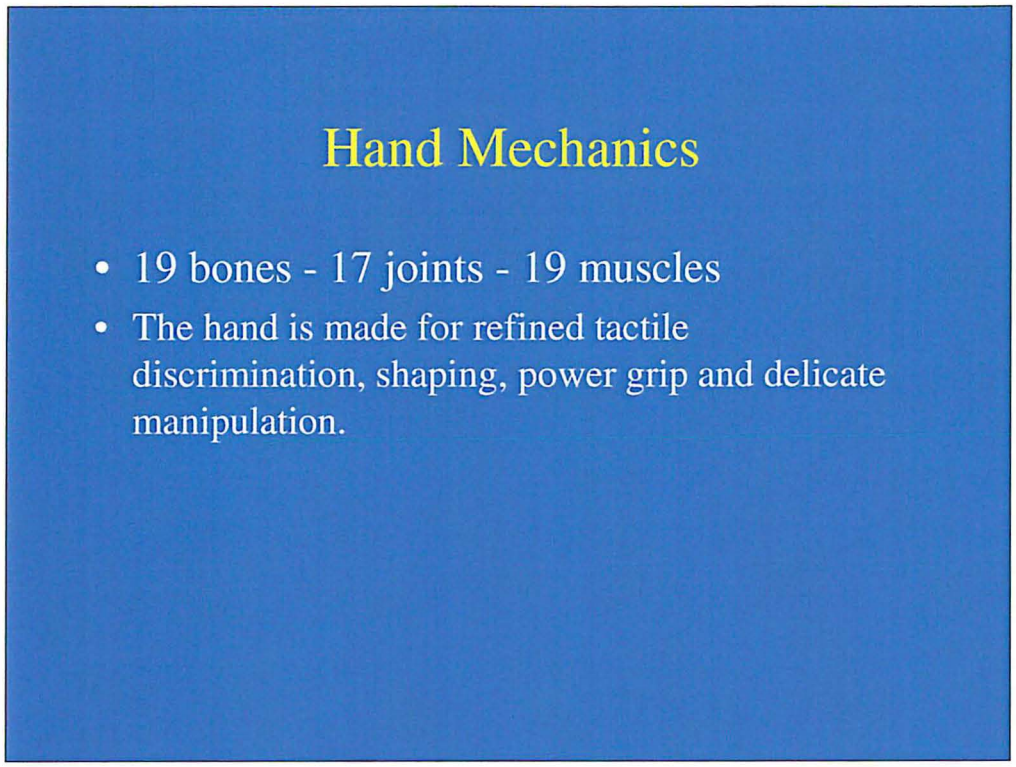
However, a study by Koziatek & Powell (2003) looked at the pencil grips, legibility and speed of fourth graders' writing in cursive. The 101 students used a variety of pencil grips: 38 used the dynamic tripod grasp, 18 used a dynamic quadropod pencil grip, 22 used a lateral tripod pencil grip, 21 used a lateral quadruped pencil grip, one used a four-finger grip and one used an interdigital grip. The findings of no significant legibility and speed differences among the first four pencil grips strengthens the argument that these grips may be equal in function to those of the dynamic tripod grasp. As only one student used the interdigital grasp and the four-finger grasp, further study is warranted with these two grips.



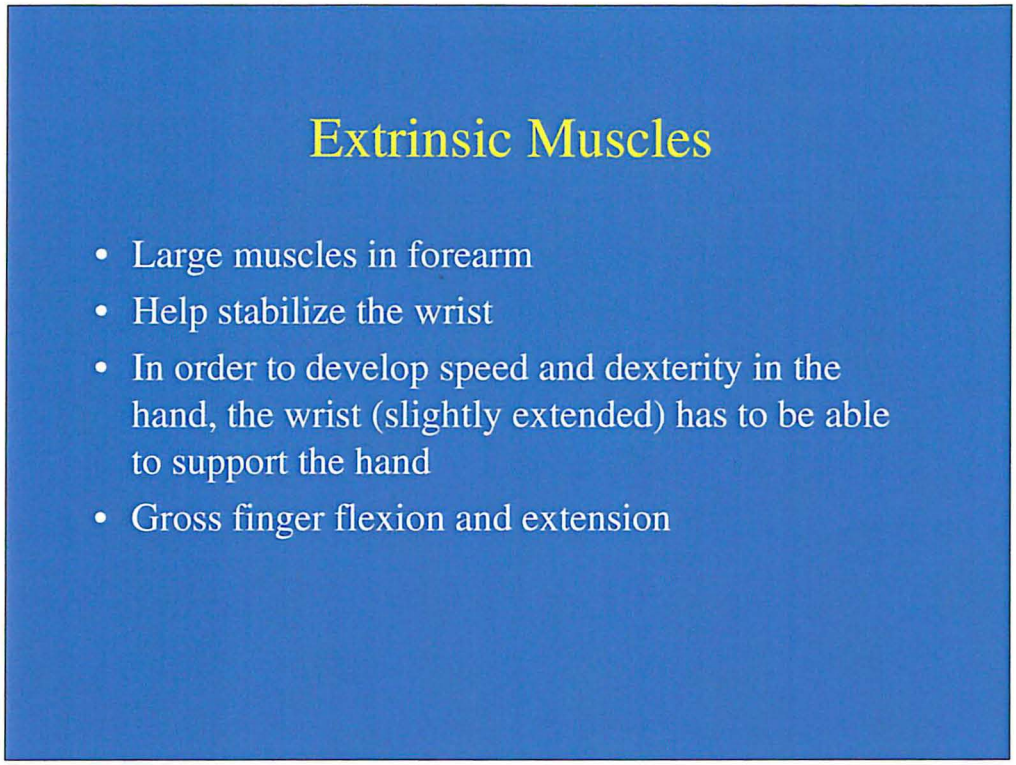
Providing writing tools with a variety of grips for preschool children who are just beginning to work on positioning their hands correctly on a pencil is the most sensible and effective use of these devices. If the correct grip is reinforced at an early age, this will eliminate the struggle to correct the inefficient grip after it has been used repeatedly and kinesthetically locked in (Benbow, 2006).



The discussion of what size of pencil should be used with young children comes up frequently when children are referred for handwriting problems. One study was designed to see if there were any differences in the pre-writing skills of kindergarten children when given a standard, primary or triangular-shaped pencil. 126 children, ages five and six, participated in the study. The writing tools used were a standard #2 round pencil, a primary #2 7/8 centimeter round pencil and a #2 7/8 centimeter triangular-shaped pencil. Grasp patterns were also recorded. 36-40% of the children used a dynamic tripod grasp when writing. The overall results of this study indicated that the children's performance did not differ when using the various sizes and shapes of pencils. **One thing to keep in mind with this study is that children receiving OT services or having handwriting difficulties were not assessed in this study. It is possible that using an alternative grip may benefit them (Oehler et al. 2000).**

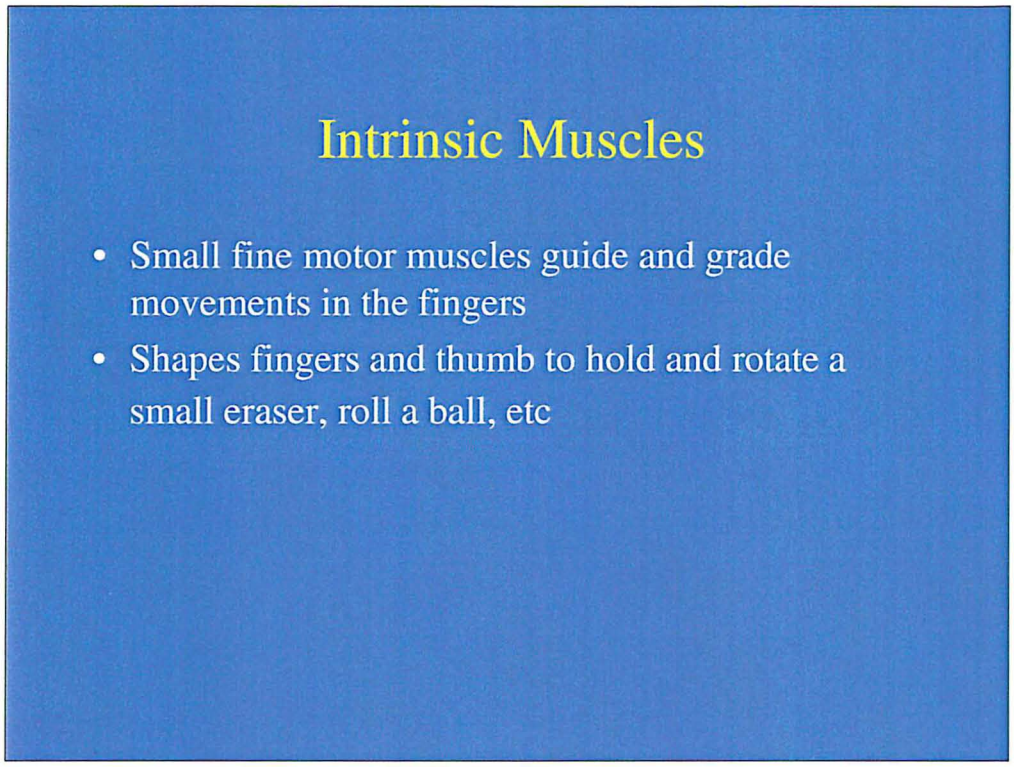


Normal use of the hand is dependent upon many of the muscles working together; those acting on the wrist as well as the fingers.



Good hand function is dependent on interplay of intrinsic and extrinsic muscles working together.

The extrinsic, large muscles help to stabilize the wrist and provide gross flexion and extension of the fingers and thumb when holding objects. The lateral wrist movements by the extrinsics help to move the writing tool across the paper.

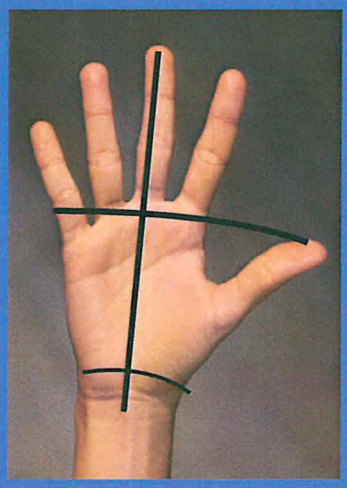


The smaller, intrinsic muscles in the hand grade the movements needed to manipulate and rotate objects within the hand. Flexion and extension movement of the digits, by these muscles are used to draw the vertical lines needed in writing and drawing.

The ability to transfer thought to paper has less to do with how a person holds the writing utensil and more to do with the ability to combine and sequence finger and wrist movements. (Benbow et al. 1992; Boehme, 1988).

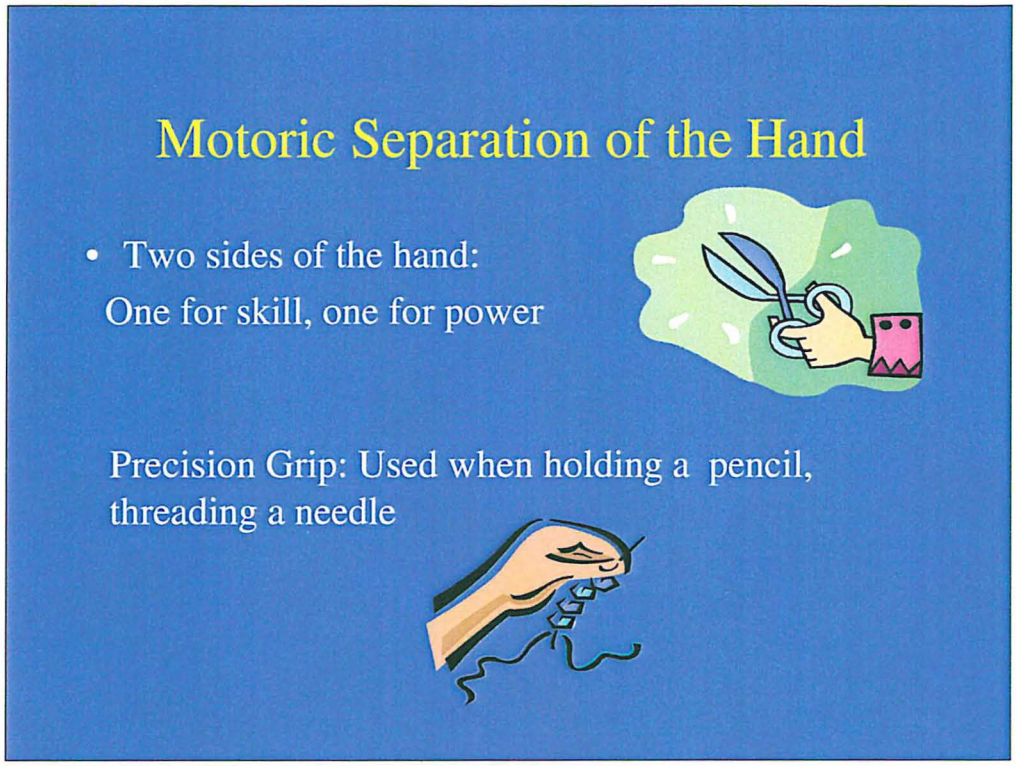
Shaping of the Hand - Arches

- 4 longitudinal arches
- Proximal transverse arch
- Distal transverse arch
- Arches form the deep hollow at base of middle finger



The hand consists of four oblique, four longitudinal and two transverse arches. When arches are well developed, they will form a deep hollow in the palm at the base of the middle finger. They are an important component in shaping the hand when holding the pencil and allow skilled movement of the fingers. Examples of this include: unscrewing the cap off a tube of toothpaste or turning a pencil over to use the eraser (Benbow et al. 1992).

Spider example: Hands together praying position – then arch both hands so only fingertip to fingertip is touching.
Shaking of dice – hands need to be arched to do this- math work with this – shake dice add the dice together – each child gets a pair of dice.
Opening a jar – hand arches over the lid as it unscrews the jar.



Separation of the sides of the hand: The hand has a midline that separates out its two important functions: skill and power.

The ulnar (little finger) side is used for power, while the radial (thumb) side is used for more skilled movements.

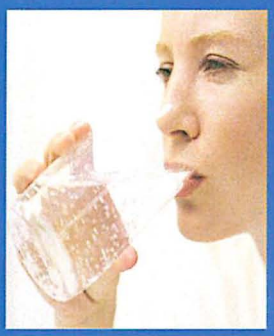
When a student writes, the ring and little finger should be flexed and remain "quiet" to stabilize the arch, while the radial side (thumb, index and third finger) manipulates the pencil.

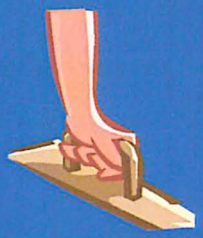
The motoric separation of the hand can be seen when a student is cutting with a scissors. One side of the hand stabilizes the object and the other side of the hand is in motion.

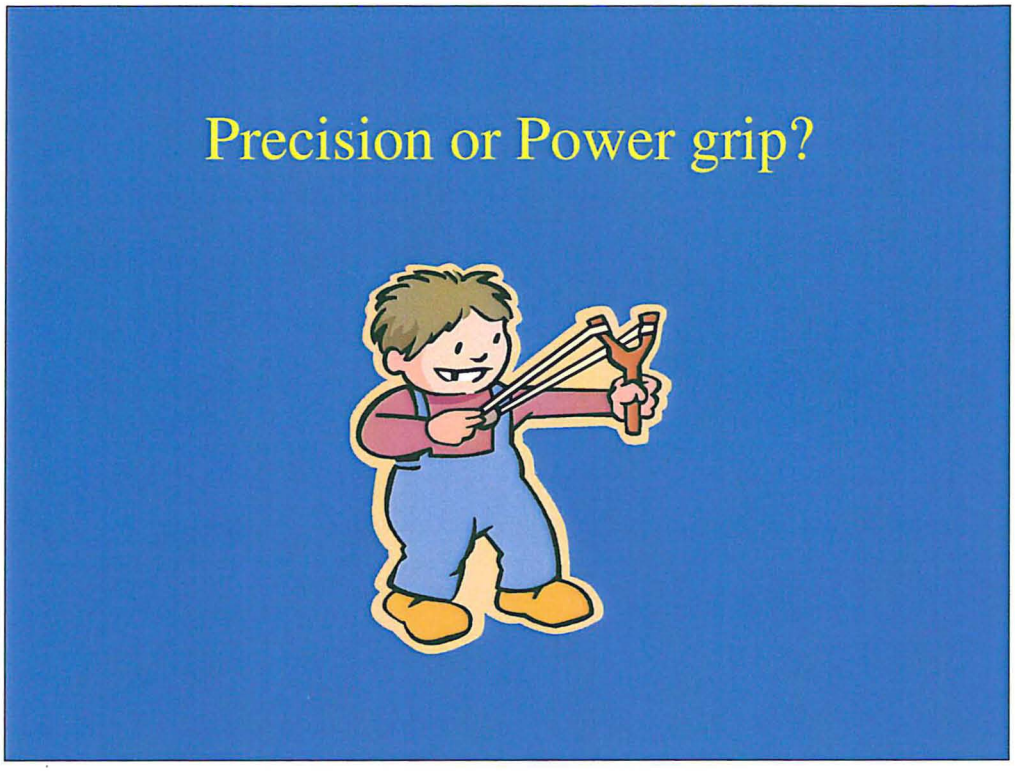
Shoe tying, removing a pen cap with one hand and holding a pump water bottle and squirting it are other examples of motoric separation (Benbow et al. 1992; Boehm, 1988).

Motoric Separation of the Hand

Power Grip: Used when holding a bat, a glass or a suitcase



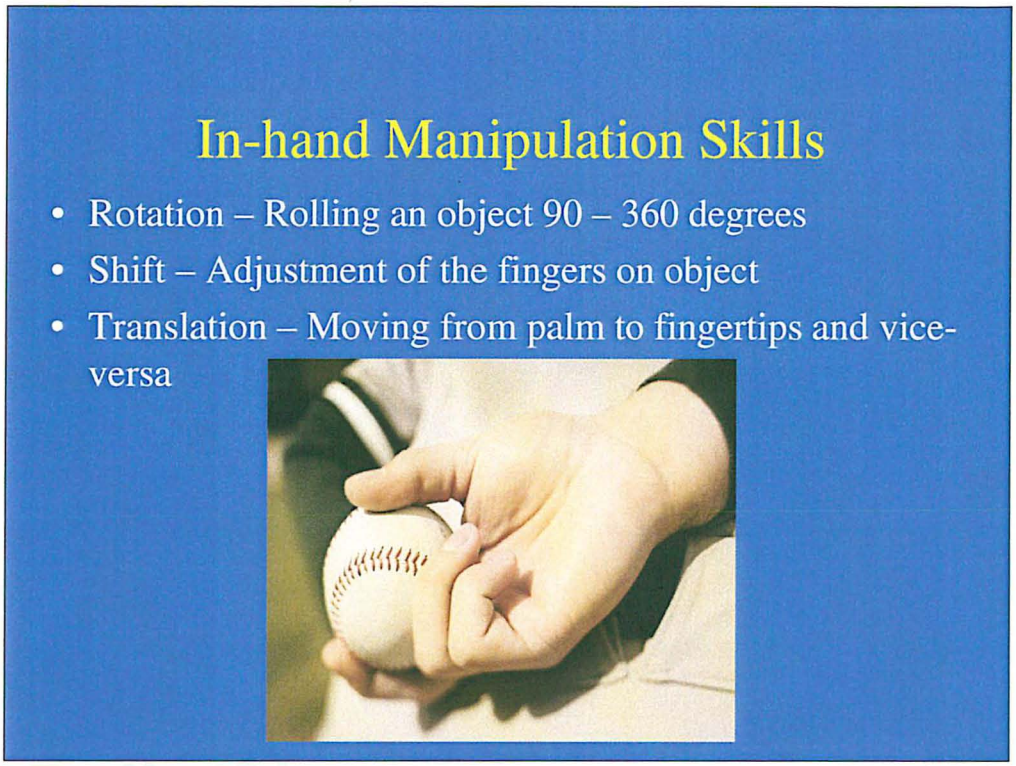




The right hand is holding the rock in a precision grip – using the thumb and index finger

The left hand is using the whole hand in a power grip.

This activity is frowned upon in the school system – even if you are working on developing a child's fine motor skills.



Manipulation skills of the hand: In-hand manipulation involves the adjustment of an object within one hand while it is being held.

Simple rotation within the hand involves rolling an object 90 degrees or less while complex rotation involves turning an object 90 to 360 degrees while isolating thumb and finger movements. An example of this is turning a pencil over to use the eraser.

A shift is an in-hand manipulation movement where there is a slight adjustment of the object being held by the fingertips.

Translation is a form of manipulation where an object is moved in a linear direction between the palm and the fingertips.ie. picking up pennies or checkers and moving them into the palm or placing them onto a board

Both of these movements are used in writing to help adjust the pencil in the hand, once it is initially grasped.

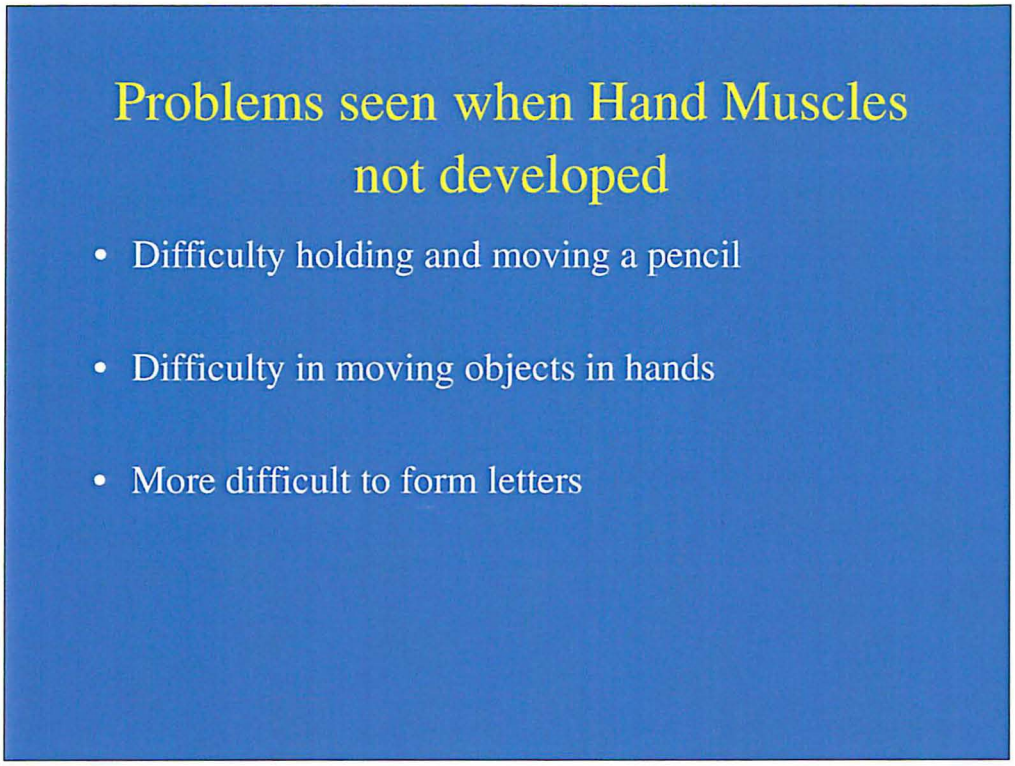
The intrinsic muscles of the hand are responsible for these in-hand manipulation skills (Exner, 2006; Benbow, 1990 as cited by Benbow, et al. 1992).

In a study by Cornhill and Case-Smith (1996), evidence of a strong association between handwriting performance and in-hand manipulation skills was shown. The results of the study support the contention that precise control of fingers and thumb, needed to move objects in and out of the hand, is highly associated with letter formation in writing. This is an area that should be assessed when a student is identified as having handwriting problems.

Problems seen when Hand Muscles not developed

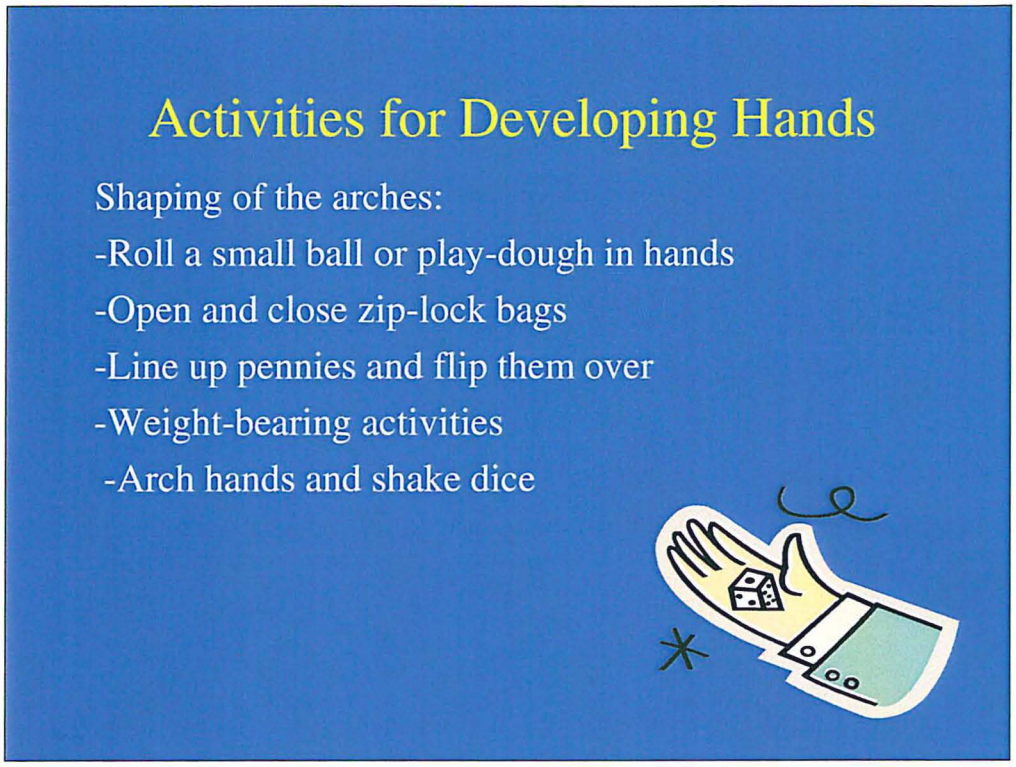
- Poor object manipulation
- Unable to turn pencil over to erase
- Difficulty cutting

A child may need to use two hands to manuever the pencil around in order to use the eraser.



Difficulty in picking up a pencil and moving slightly up and down the shaft to adjust the pencil.

Many objects require minute adjustments in the hands – holding a ball, turning a jar lid.



Shaping of the arches:

-Roll a small ball or play-dough in hands

-Open and close zip-lock bags – **Make sure your arches don't collapse**

-Arch hands and shake dice

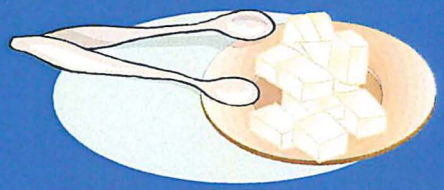
Line up pennies and flip them over

Activities requiring weight-bearing through hands: Wheelbarrow walking and acting like animals on all fours

Activities for Developing Hands

Separation of the sides of the hands

- Squirting a water bottle
- Cutting with a scissors
- Hold coins in hand and sort them, one at a time, using thumb and index finger

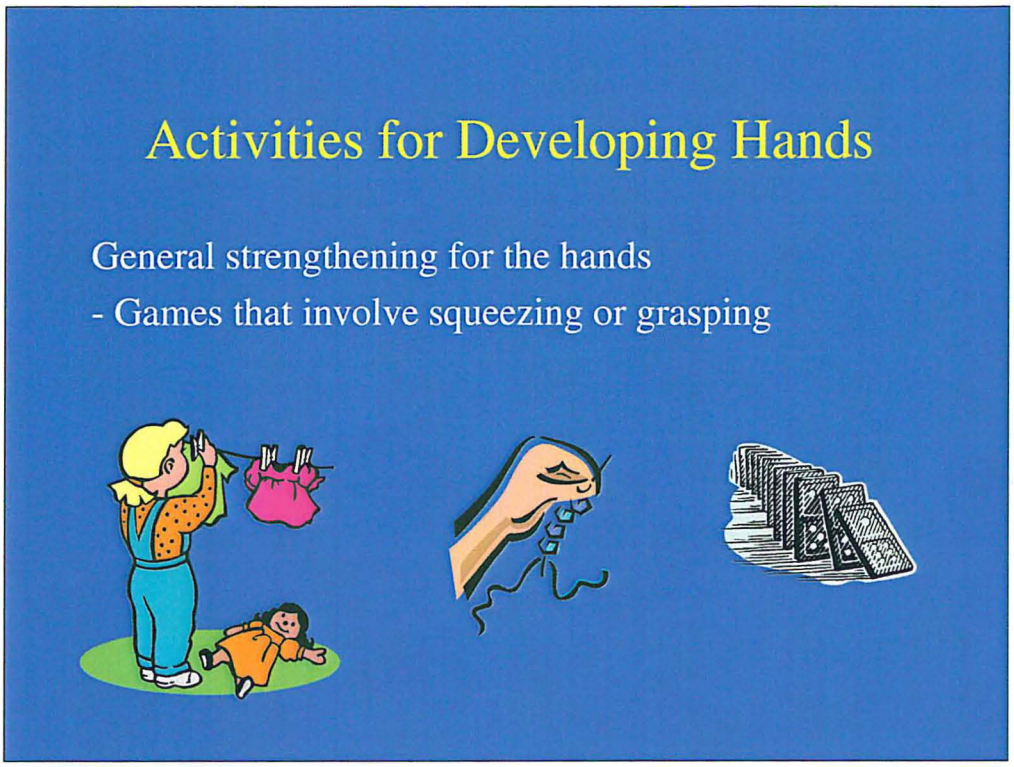


Using tongs to pick up objects, big or little.

Thumb and index do the work, 4-5 digits stabilize.

Large nuts and bolts attached to a perpendicular board makes an ideal activity for young children.

Snapping your fingers requires this kind of skill.



Items that force pinching like clothespins

Needle and thread

Picking up and placing dominoes

Activities for Stabilizing Wrist

Wrist is held steady by the flexors and the extensors

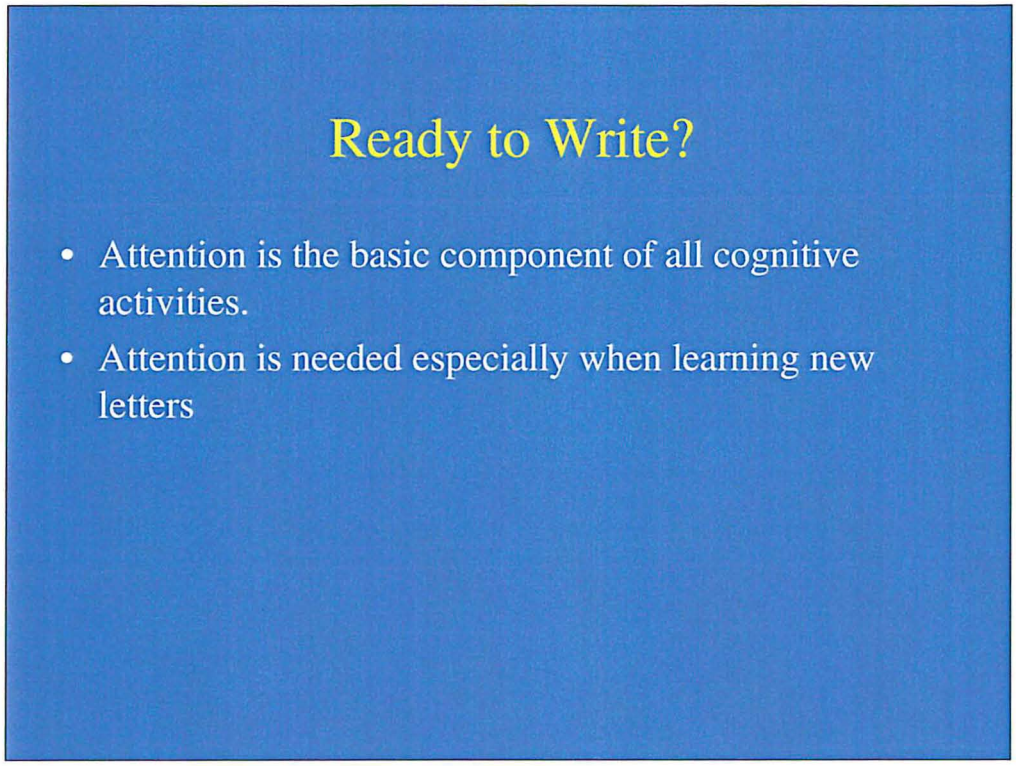
- Write on chalkboard above eye level
- Work in vertical positions to play games, such as, Lite Brite, Magnadoodle, lacing
- "Donkey kicks"

The wrist provides the stabilizing force for the hand to operate.

The wrist helps to shape the hand to perform fine motor tasks with the tiny muscles in the hand.

The wrist should be slightly extended for fine motor skills.

Brain Break



A child needs to be alert and focused, but not over-stimulated before beginning any activity for optimal response.

Calming factors are slow repetitive movements

Arousing factors are rapid, fast and irregular

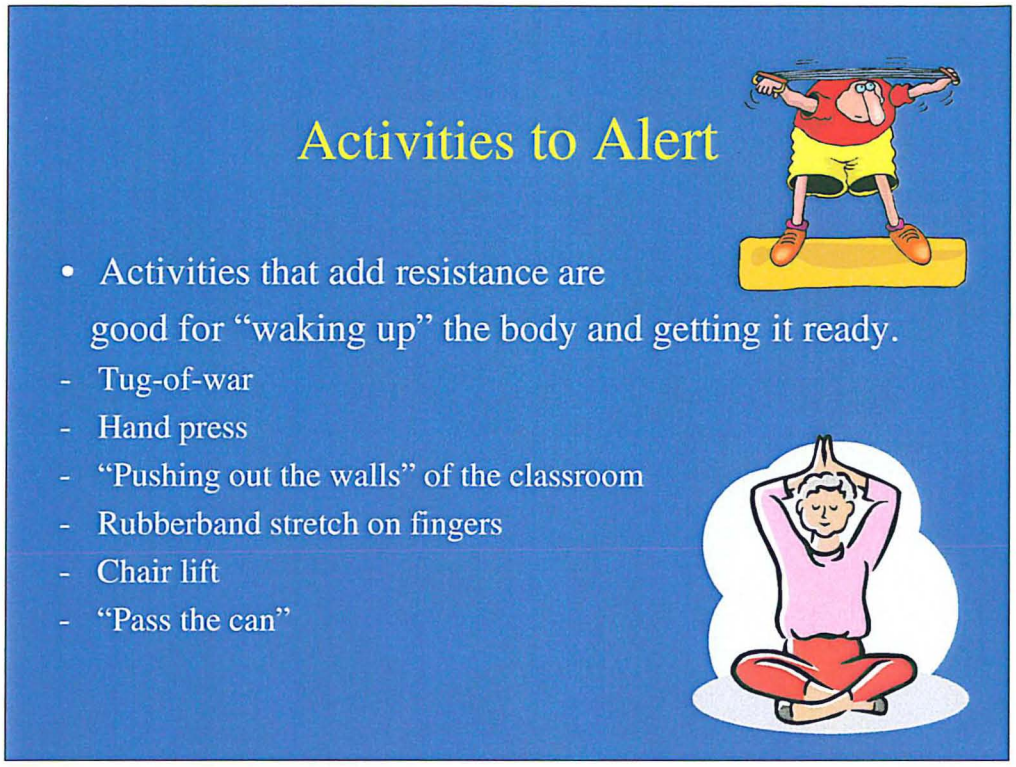
Help get Kids Ready to Write?

Add **movement** prior to handwriting lesson–

- Helps child with general organization for specific tasks
- Regulates arousal so student can attend

Normal movement requires good postural tone.

Movement in and of itself is alerting and needed for learning.



Tug-of-war: For the brave, can be done outside or in gym class prior to coming to the classroom. Can do a one-handed tug-of-war with a smaller length of rope – work on right hand/left hand concepts. I.e. "Hold onto the rope with your left hand now"

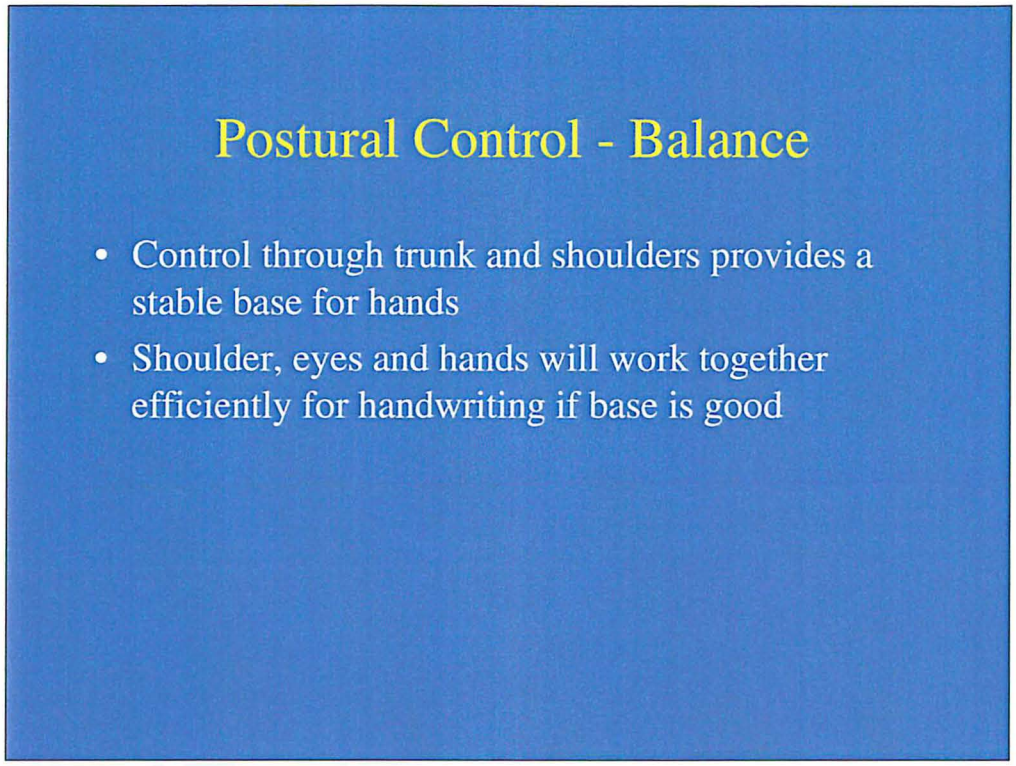
Hand press: Press hands together as hard as you possibly can – flat as a pancake.

"Pushing out the walls" of the classroom. Young kids will enjoy this. " I need more space in this class, everyone move to the walls and on the count of 3, push out with all your strength"

Rubberband stretch on fingers: Keep the rubberbands until needed!! Large ones work best. Place the rubberband over the closed fingers of the thumb and four digits, on the count of 3, stretch it out and hold it while I count to 5.

Chair lift: Make it a game. Like the wave at a football stadium, as you point to each row, they have to lift their chairs at the same time, set them down and get ready to lift again.

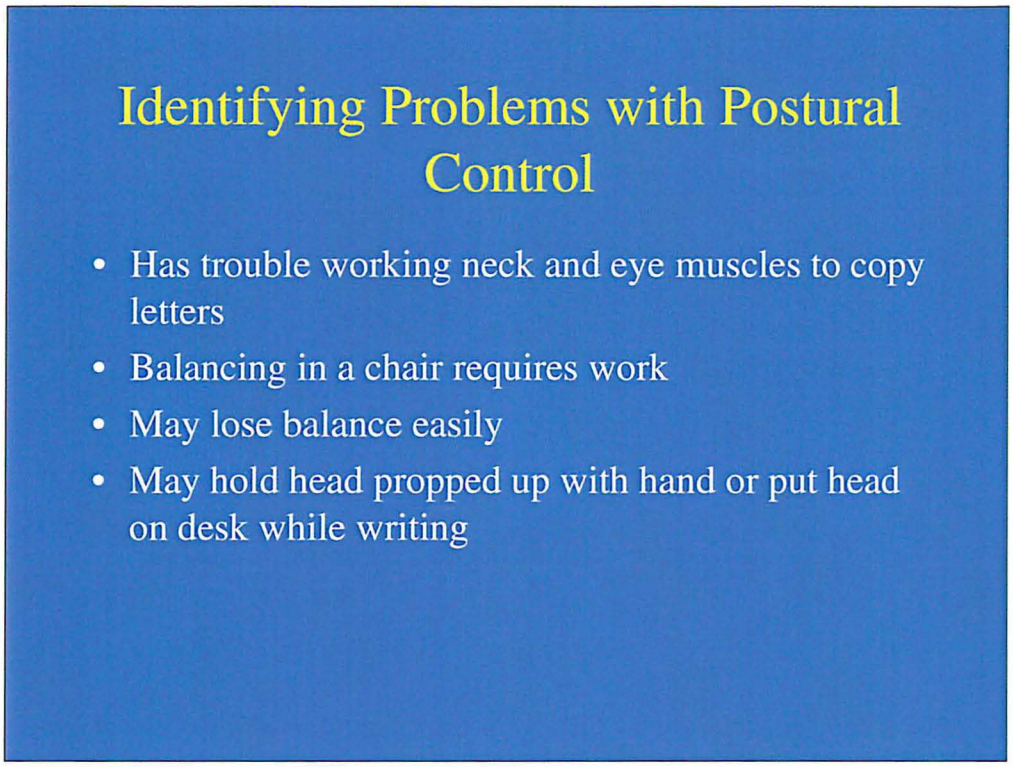
Pass the Can- Gather cans or other heavy objects. Each row gets a box of cans to begin with. Kids stand sideways. Grab the cans with both hands from the right and pass with both hands to the left. Doesn't have to be excessively heavy. Kind of like a sandbagging operation. Last kid in the row can bring them to a back table, counter or box and replace them or build a pyramid, etc.



Use of the hands begins at the shoulders. Control throughout the shoulder girdle (proximal stability) is necessary to provide a stable base of support from which the arms and hands can function. Children must be sensitive to how their bodies are positioned and be able to make minute adjustments. The muscles in the front and the back of the trunk are needed to maintain the trunk in erect alignment with gravity. Students who have difficulty with postural control and balance. If a student is unable to maintain an erect upright posture, there is a disadvantage for the shoulder, eyes and hands to work together efficiently for handwriting (Benbow, 1990; Benbow et al. 1992; Vreeland, 1998 as cited by Pape & Reba, 2004).

The vestibular system is key here: It is your sense of movement. This system helps with posture, balance and motor control, spatial awareness and a stable visual field

It also, helps regulate attention and puts the child in a calm or alert state.



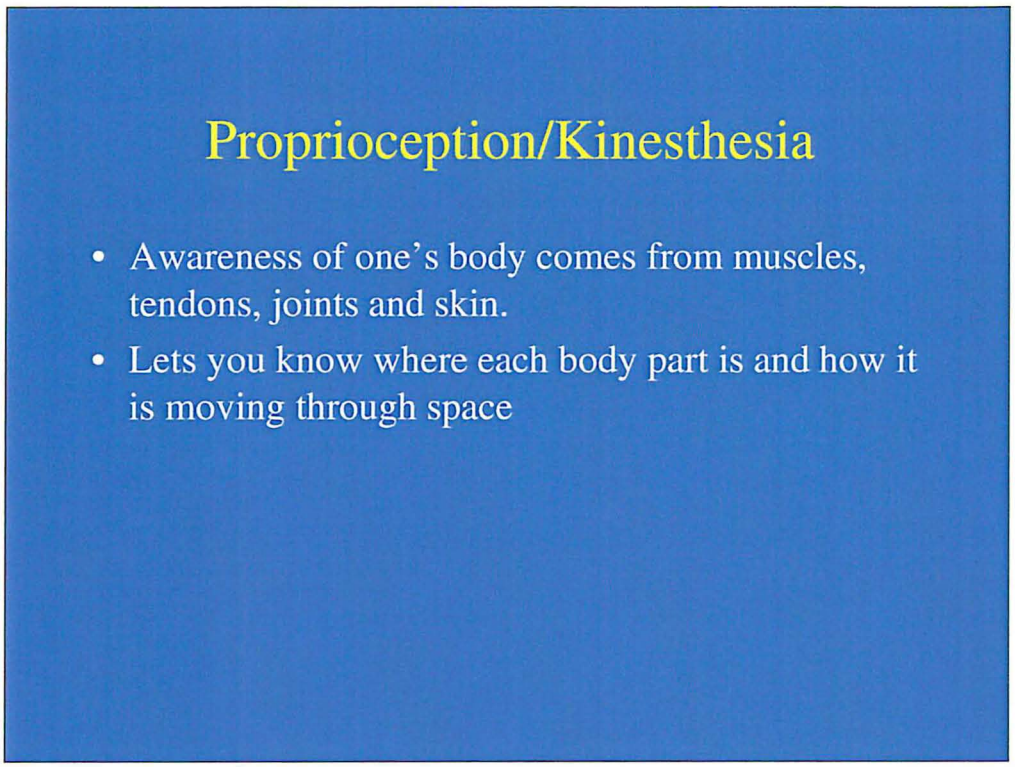
These are the kids who fall out of their chairs. May appear clumsy.

May prop their hands on their heads to support it.

Have difficulty in adjusting themselves at their desk.

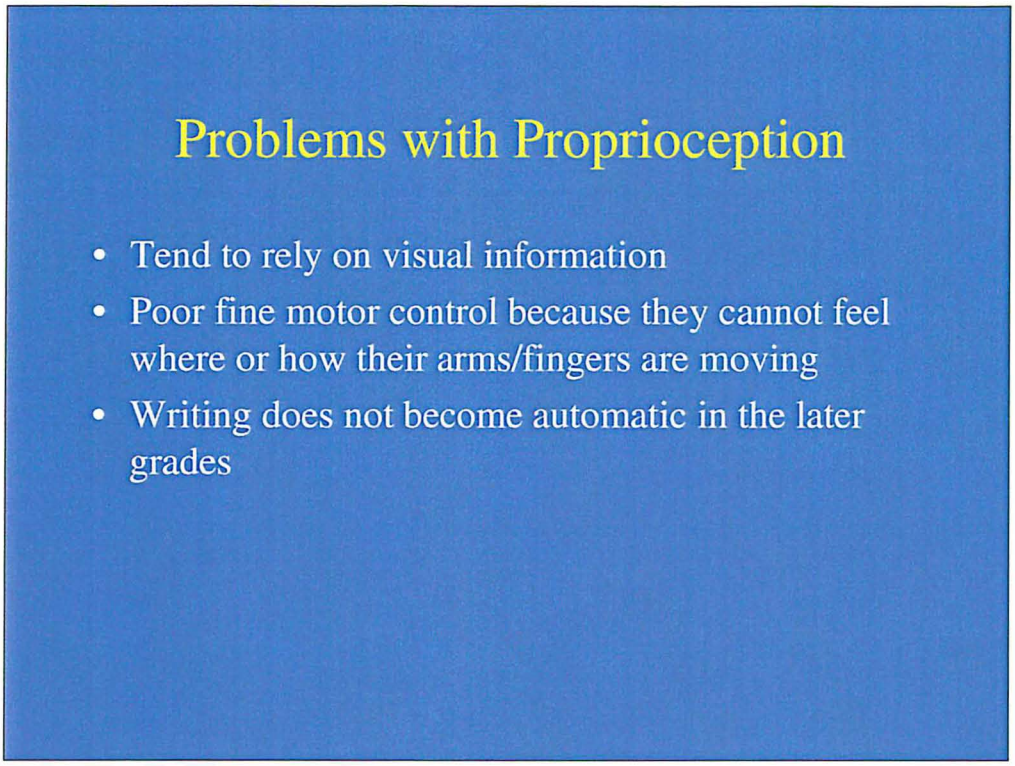
How to help with Postural Control

Properly fitted furniture is essential in developing postural control



The proprioceptive system gives information about the stationary position of the limbs (limb position sense) and movements of the limbs (kinesthesia). It helps to let you know where your body is in relation to the writing surface, desk, or chalkboard.

A study by Schneck 1991, found that students with good kinesthetic finger awareness used a more mature pencil grip than students who did not.



What does a child who has poor proprioception look like?

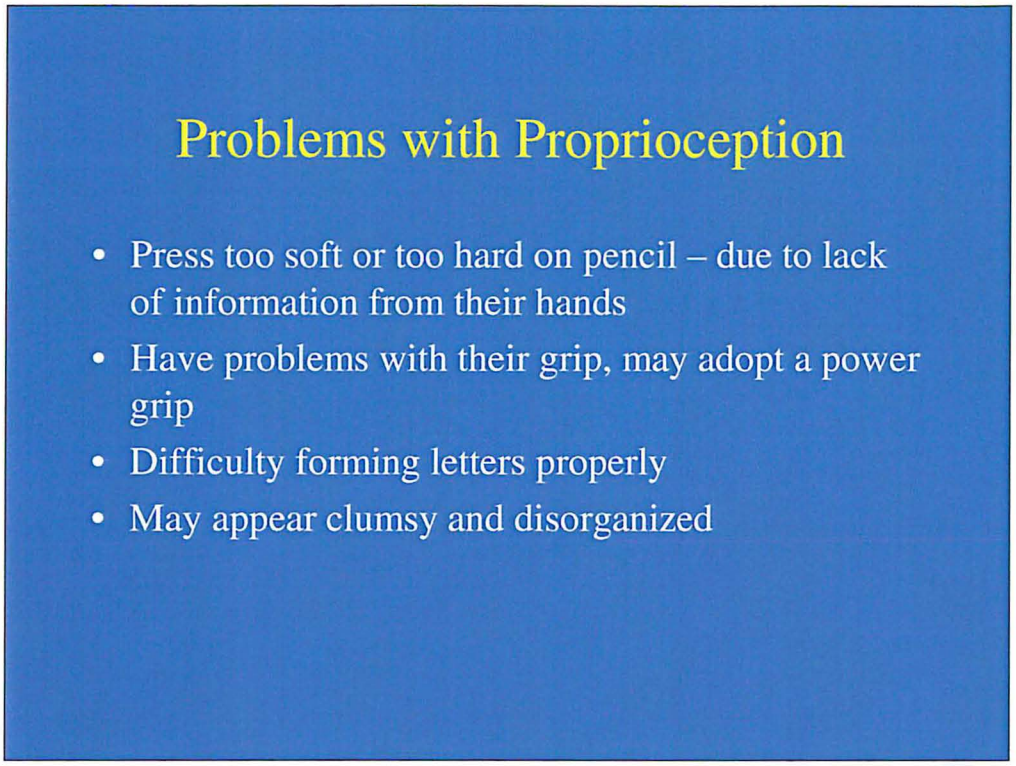
Tend to rely on visual information – because their proprioceptive system is not giving them enough feedback. The child will need to continually monitor their own hand movements.

Poor fine motor control because they cannot feel where or how their arms/fingers are moving

Initially – the child will need to look at how he is forming every letter in the early grades – but then prop/kinesthetic input will take over and the child will be able to pick up the speed with what they are doing.

ACTIVITY: ** Close your eyes: Can you tell exactly where your arms are right now? Can you tell how your legs are positioned?

Pick a partner: One person closes their eyes. The partner takes one arm and positions it in a unique fashion, make sure you move shoulder joint, elbow joint, wrist, thumb and fingers. The player (with closed eyes) is to position the other arm in the mirror image of the first arm moved.

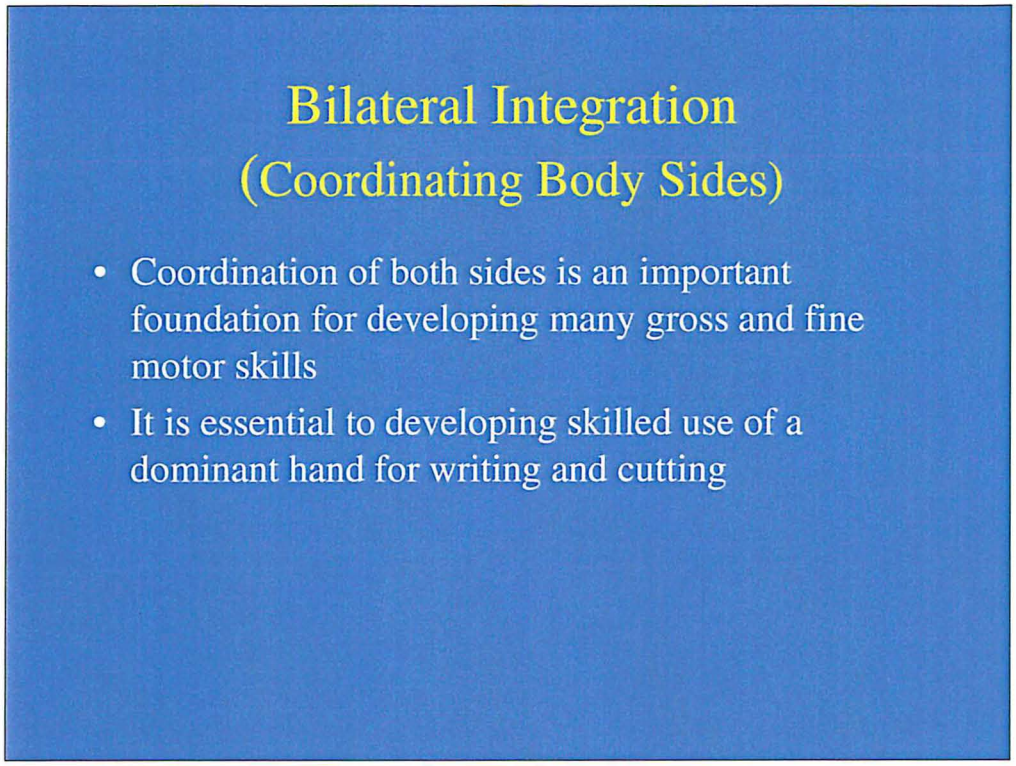


Press too soft or too hard on pencil – due to lack of information from their hands. This is the child who continually is up at the pencil sharpener because he keeps breaking his pencil tip. Is this child frustrated?

Have problems with their grip, may adopt a power grip, with thumb wrapped over fingers

Difficulty forming letters properly

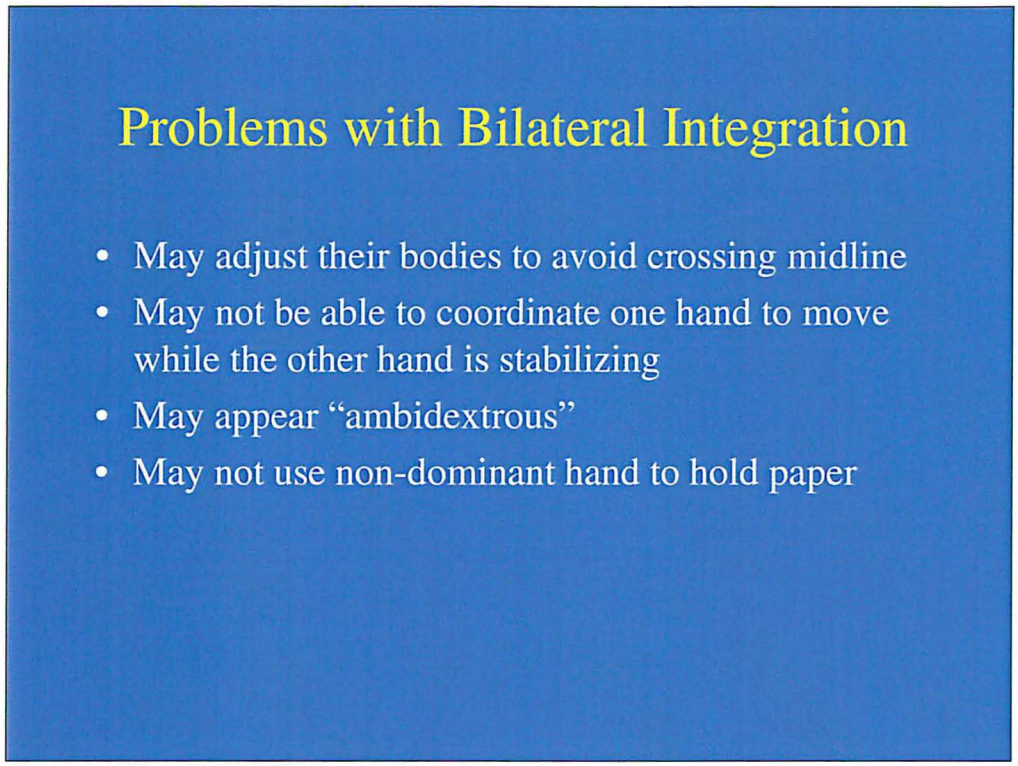
May appear clumsy and disorganized



Both sides of the brain are working well (strong indicator of maturation of the cerebral hemispheres) when you can coordinate both sides of the body and share information efficiently

Crossing Midline and Bilateral Coordination: A child needs to have good bilateral coordination when writing. One hand is used for manipulating the writing implement and the other hand is needed to stabilize the paper. As the child writes across the paper, he will cross midline. Children who struggle within this area may write with their left hand when they are writing on the left side of the page and when they get to midline they will switch hands and use their right hand to finish the line.

By the time most peers are doing well in the graphic motor area, a child with bilateral integration dysfunction is still using their hands interchangeably to do far less complex activities. The child is unable to change stroke direction in a continuous flow pattern. When writing the following letters in cursive (h, k, b, f, and l), it is almost impossible for the child to make the transition (Benbow, 2006).



What does a child who is having difficulty with bilateral integration look like?

Children may adjust their bodies to avoid crossing midline. May look like they are sitting awkwardly in their seat.

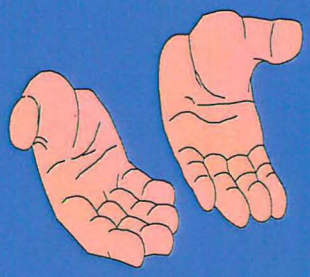
May not be able to coordinate one hand to move while the other hand is stabilizing

May appear ambidextrous because they are delayed in developing a dominant hand, may switch hands during a fine motor task

May not use non-dominant hand to hold paper

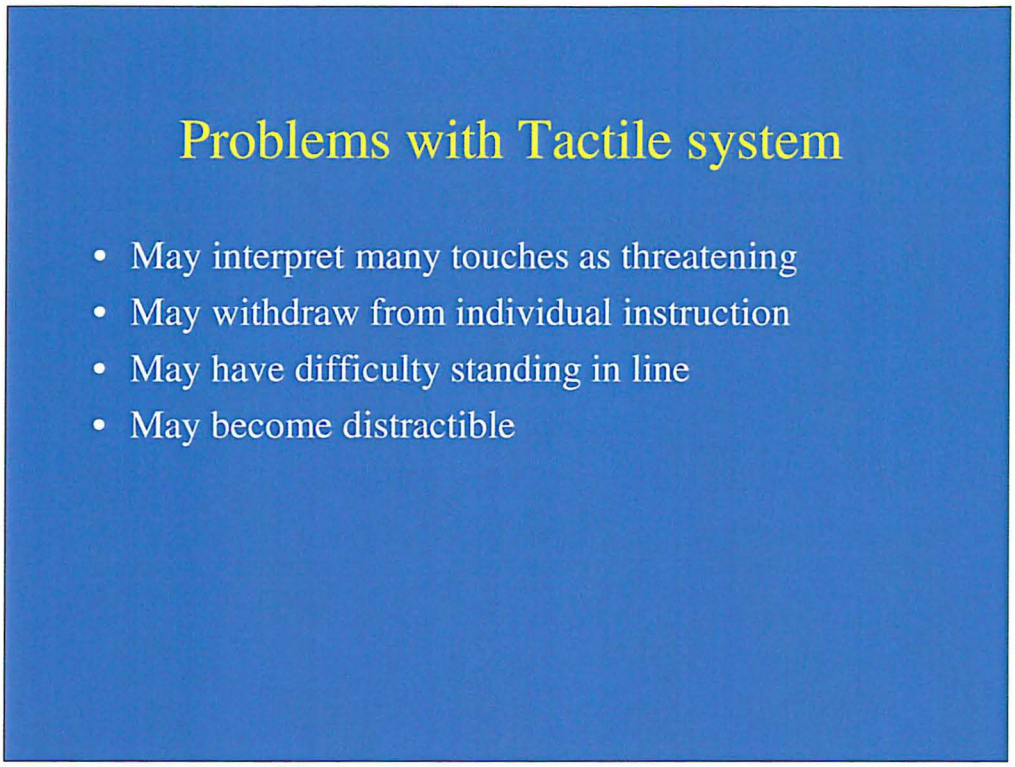
Tactile (Touch Perception)

- Two-fold system
- Protective system – defends itself from harm
- Discriminative system – provides brain with information regarding size, shape, and texture of objects without vision



ACTIVITY: ** Three brown bags each filled with something different. I.e. key, comb, coffee mug or empty plastic bottle.

Hand to three participants. Ask them to identify objects without looking in bags. After all three have given you the correct answers, reinforce that they were using their tactile – discriminative system.



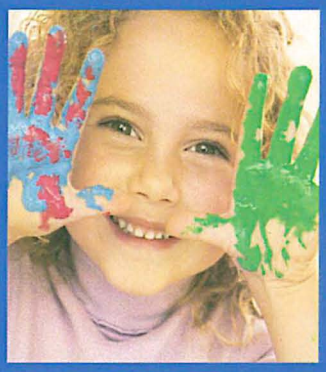
May withdraw from individual instruction: Particularly if teacher stands behind and leans over student's shoulder, tries to adjust grip for child or tries to move student's hand unexpectedly.

May have difficulty standing in line: May push and shove other kids, not to be mean, but may be reacting to sudden, unexpected touch.

Distractible: Too much input coming into the student's system at once.

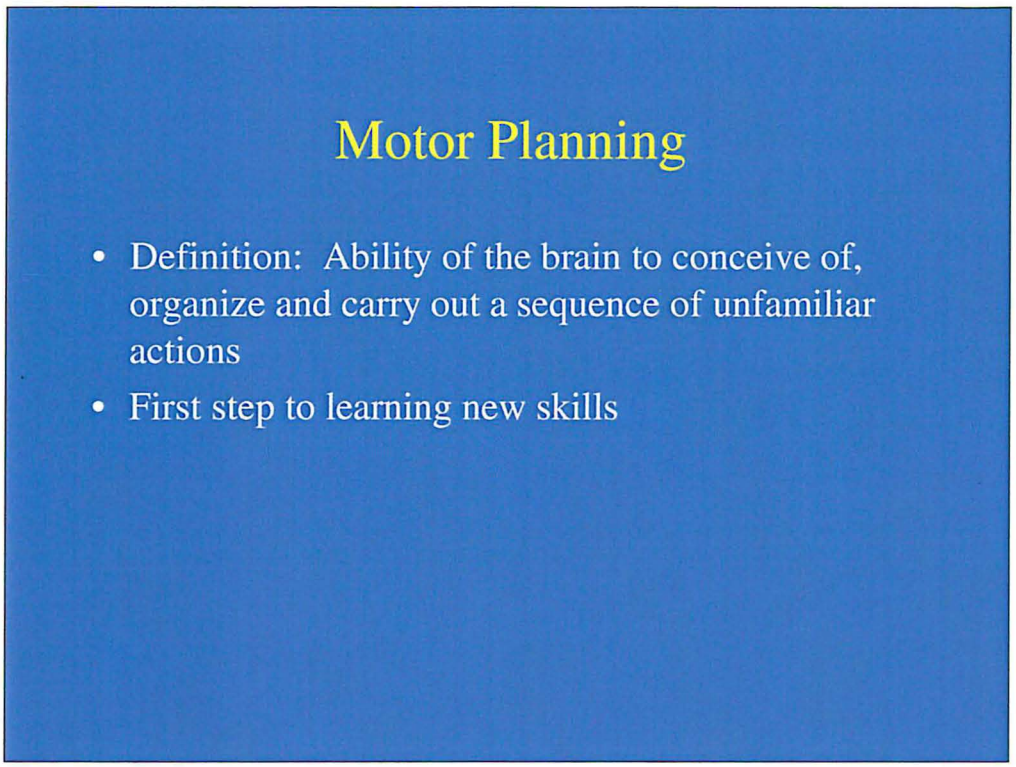
Problems with Tactile System

- Have trouble with certain types of clothing
- May dislike getting dirty or touching fingerpaints
- May have difficulty manipulating tools, holding a pencil or forming letters correctly



May have difficulty with food textures.

These kids may be seen as behavior problems if the teacher does not recognize tactile issues.

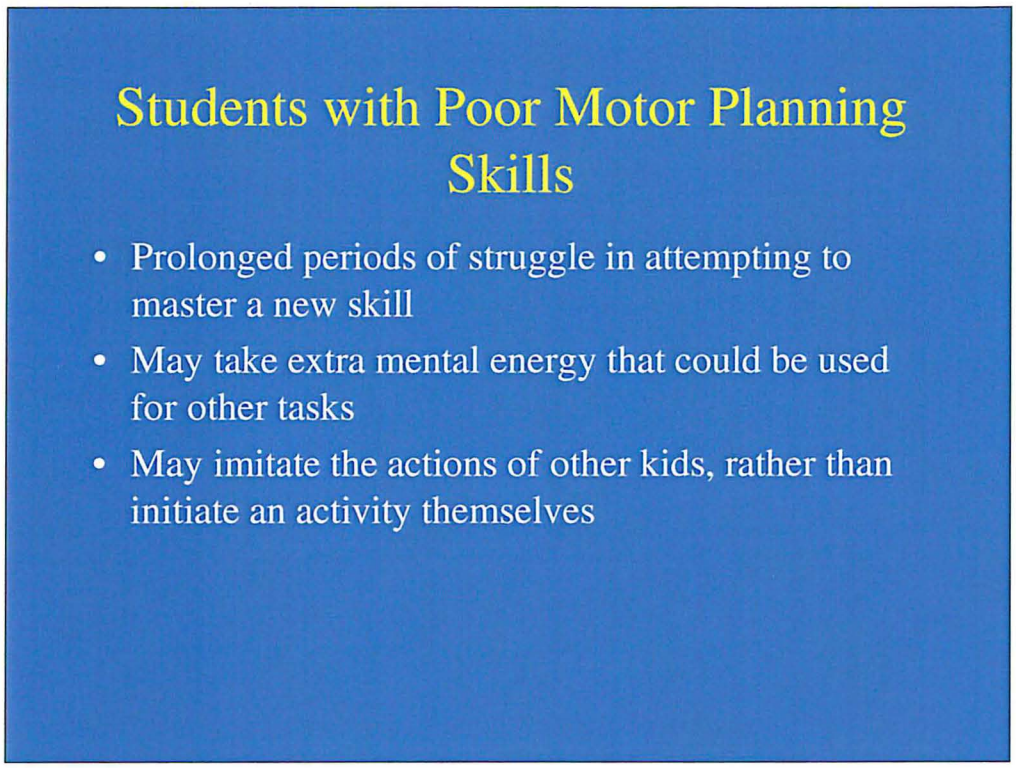


ACTIVITY: Chinese handwriting as a new motor planning activity

Motor Planning

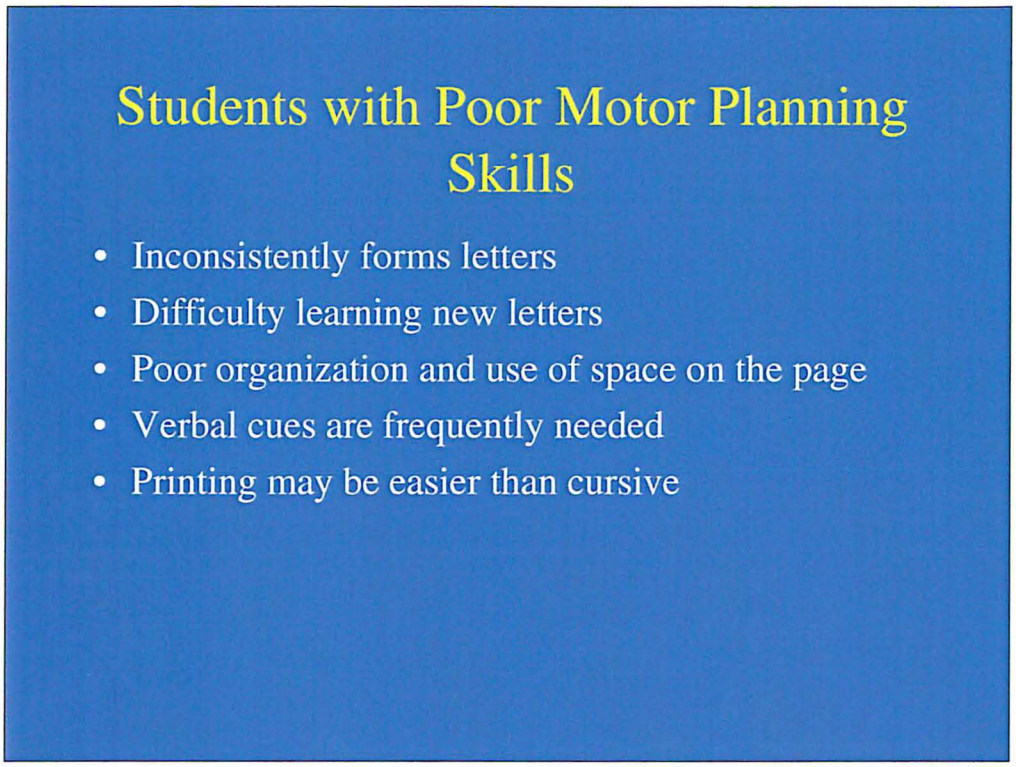
Two steps-

1. Formulating an ideomotor plan of what one intends to do
2. Able to formulate the plan, but difficulty in carrying out the steps of the plan



Has been shown through several studies to be one of the factors related to poor handwriting.

Handwriting is a skilled motor act.



Inconsistently forms letters, even for the same letter within a word or paragraph

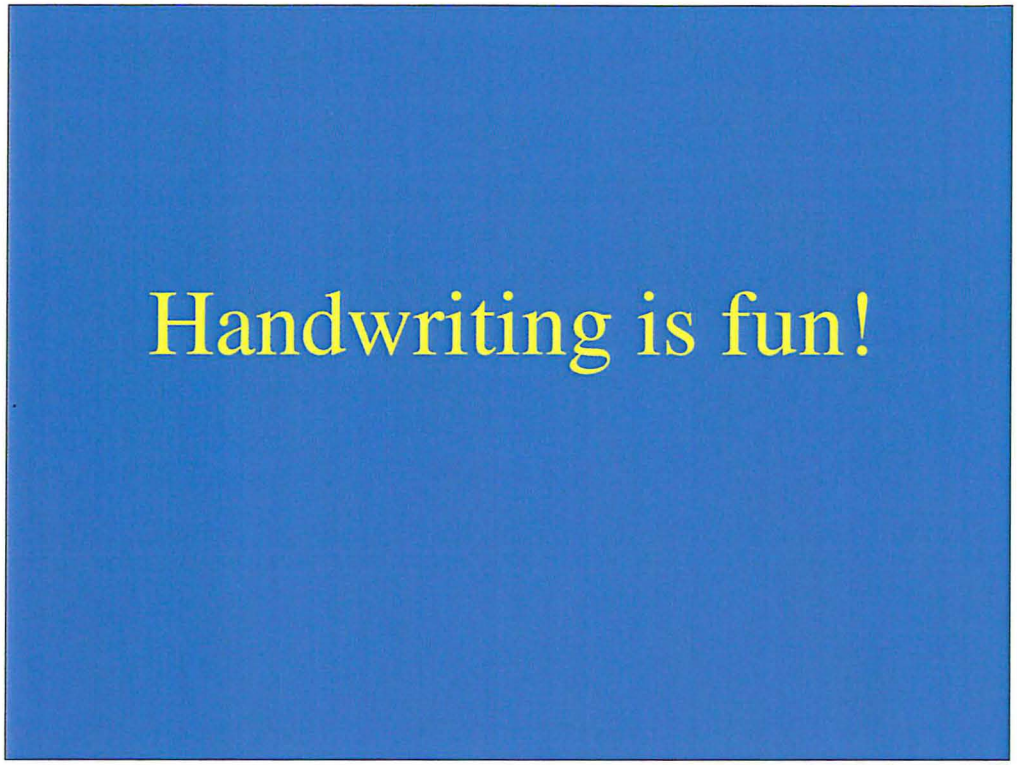
Difficulty learning new letters, or resistance to learning cursive or using paper with different lines

Poor organization and use of space on the page

Verbal cues are frequently needed

Printing may be easier than cursive – they can take a breather in between letters. Writing will still be slow and awkward

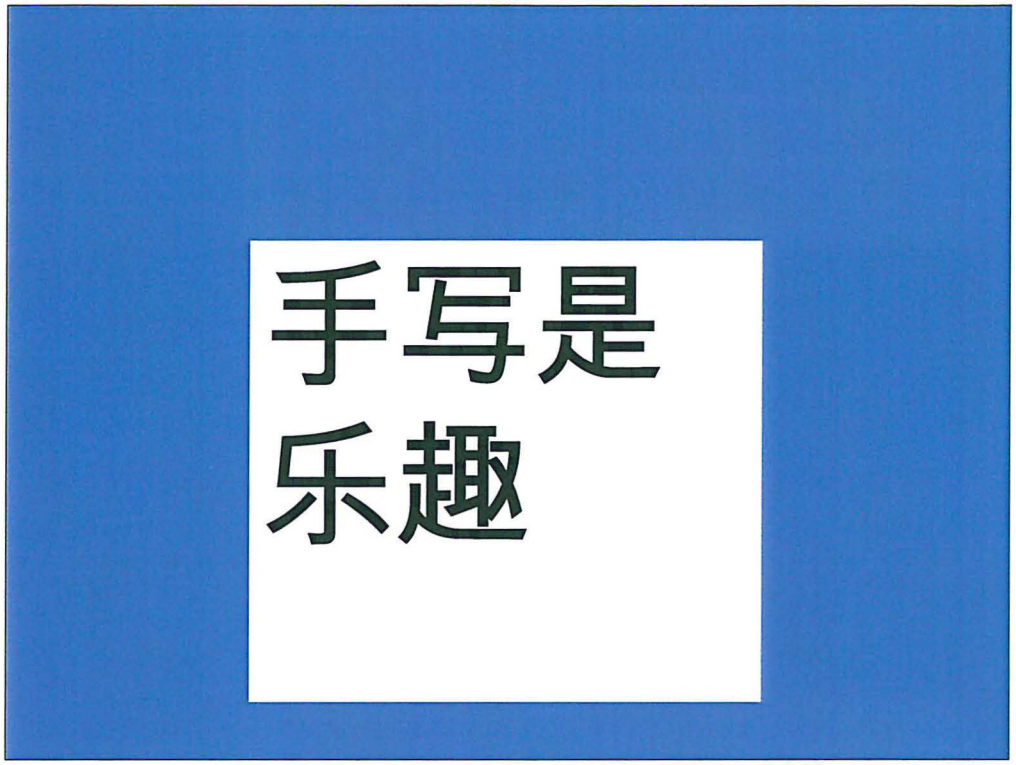
Learning Task: Next slide – Directions: Use dominant hand, regular grip, print the sentence, you will be timed.



Good job!! Averaged 8-10 seconds?

Learning Task: Next slide – Directions: ½ the audience: Use non-dominant hand, ½ the audience use dominant hand

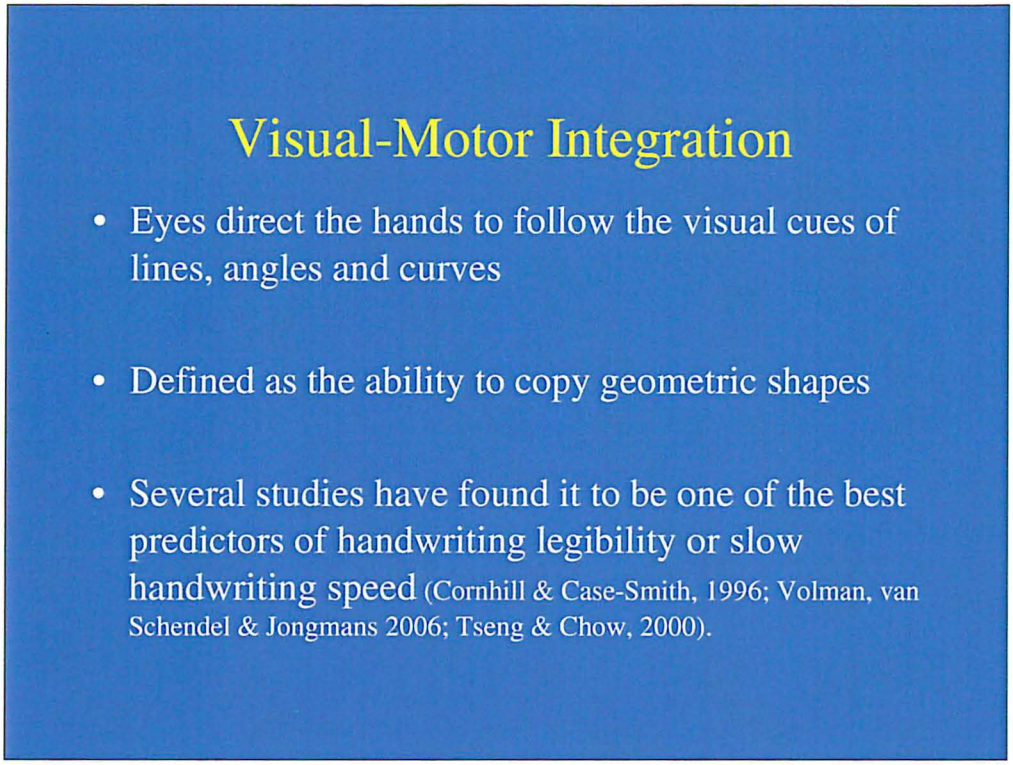
Same sentence, you will be timed.



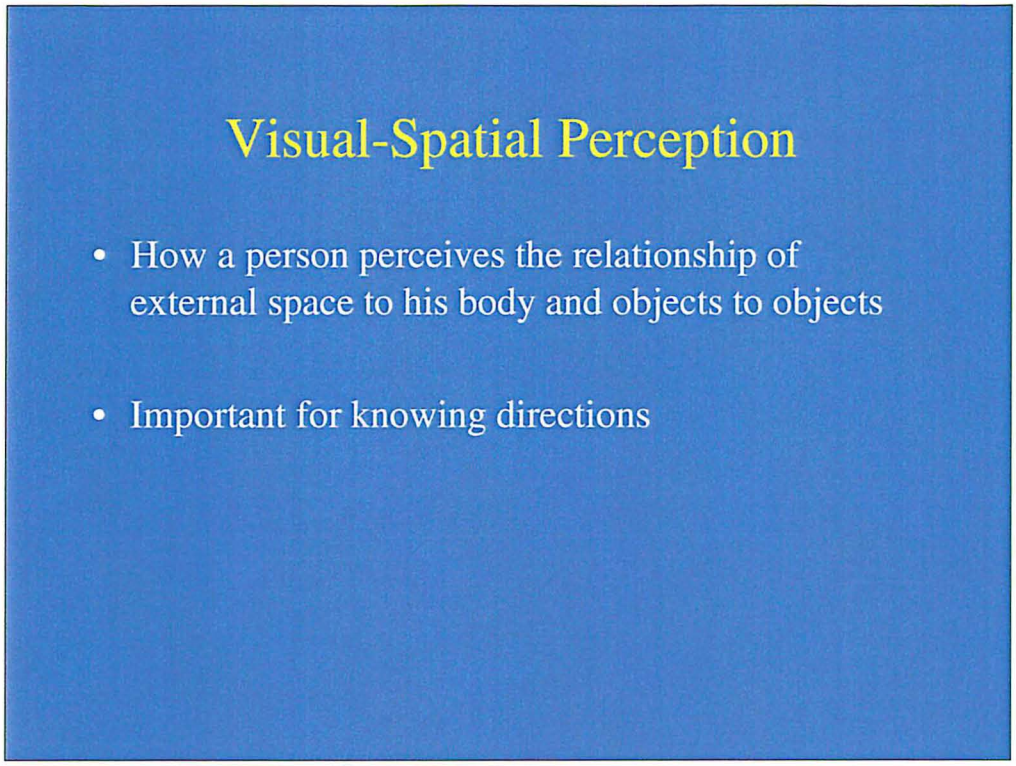
How did that feel?

How many times did you have to look back up to the screen and use your vision to help you?

Over a minute to complete – and how does it look?

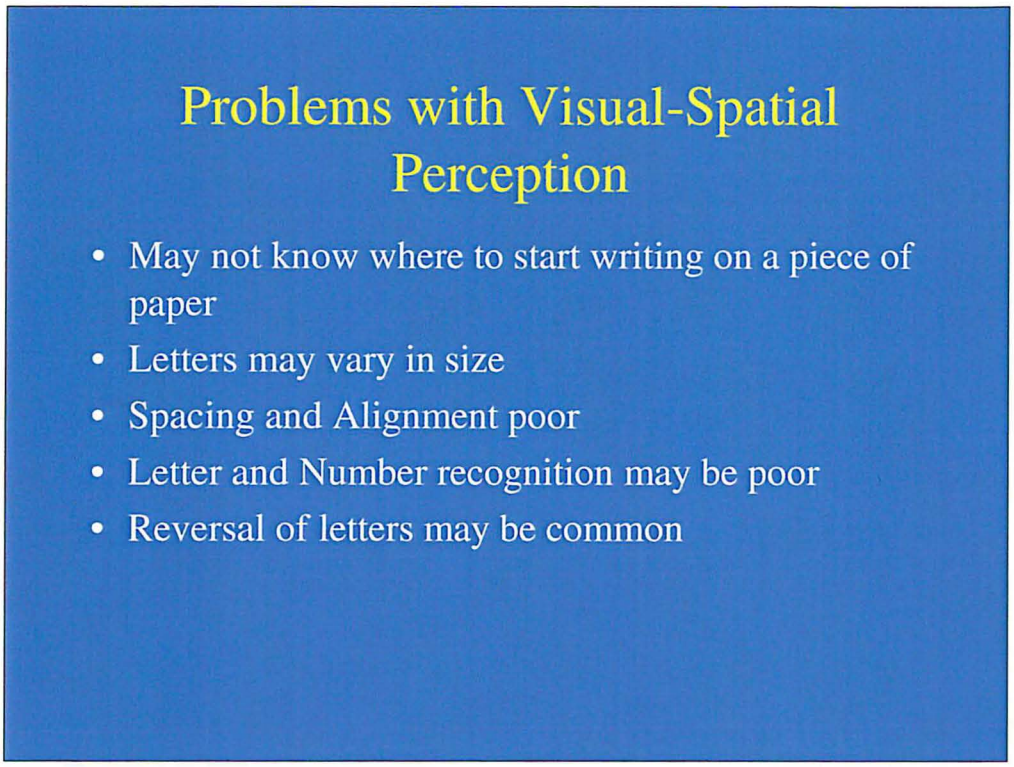


Use of vision is an essential piece as children learn to plan, execute and monitor their handwriting attempts. The reliance on the visual system generally diminishes as the child becomes more skilled in handwriting and feedback from the somatosensory system provides greater feedback (Cornhill & Case-Smith, 1996). A number of researchers have documented a significant relationship between handwriting skills and visual motor control.

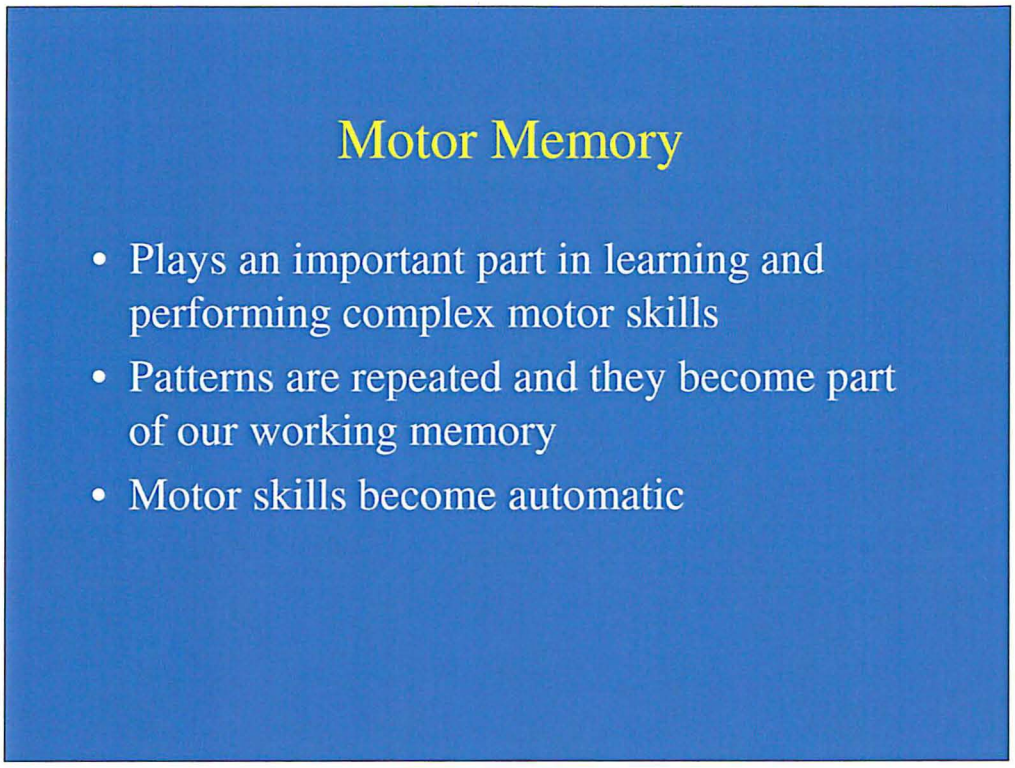


Important for knowing directions-

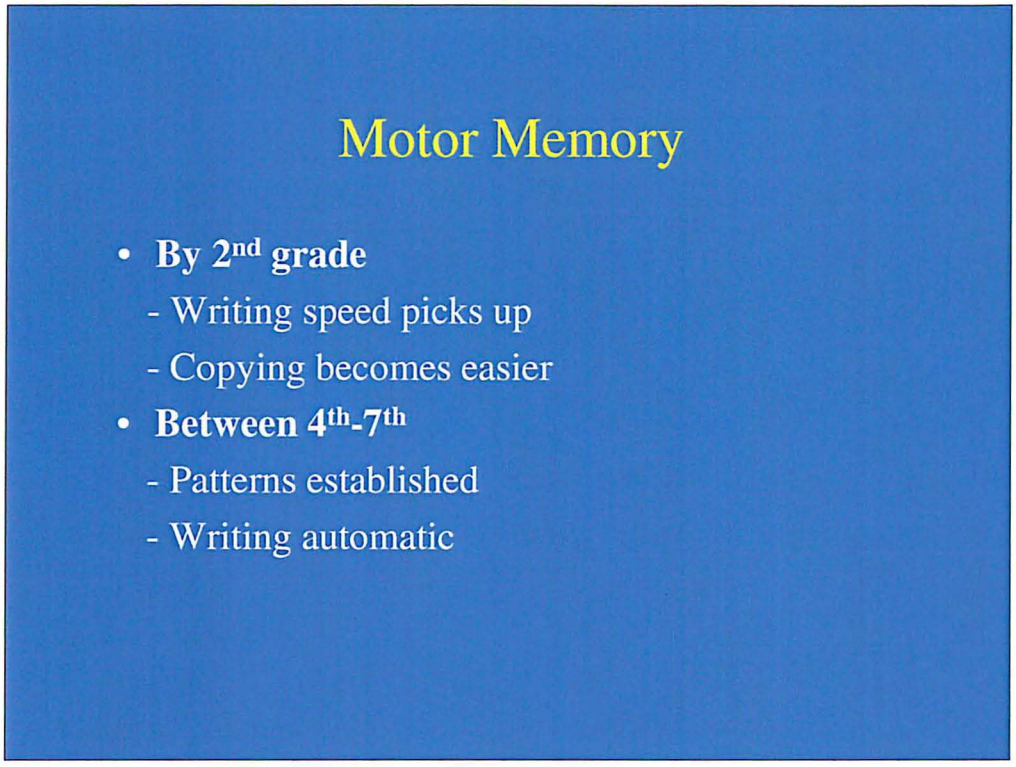
Up, down, learning left and right, higher and lower



In research studies, visual perception has not been found to be a significant predictor in kids struggling with handwriting problems.



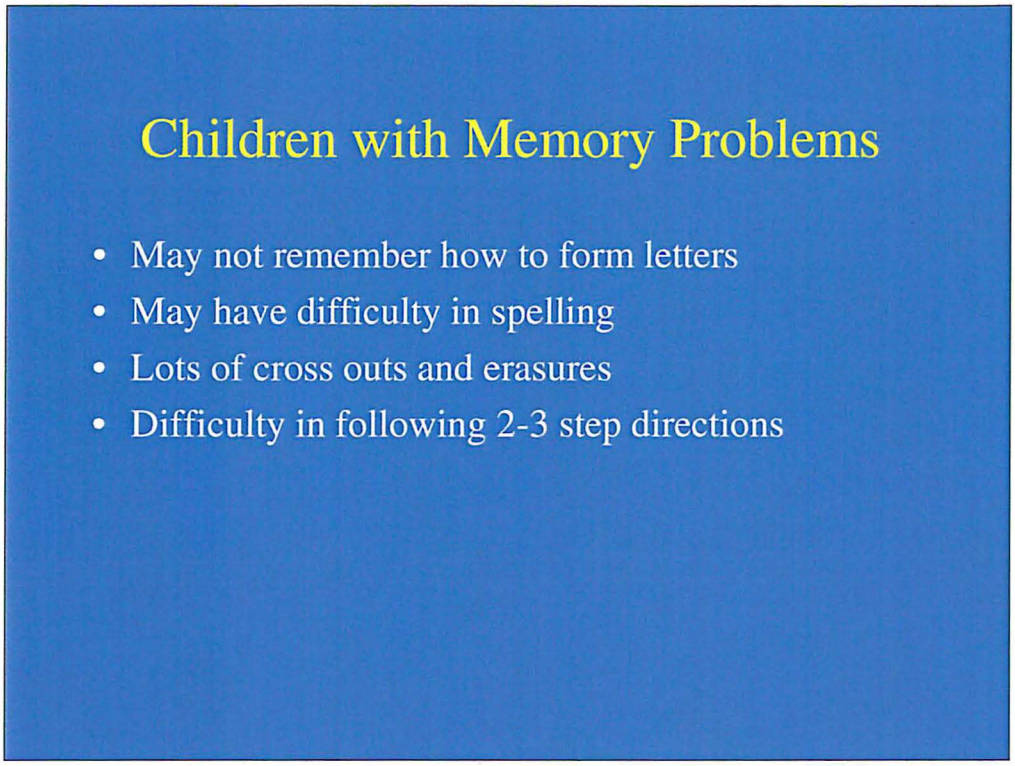
Learning Task: How well can you do the alphabet with your eyes closed? This will test your motor memory. It doesn't have to look great, just try to write the entire alphabet in cursive and connect it all as if it is one word.



In Kindergarten and 1st grade children rely heavily on visual feedback to write letters and place them on lines.

Performance is slow and hesitant.

Discussion: Remember Handwriting is Fun! How many of you can remember how to write it in Chinese? It was



May not remember how to form letters- may form letters several different ways.

May be because of sequencing weakness, poor memory in general

Poor kinesthesthetic memory, difficulty remembering how a sequence of movements feel, so an accurate pattern is not stored in memory – can't retrieve what you don't have.

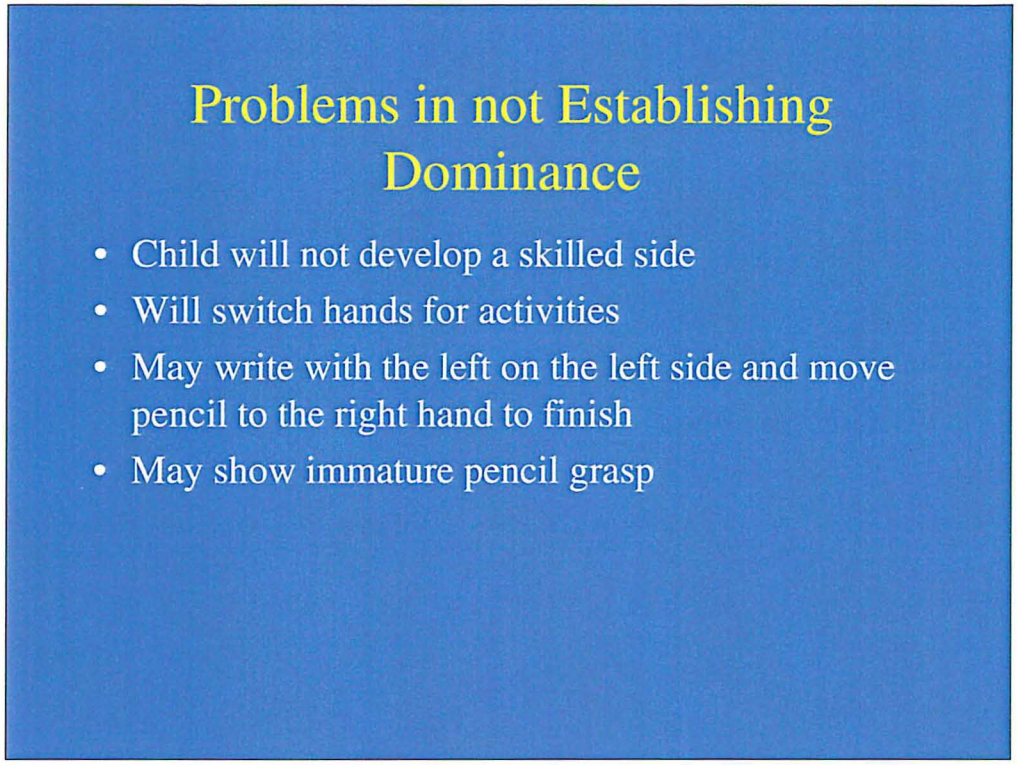
Attentional problems – first step in remembering something is attending to it while it is being taught.

Between 4-6 years, a young child will begin to show a hand preference when playing with toys, using tools and performing fine motor tasks. Some children don't take that long. Some are strongly one hand dominant by 3 years, some not until 7-8 years.

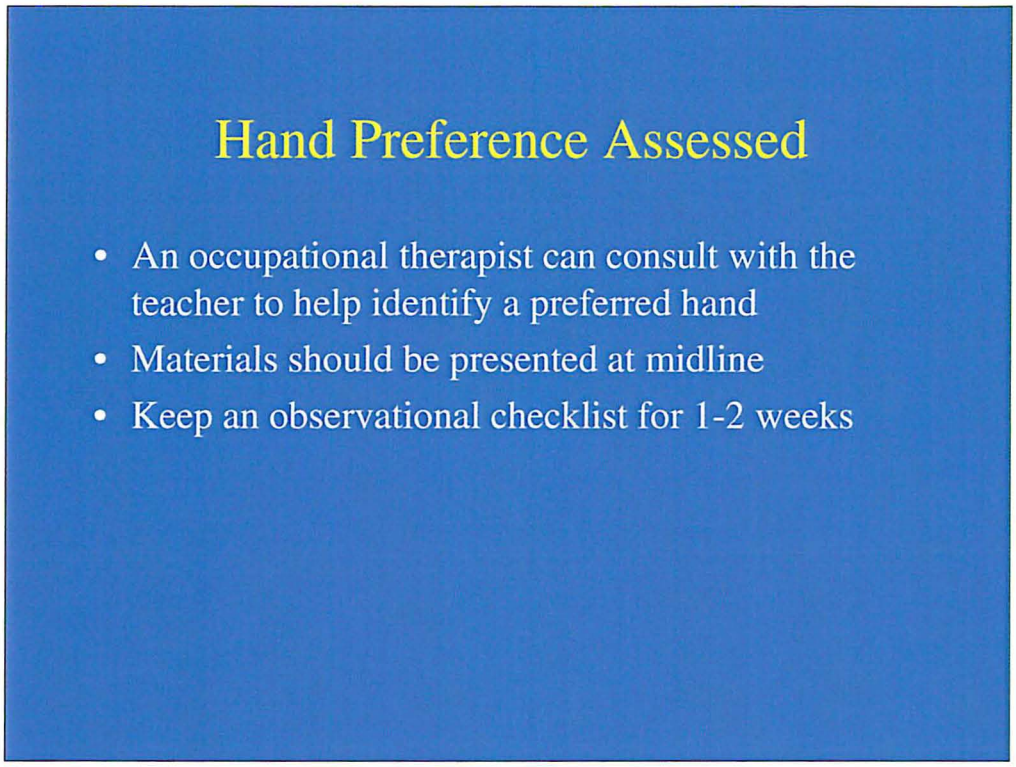
Hand dominance develops as a result of the ability to coordinate the two sides of the body (Pape & Ryba, 2004).

Dominant is used for the finer manipulative tasks

Non-dominant is used for manipulating (turning paper as you cut it), stabilizing (holding paper for writing), and positioning objects.

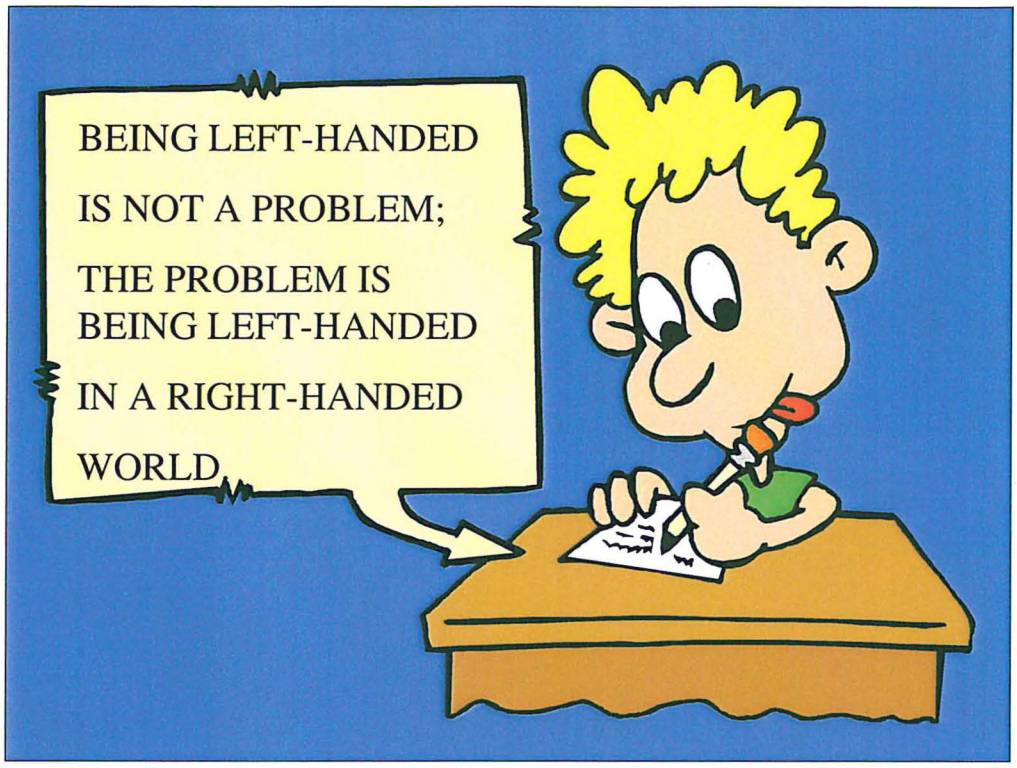


May also cut paper and switch hands while doing it.



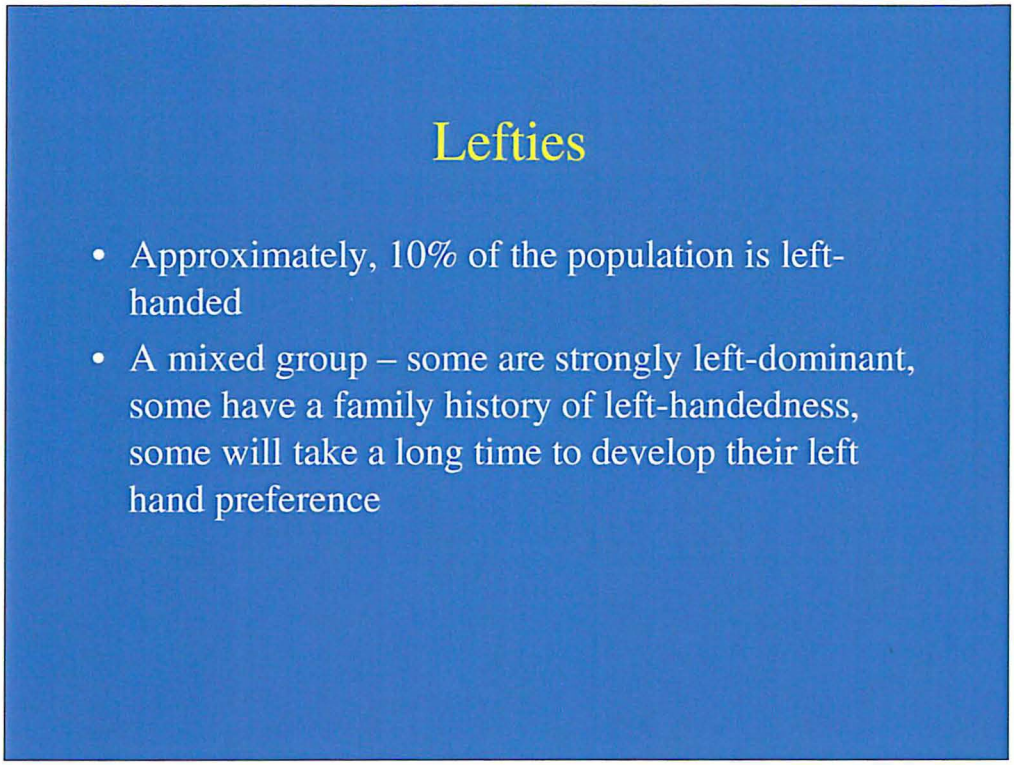
Materials should be presented at midline: This includes silverware!! If dominance hasn't been established, the child will use left hand if spoon is on left side. Many well-meaning individuals have placed items in (the right) hand, hoping they wouldn't use their left. Unless your brain is exactly like the child's brain, you don't know which hand they should be using.

Keep an observational checklist for 1-2 weeks: Teacher and family can watch to see which hand is used for coloring, writing, eating or cutting with scissors, hammering toys, lacing.

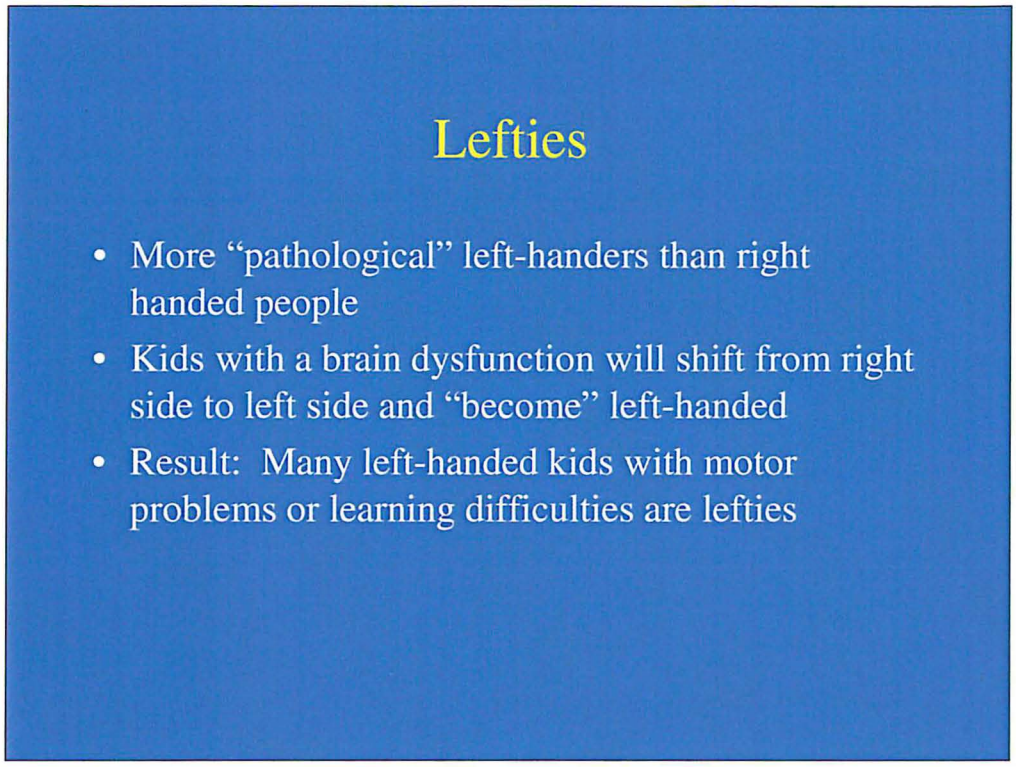


Left handers in general are not the mirror image of right handers.

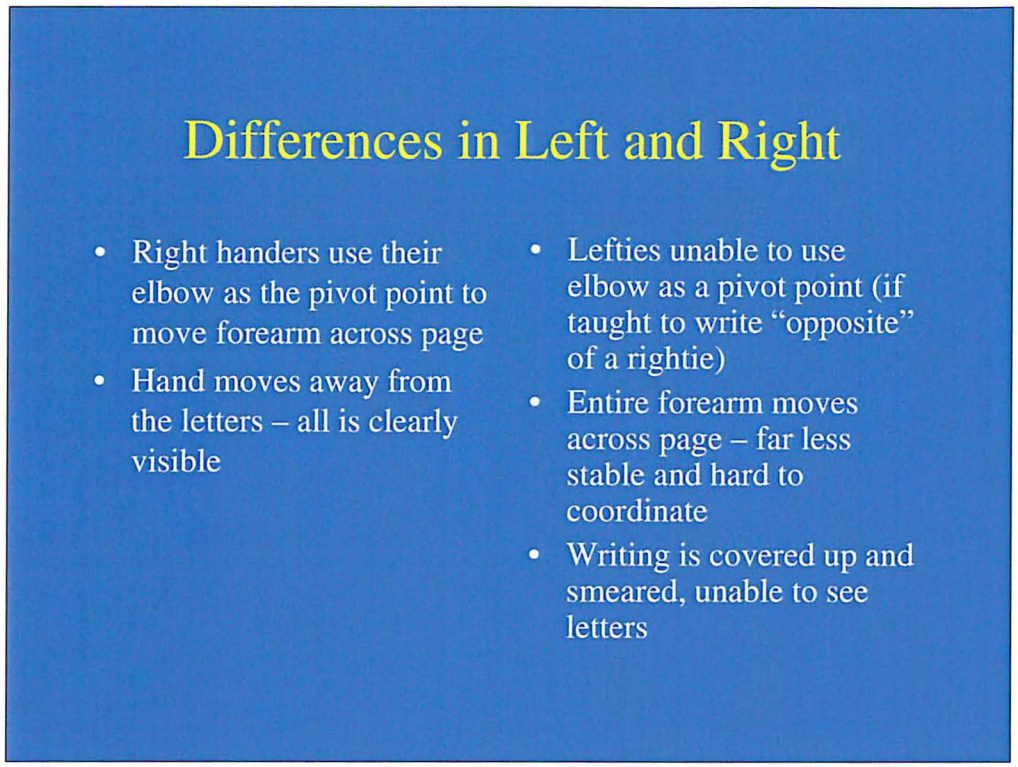
Evidence suggests that left handers, many of them, are less strongly lateralized than right handers.



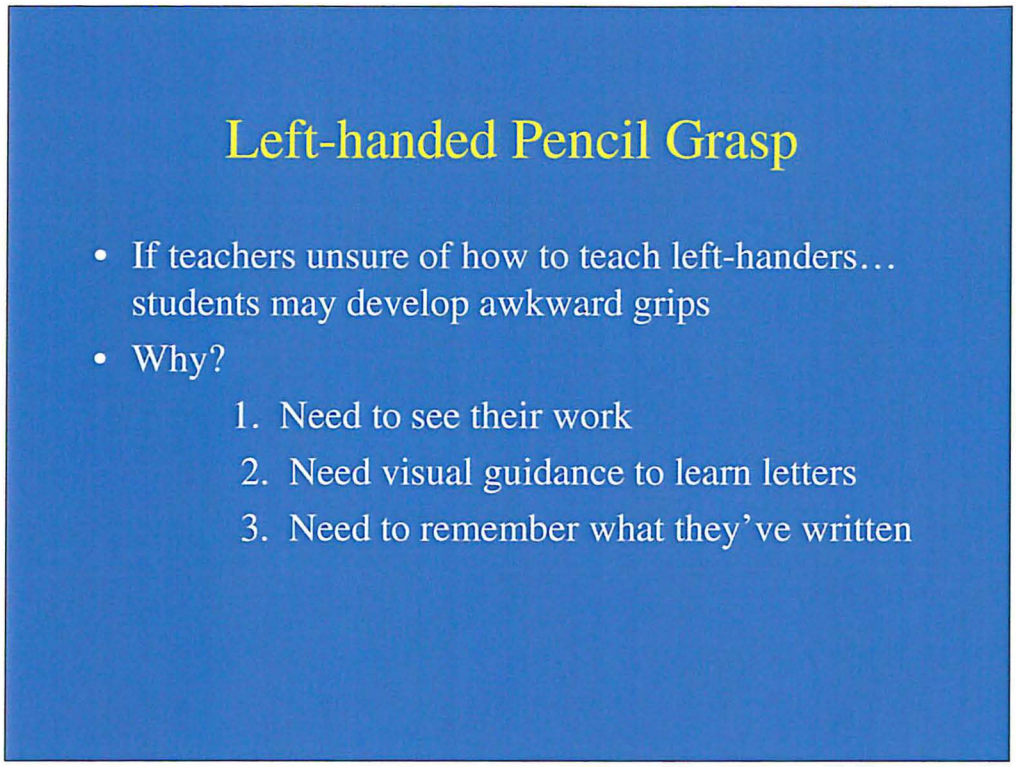
A mixed group – some are strongly left-dominant from an early age, some have a family history of left-handedness, some of the children will take a long time to develop their left hand preference



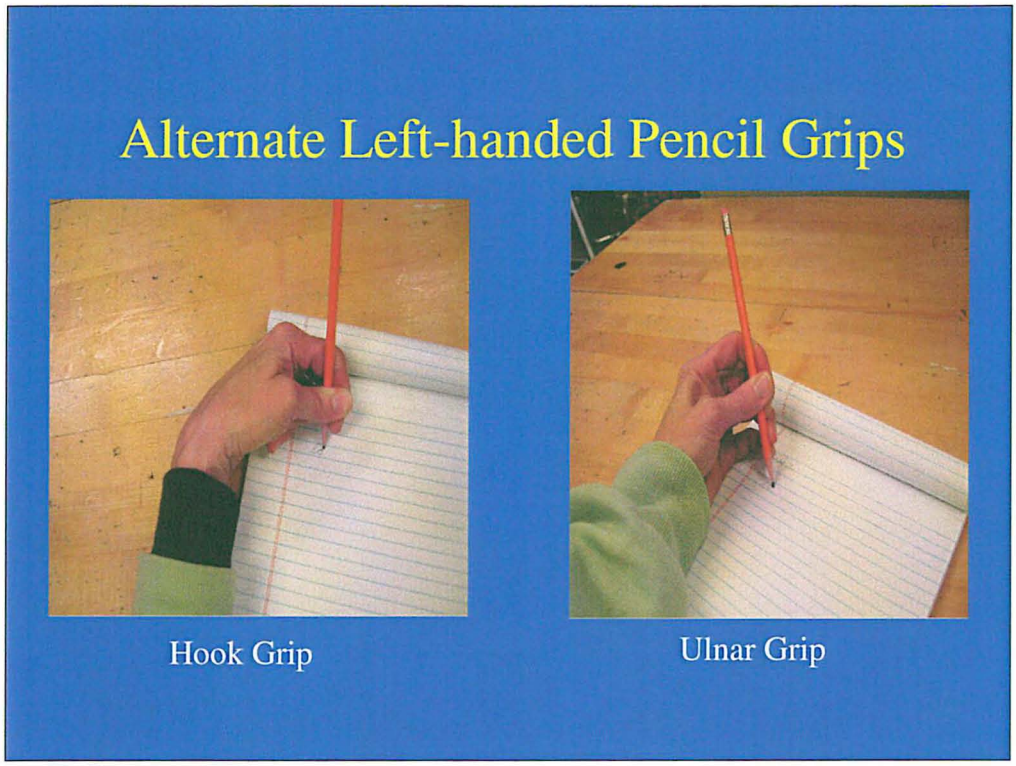
There are more "pathological" left handers than there are pathological right-handers. This means that more left-handed children are naturally right-hand dominant children who choose to use their left hand because, for some reason, the right hand is clumsy. Interference with development or damage to one side of the brain can lead a child to use the non-dominant hand as the dominant hand, because it works better (Levine, 1991). Coren (1993) has done several studies and has come to the conclusion that left-handedness appears to be associated with the presence of certain abnormal or pathological conditions, such as birth or pregnancy difficulties.



Origins aside, it is still important to remember that a left-handed writer will always be in the minority in any classroom and how they learn to write is not simply opposite of a right-handed individual.



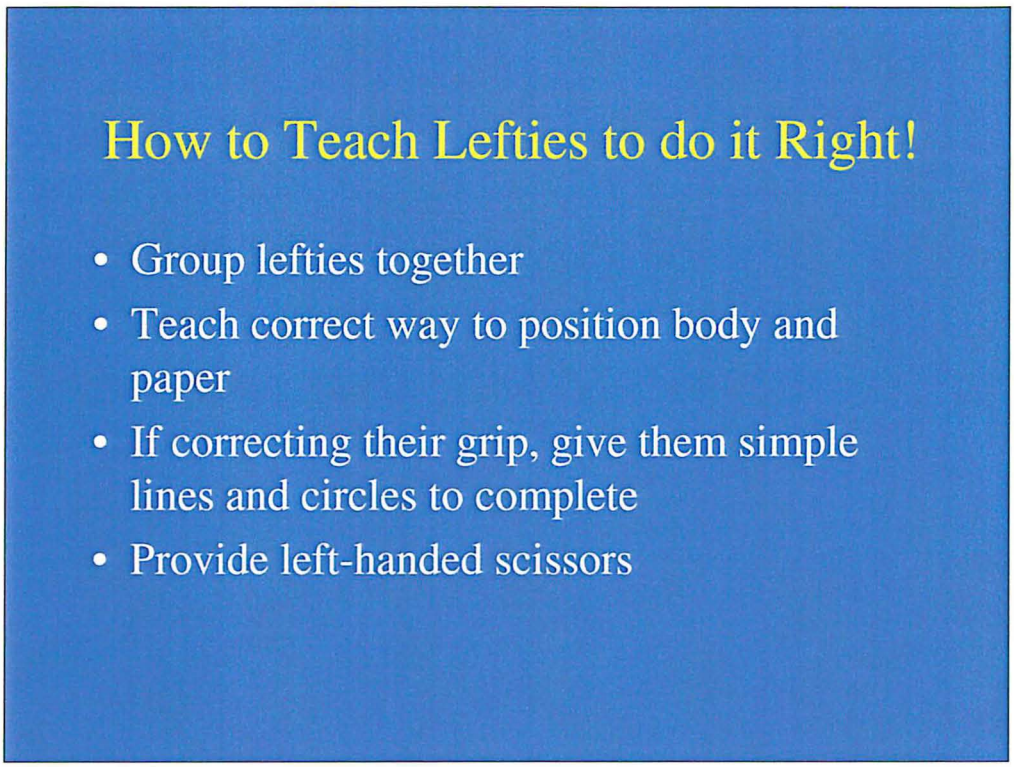
Children need to be given guidelines right from the start on how to position their paper. This will help them to develop a better grip.



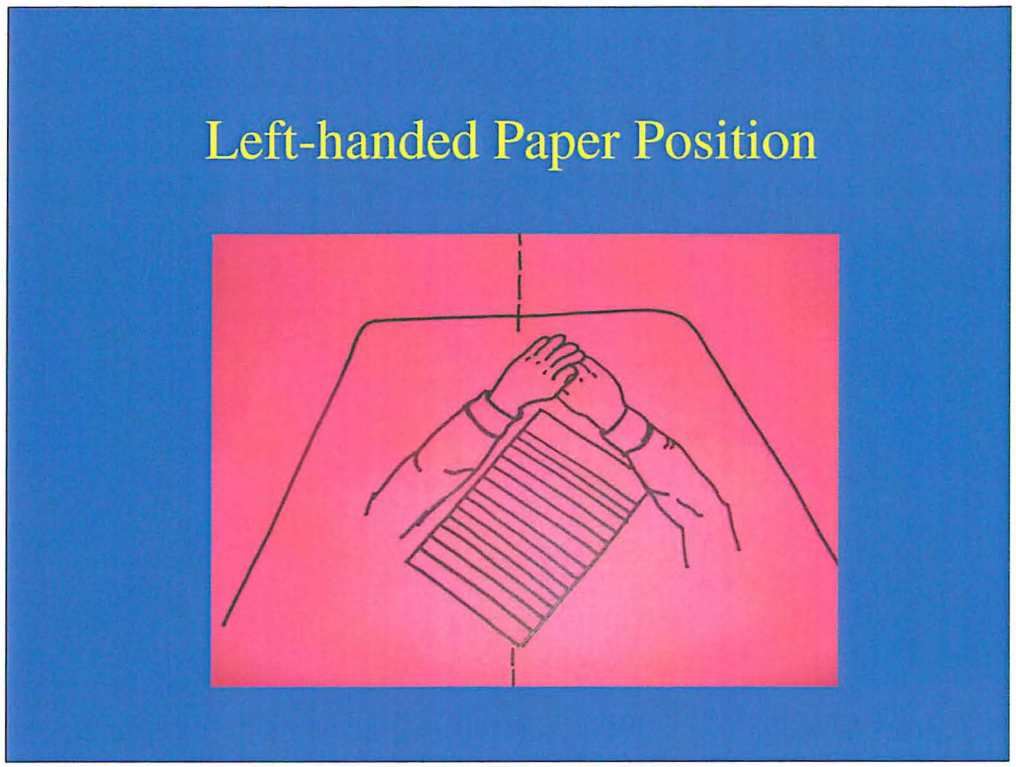
These grips interfere with smooth, controlled movements

Biomechanically, flexing your wrist means you are not able to hold onto objects the same way as when the wrist is in extension. Think about typing with a computer, would you use wrist flexion to that degree for any length of time without repercussions.

Students may use a hook grip to see the words they are writing. An ulnar grip as they push the pencil across the page allows for the same visual advantage.

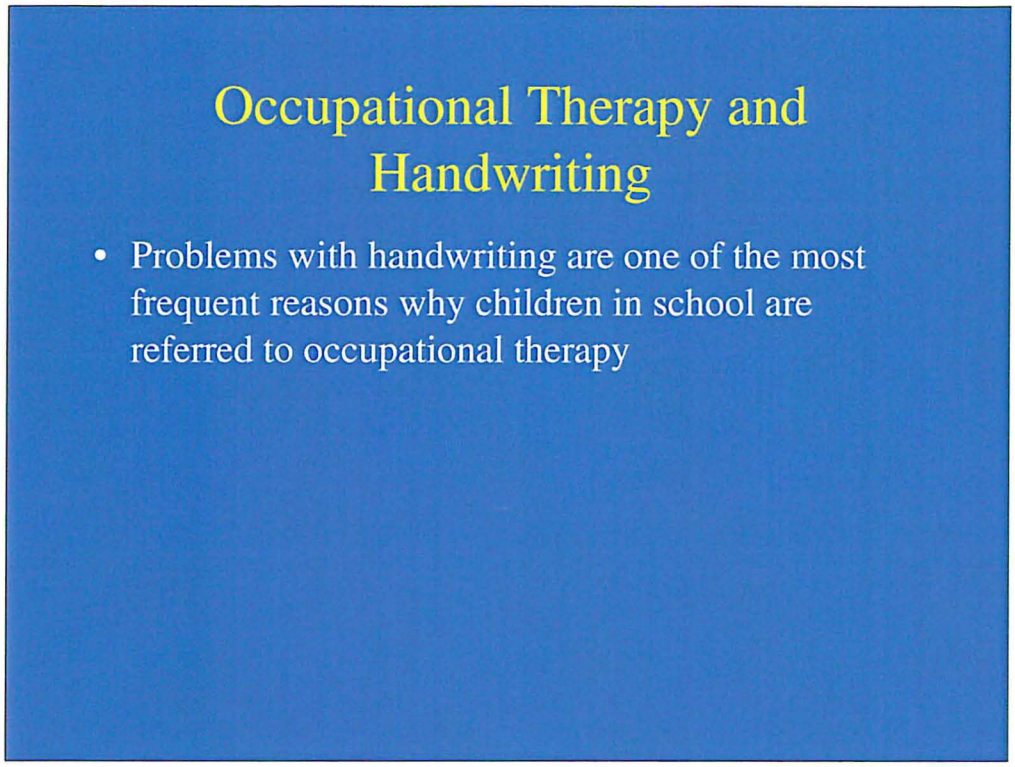


Remember to position the paper in a clockwise direction, slightly to the right of center.

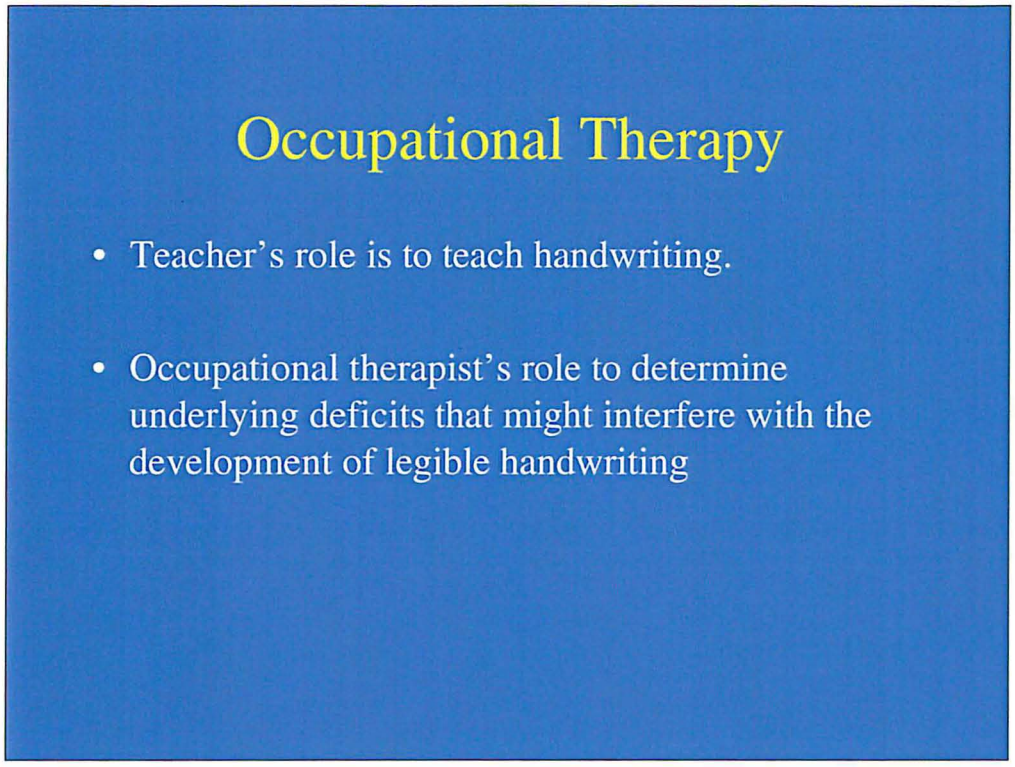


Note the dotted lines in the middle. Left handers should slant their papers clockwise about 30-35 degrees. This will allow them to move their writing hand below the line they are writing on.

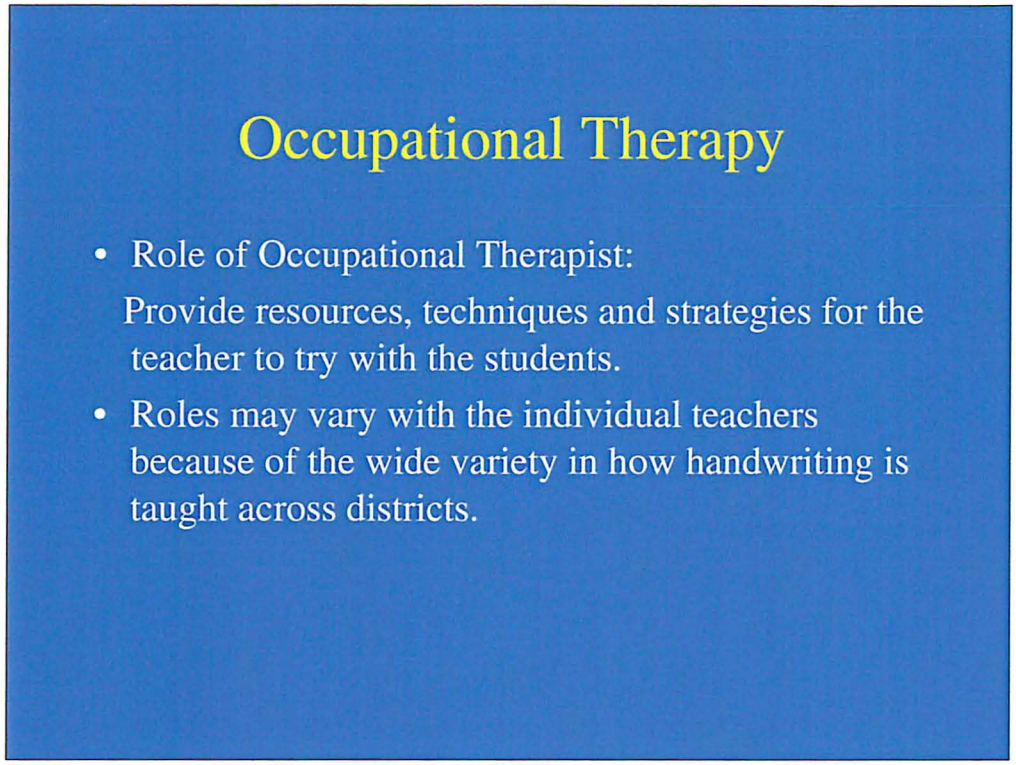
This position can be taped onto desks with young left handed kids as they learn how to position their papers.



A study conducted by Case-Smith (2002) investigated the effects of school-based occupational therapy services to see if intervention was effective. The study examined a control group of students with poor handwriting who did not receive occupational therapy services with a group of students with poor handwriting who did receive occupational therapy services. Handwriting legibility, speed and other associated handwriting components were examined. Forty-four elementary students in 2nd through 4th grades were recruited for this study. 31 were receiving occupational therapy intervention and 13 were not. Students who received services improved in overall letter legibility but did not improve in numeral legibility and handwriting speed.



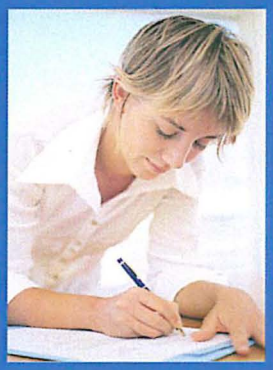
It is the teacher's role to teach handwriting. It is the occupational therapist's role to determine **underlying postural, motor, sensory integrative, or perceptual deficits** that might interfere with the development of legible handwriting .



It is the teacher's role to teach handwriting. It is the occupational therapist's role to determine **underlying postural, motor, sensory integrative, or perceptual deficits** that might interfere with the development of legible handwriting .

Summary

- Handwriting is a complex process
- There are multiple components involved in learning how to write and handwriting problems may not arise from the same problem areas

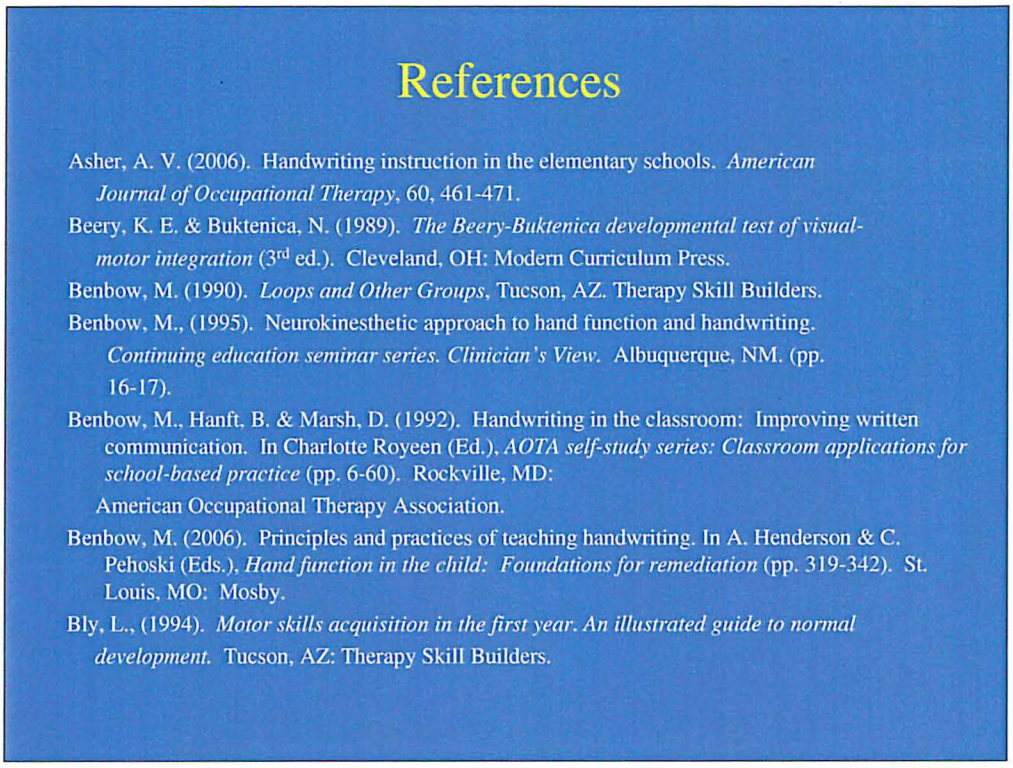


Common handwriting problems, such as, **incorrect letter formation, poor alignment, reversals, uneven size of letters, irregular spacing between letters and words, and slow motor speed** may not arise from the same underlying mechanism

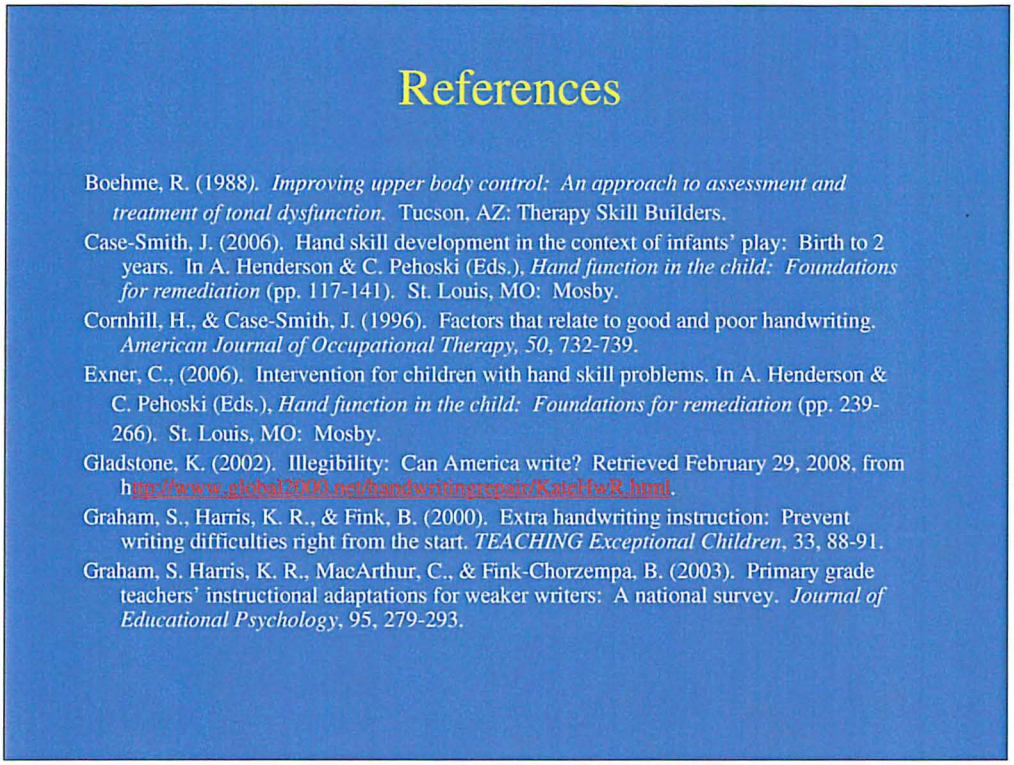
Summary

- Instructors can implement a number of things within a classroom to assist the child in developing skills for handwriting
- When handwriting problems cannot be solved partner with an occupational therapist

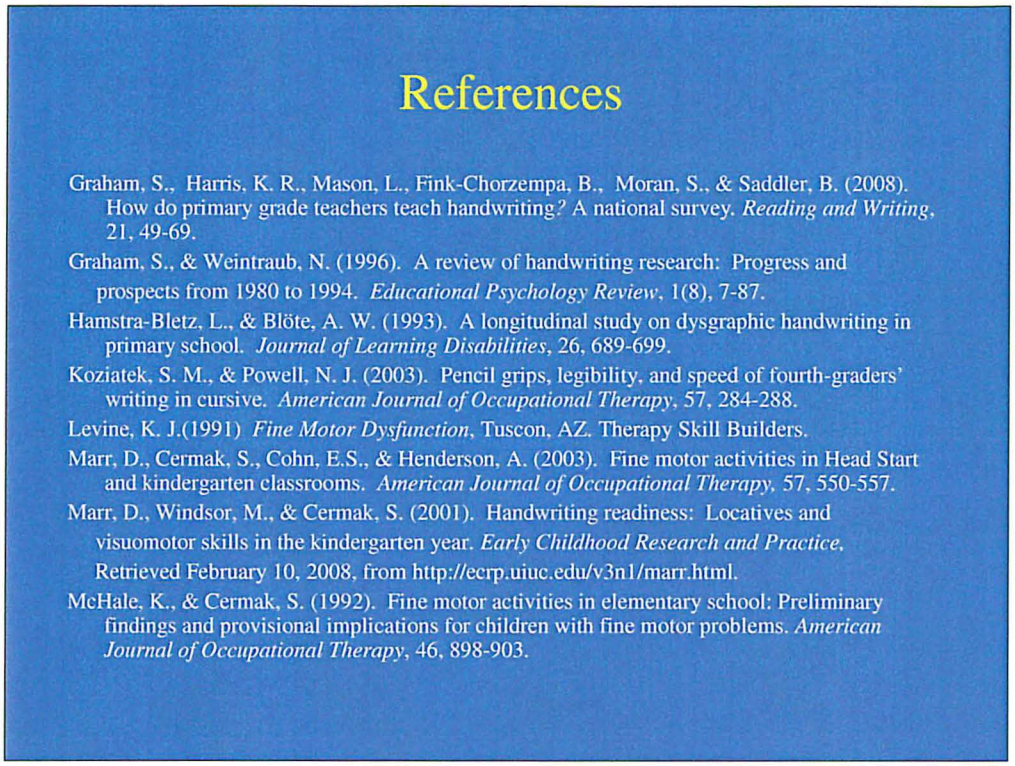
Common handwriting problems, such as, **incorrect letter formation, poor alignment, reversals, uneven size of letters, irregular spacing between letters and words, and slow motor speed** may not arise from the same underlying mechanism



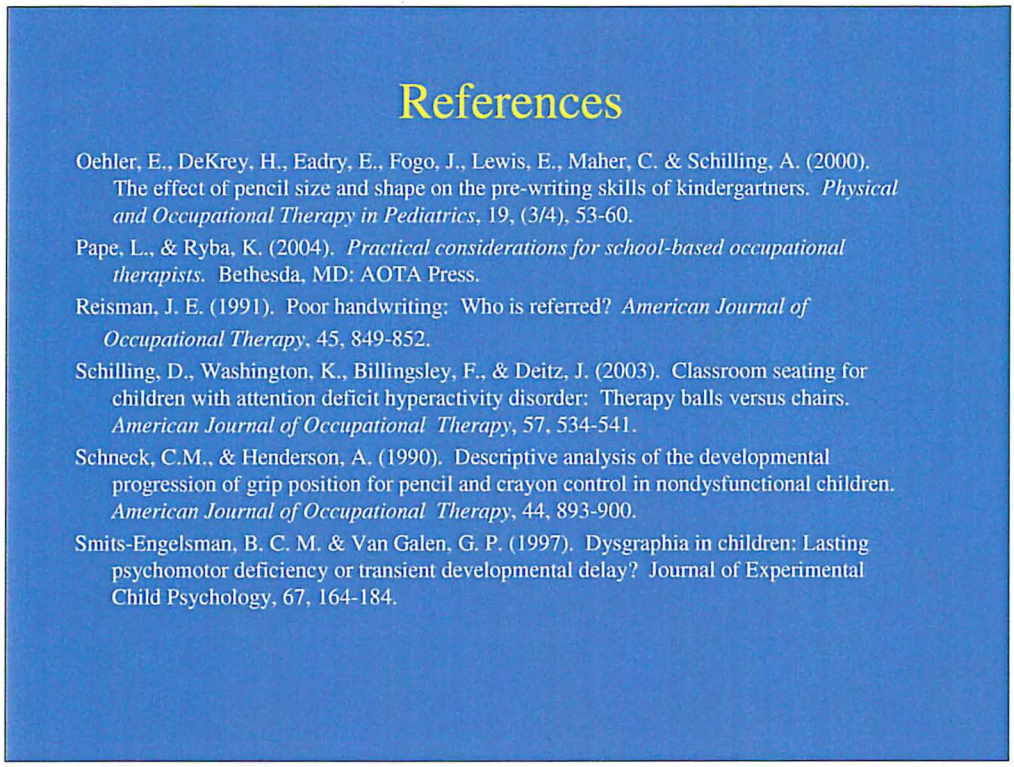
Asher A. to Bly, L.



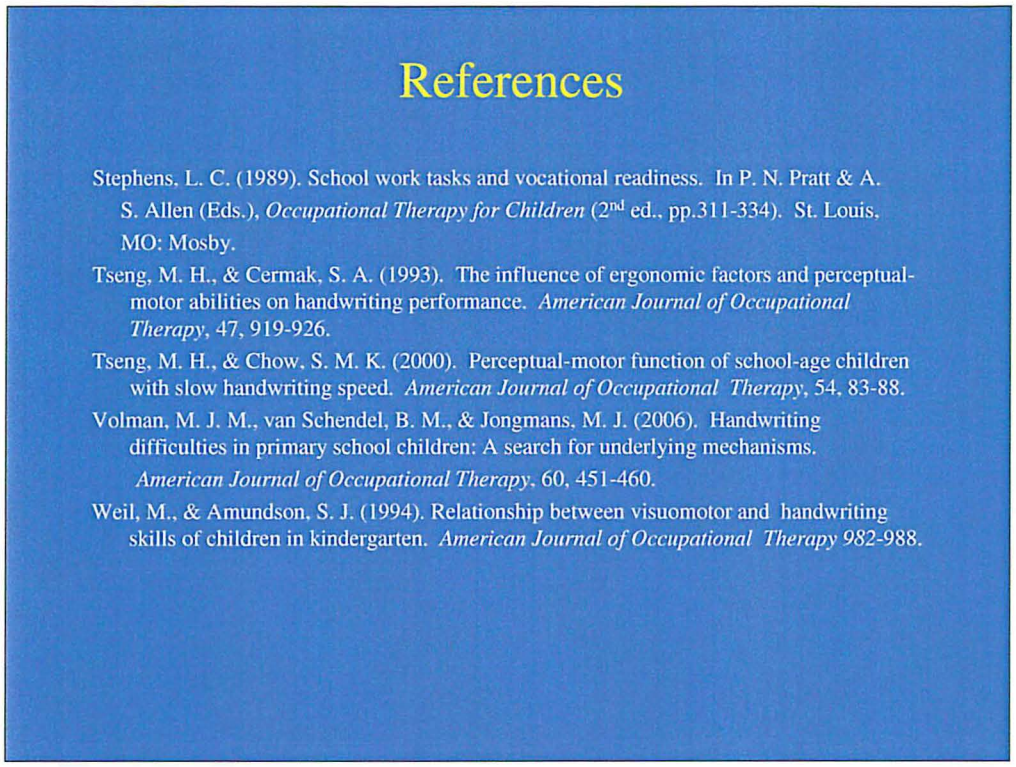
Boehme, R. to Graham, S.



Graham, S. to McHale, K.



Oehler, E. to Smits-Engelsman, B. C. M.

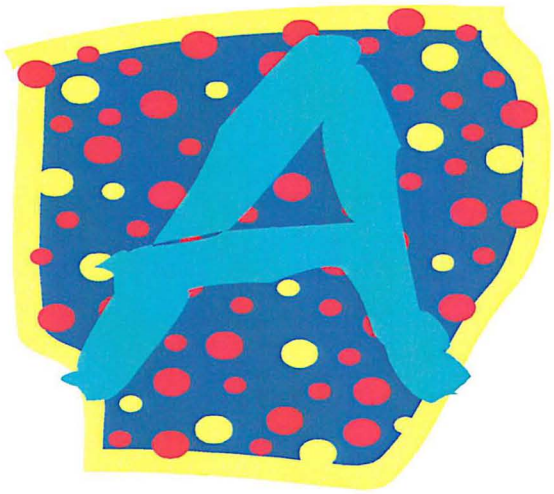


Stephens, L. C. to Weil, M.

Appendix B

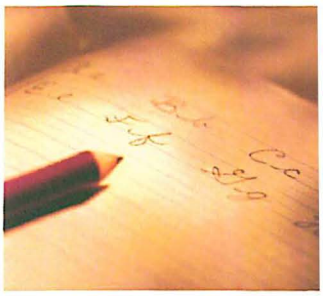
Handouts for Learners

Handwriting from A-Z



Course Objectives: At the conclusion of the presentation, participants will:

- Increase their understanding of the importance of early developmental activities for a child and their impact on handwriting.
- Understand the impact over time that poor handwriting may have on a student.
- Gain an understanding of the differences in teaching handwriting among teachers.
- Understand the complexities of the process and the underlying mechanisms needed to learn to write.
- Understand the role of the occupational therapist on the team.



Introduction:
12% to 21% of students struggle in school
• Poor handwriting may affect:
- A student's grades
-The ability to compose
- A student's confidence

Development of Fine Motor:

Groundwork for fine motor begins as an infant
Learn to control of arms and hands
Movements develop from the trunk
Development of reach and grasp in the first year

Newborn:

4 months: Ulnar grasp develops

5 months: Palmar grasp developing

6 months: complete weight-bearing, radial-palmar grasp beginning

8 months: Radial-digital grasp beginning, early hand separation

9-12 months: Pincer grasp; grasp and release.

Development of Fine Motor in Toddler Years:

Interference with development:

Fine Motor Skills Needed:

Head Start: 37% time spent in fine motor tasks
- Self-care: 45%
- Manipulative activities: 46%
- Paper/pencil activities: 10%

Kindergarten: 36-66% time spent in fine motor tasks
- Self-care: 14%
- Manipulative activities: 44%
- Paper/pencil activities: 42%

2^{nd}-4^{th}-6^{th} grades: 31- 60% time spent in fine motor tasks
- Self-care: 14%
- Manipulative activities: 44%
- Paper/pencil activities: 42%

Handwriting Instruction in Elementary Schools:

Training in undergraduate courses
Out of 2,842 primary grade teachers surveyed – 64% had not received any training in handwriting

How often? 3 surveys compared

Teach handwriting daily:
Teach several times/week:
Teach handwriting once/week:
Do not teach it:

Graham et al. 2008; Graham et al. 2003, Asher, 2006

Handwriting taught how often?
Average instruction: 70 minutes a week
Time varied: 2 min to an hour/day

How are letters introduced?
Developmental approach, straight lines first – 4 teachers
Taught letters with class themes – 5 teachers
Intro with language arts weekly
3 teachers
Waited for mastery of a letter
1 teacher
Asher (2006)

How are letters introduced for cursive writing?

- Lower case first, then upper case
- Upper-case first, then lower case
- Teach both together

Are commercial programs used?

What grade should handwriting instruction begin?
Kindergarten
1st grade

Components of Handwriting
Motor: Pertaining to body movement, muscles, posture.

Sensory: Organizing sensory input for use. Helps the person to interact with the world efficiently and effectively.

Cognitive skills: Using knowledge from past experiences and be able to process what that means.

Perceptual skills: Ability to use visual information to recognize, recall, discriminate and make sense of what we see.

Learning to write requires a combination of all of the above. It is a process that begins with recognizing and producing a specific shape (Benbow et al. 1992). Before a pencil is put to paper, a child needs to be **prepared** to write.

Proper Seating
•Feet on floor
•Knees and hip at 90 degrees
•Writing desk – 2" above elbow

Pencil Grip
• Children use a variety of grips
• Ages 3-3 ½: Grips primitive to mature
• By 4 ½ years: Grips transitional to mature
• By 6 ½ years: Mature grips

Types of Grips - Primitive
• **Radial cross-palmar grasp**: Fisted hand, thumb-side down, full arm movement

• **Palmar supinate grasp**: Fisted hand, wrist slightly flexed, full arm movement

• **Digital pronate grasp** – pencil held in palmar grasp with the index finger extended, arm not supported, full arm movement

• **Brush grasp**
Held with fingers, whole arm movement, forearm in air

• **Grasp with extended fingers**
Thumb and index grasp, wrist straight, fingers extended

Transitional Grips:

•**Cross thumb** – Fingers loosely fisted, pencil held against index finger, thumb crossed over, forearm on table

Four fingers – All fingers on shaft, uses wrist and finger movement, forearm rests on table.

• **Static tripod grasp -**
Stabilized against side of third digit by thumb pulp, thumb in opposition; hand moving as a unit and pencil resting in open web space

• **Lateral tripod grasp –**Pencil is stabilized against radial side of 3rd digit, thumb adducted and braced anywhere against side of index finger, 4th and 5th digits flexed, forearm resting on the table.

•**Dynamic tripod grasp –** Open web space, held with thumb, index finger, resting on the third digit, 4th and 5th digits are tucked under, wrist extended, localized movements of digits, forearm on table

Variations on grasps:
Hook grasp (Lefties)

Alternate grasp: Pencil between the 2nd and 3rd digits

Pencil Grips:
- May work for kids who are just beginning to work on positioning of their hands on a pencil

- Reinforce correct grip at an early age – over and over and over again!

Does Size of Pencil Matter?

Hand Mechanics
19 bones - 17 joints - 19 muscles
•The hand is made for refined tactile discrimination, shaping, power grip and delicate manipulation.

Extrinsic Muscles:

Intrinsic Muscles:

Shaping of the Hand – Arches
- 4 longitudinal arches; Proximal transverse arch
- Distal transverse arch
- Arches form the deep hollow at base of middle finger

Motoric Separation of the Hand:

In-hand Manipulation Skills:

Getting kids Ready to Write:
Attention is the basic component of all cognitive activities.

Movement - Helps child with general organization for specific tasks.
Regulates arousal so student can attend

Postural Control and Balance:

Problems with postural control and balance:
- Has trouble working neck and eye muscles to copy letters
- Balancing in a chair requires work
- May lose balance easily
- May hold head propped up with hand or put head on desk while writing

Proprioception/Kinesthesia:

Problems with Proprioception/Kinesthesia:
- Tend to rely on visual information
- Poor fine motor control because they cannot feel where or how their arms/fingers are moving
- Writing does not become automatic in the later grades

Bilateral Integration:

Problems with Bilateral Integration:
- May adjust their bodies to avoid crossing midline
- May not be able to coordinate one hand to move while the other hand is stabilizing
- May appear "ambidextrous"
- May not use non-dominant hand to hold paper

Tactile (Touch perception):

Problems with the Tactile System:
- May interpret many touches as threatening
- May withdraw from individual instruction
- May have difficulty standing in line
- May become distractible

Motor Planning:

Problems with Poor Motor Planning Skills:
- Prolonged periods of struggle in attempting to master a new skill
- May take extra mental energy that could be used for other tasks
- May imitate the actions of other kids, rather than initiate an activity themselves

Visual-Motor Integration:

Visual Perception:
Problems with Visual Perception:
- May not know where to start writing on a piece of paper
- Letters may vary in size
- Spacing and Alignment poor
- Letter and Number recognition may be poor
- Reversal of letters may be common

Motor Memory

Problems with Motor Memory:
- May not remember how to form letters
- May have difficulty in spelling
- Lots of cross outs and erasures
- Difficulty in following 2-3 step directions

Hand Dominance/ Hand Preference:
- Between 4-6 years, a hand preference emerges
- Develops as a result of the ability to coordinate both sides of the body
- Dominant hand becomes the skilled hand
- Non-dominant hand develops different skills

Problems in not Establishing Dominance:
Child will not develop a skilled side
- Will switch hands for activities
- May write with the left on the left side and move pencil to the right hand to finish
- May show immature pencil grasp

Lefties
10% of population is left-handed
More pathological left-handers than right handers

Differences in Left and Right Handers:
Right-handers use their elbow as the pivot point to move forearm across page
Lefties unable to use elbow as a pivot point (if taught to write "opposite" of a right-hander)

Left-handed paper position:
Paper turned clockwise, about 30 degrees slightly to right of midline

Occupational Therapy
• Problems with handwriting are one of the most frequent reasons why children in school are referred to occupational therapy.
• Teacher's role is to teach handwriting.
•Occupational therapist's role to determine underlying deficits that might interfere with the development of legible handwriting.

ACTIVITIES TO DEVELOP HAND SKILLS IN KIDS

The arches of the hand direct skilled movements of the fingers and help to grade how much strength is used in the fingers. The hand should be able to form a deep gutter in the middle of the palm.

Shaping of the arches:
- Press a round shaped object or toy into the palm to encourage cupping the hands around it.
-Roll a small ball or play-dough in hands
-Open and close zip-lock bags
-Line up pennies and flip them over
-Weight-bearing activities
-Arch hands and shake dice

Separation of the sides of the hands: One side of the hand is used for skillful activities (precision) and the other side is used for power (4^{th} and 5^{th} digits). It helps to provide stability (support) to the other side of the hand.

Activities for separation of the sides of the hands:
-Squirting a water bottle
-Cutting with a scissors
-Hold coins in hand and sort them, one at a time, using thumb and index finger
- Roll a ball between index and thumb while keeping 4^{th} and 5^{th} digits still and flexed.
- Use a tongs to pick up sugar cubes or small blocks.

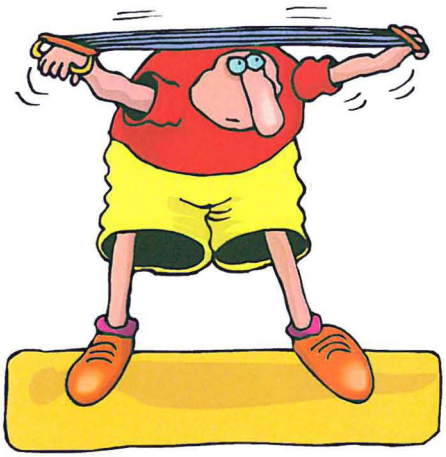
Precise rotation in hands
-Spinning tops
-Hold a plate on fingertips and turn it
-Turning nuts and bolts
-Turn two balls around each other in hand
- Flip a pencil from writing to erasing position, multiple times

Wrist Stabilization- Children with fine motor delays often bend the wrist down in order to stabilize their hand. This will compromise arching of the hands, isolation of intrinsic muscles and abduction of the thumb. The wrist is held steady by the flexors and the extensors.

Activities to help to stabilize the wrist:
-Write on chalkboard above eye level
-Work in vertical positions to play games, such as, Lite Brite, Magnadoodle, lacing

-"Donkey kicks" – Place hands directly on the mat or floor, with fingers pointing straight ahead, open palms. Ankles should be touching each other at all times. Kick to the left and to the right sides.
- Towel scrunching – With palms down and wrists on table, scrunch a towel that has been laid out flat. The object is to gather up the towel into the palms of the hands.

Alerting Activities: Activities that add resistance are good for "waking up" the body and getting it ready.
-Tug-of-war – Can use a large rope or small bits of yarn that the kids can pair up with a partner and pull back and forth
-Hand press – Press hands together, holds for a count
-"Pushing out the walls" of the classroom
-Rubberband stretch on fingers
-Chair lift – Have kids stack their chairs or lift their chairs up and down for 10-15 reps. Use good body mechanics.
-"Pass the can" – Pass several weighted objects up and down the rows. It can become a friendly game for the kids.



RESOURCES

Loops and Other Groups by Mary Benbow MS, OTR. A kinesthetic writing system. Easy to remember motor and memory cues. Learn upper and lower case letters in 12 weeks.
http://www.theraproducts.com/index.php?main_page=index&cPath=19161

Handwriting Without Tears by Jan Olsen, OTR. Developmentally based, incorporates visual, auditory, manipulative, tactile, and kinesthetic teaching strategies. Easy to teach.
http://www.theraproducts.com/index.php?main_page=index&cPath=19161

Zaner-Bloser Handwriting programs: Developed manuscript and cursive alphabet, each based on just four strokes
http://www.teachers-store.com/html/WRresults.html?cat=Writing

Finger or Preschool crayons. Shapes small hands when writing. Open web space.
http://www.theraproducts.com/index.php?main_page=index&cPath=19161

Flip Crayons – Handwriting Without Tears program. Good for in-hand manipulation.
http://www.theraproducts.com/index.php?main_page=index&cPath=19161

Vertical surfaces and Easels
http://www.theraproducts.com/index.php?main_page=product_therapro_info&cPath=4146_4192&products_id=4210

Bubble Rocket/Bubble Toys: Good for developing muscle strength/arches in the hands.
http://tangenttoys.stores.yahoo.net/pusbubtoy.html

Pencil Grips: A variety of pencil grips. http://www.otideas.com/Items/PencilGrips.htm

Pencil Grips: A variety of pencil grips. http://www.peterson-handwriting.com/pencilgr.htm

REFERENCES

Asher, A. V. (2006). Handwriting instruction in the elementary schools. *American Journal of Occupational Therapy*, 60, 461-471.

Beery, K. E. & Buktenica, N. (1989). *The Beery-Buktenica developmental test of visual-motor integration* (3rd ed.). Cleveland, OH: Modern Curriculum Press.

Benbow, M. (1990). *Loops and Other Groups*, Tucson, AZ. Therapy Skill Builders.

Benbow, M., (1995). Neurokinesthetic approach to hand function and handwriting. *Continuing education seminar series. Clinician's View.* Albuquerque, NM. (pp. 16-17).

Benbow, M., Hanft, B. & Marsh, D. (1992). Handwriting in the classroom: Improving written communication. In Charlotte Royeen (Ed.), *AOTA self-study series: Classroom applications for school-based practice* (pp. 6-60). Rockville, MD: American Occupational Therapy Association.

Benbow, M. (2006). Principles and practices of teaching handwriting. In A. Henderson & C. Pehoski (Eds.), *Hand function in the child: Foundations for remediation* (pp. 319-342). St. Louis, MO: Mosby.

Bly, L., (1994). *Motor skills acquisition in the first year. An illustrated guide to normal development.* Tucson, AZ: Therapy Skill Builders.

Boehme, R. (1988). *Improving upper body control: An approach to assessment and treatment of tonal dysfunction.* Tucson, AZ: Therapy Skill Builders.

Case-Smith, J. (2006). Hand skill development in the context of infants' play: Birth to 2 years. In A. Henderson & C. Pehoski (Eds.), *Hand function in the child: Foundations for remediation* (pp. 117-141). St. Louis, MO: Mosby.

Cornhill, H., & Case-Smith, J. (1996). Factors that relate to good and poor handwriting. *American Journal of Occupational Therapy, 50*, 732-739.

Exner, C., (2006). Intervention for children with hand skill problems. In A. Henderson & C. Pehoski (Eds.), *Hand function in the child: Foundations for remediation* (pp. 239-266). St. Louis, MO: Mosby.

Gladstone, K. (2002). Illegibility: Can America write? Retrieved February 29, 2008, from http://www.global2000.net/handwritingrepair/KateHwR.html.

Graham, S., Harris, K. R., & Fink, B. (2000). Extra handwriting instruction: Prevent writing difficulties right from the start. *TEACHING Exceptional Children*, 33, 88-91.

Graham, S. Harris, K. R., MacArthur, C., & Fink-Chorzempa, B. (2003). Primary grade teachers' instructional adaptations for weaker writers: A national survey. *Journal of Educational Psychology*, 95, 279-293.

Graham, S., Harris, K. R., Mason, L., Fink-Chorzempa, B., Moran, S., & Saddler, B. (2008). How do primary grade teachers teach handwriting? A national survey. *Reading and Writing*, 21, 49-69.

Graham, S., & Weintraub, N. (1996). A review of handwriting research: Progress and prospects from 1980 to 1994. *Educational Psychology Review*, 1(8), 7-87.

Hamstra-Bletz, L., & Blöte, A. W. (1993). A longitudinal study on dysgraphic handwriting in primary school. *Journal of Learning Disabilities*, 26, 689-699.

Koziatek, S. M., & Powell, N. J. (2003). Pencil grips, legibility, and speed of fourth-graders' writing in cursive. *American Journal of Occupational Therapy*, 57, 284-288.

Levine, K. J.(1991) *Fine Motor Dysfunction*, Tuscon, AZ. Therapy Skill Builders.

Marr, D., Cermak, S., Cohn, E.S., & Henderson, A. (2003). Fine motor activities in Head Start and kindergarten classrooms. *American Journal of Occupational Therapy,* 57, 550-557.

Marr, D., Windsor, M., & Cermak, S. (2001). Handwriting readiness: Locatives and visuomotor skills in the kindergarten year. *Early Childhood Research and Practice,* Retrieved February 10, 2008, from http://ecrp.uiuc.edu/v3n1/marr.html.

McHale, K., & Cermak, S. (1992). Fine motor activities in elementary school: Preliminary findings and provisional implications for children with fine motor problems. *American Journal of Occupational Therapy*, 46, 898-903.

Oehler, E., DeKrey, H., Eadry, E., Fogo, J., Lewis, E., Maher, C. & Schilling, A. (2000). The effect of pencil size and shape on the pre-writing skills of kindergartners. *Physical and Occupational Therapy in Pediatrics*, 19, (3/4), 53-60.

Pape, L., & Ryba, K. (2004). *Practical considerations for school-based occupational therapists.* Bethesda, MD: AOTA Press.

Reisman, J. E. (1991). Poor handwriting: Who is referred? *American Journal of Occupational Therapy*, 45, 849-852.

Schilling, D., Washington, K., Billingsley, F., & Deitz, J. (2003). Classroom seating for children with attention deficit hyperactivity disorder: Therapy balls versus chairs. *American Journal of Occupational Therapy*, 57, 534-541.

Schneck, C.M., & Henderson, A. (1990). Descriptive analysis of the developmental progression of grip position for pencil and crayon control in nondysfunctional children. *American Journal of Occupational Therapy*, 44, 893-900.

Smits-Engelsman, B. C. M. & Van Galen, G. P. (1997). Dysgraphia in children: Lasting psychomotor deficiency or transient developmental delay? Journal of Experimental Child Psychology, 67, 164-184.

Stephens, L. C. (1989). School work tasks and vocational readiness. In P. N. Pratt & A. S. Allen (Eds.), *Occupational Therapy for Children* (2nd ed., pp.311-334). St. Louis, MO: Mosby.

Tseng, M. H., & Cermak, S. A. (1993). The influence of ergonomic factors and perceptual-motor abilities on handwriting performance. *American Journal of Occupational Therapy*, 47, 919-926.

Tseng, M. H., & Chow, S. M. K. (2000). Perceptual-motor function of school-age children with slow handwriting speed. *American Journal of Occupational Therapy*, 54, 83-88.

Volman, M. J. M., van Schendel, B. M., & Jongmans, M. J. (2006). Handwriting difficulties in primary school children: A search for underlying mechanisms. *American Journal of Occupational Therapy*, 60, 451-460.

Weil, M., & Amundson, S. J. (1994). Relationship between visuomotor and handwriting skills of children in kindergarten. *American Journal of Occupational Therapy 982-*988.

Appendix C

Course Schedule and Learning Activities

Handwriting from A-Z
Course Schedule and Learning Activities

8:00 – 8:10 am: Take care of general information for the session.
Introduction: Goals/Objectives
8:10 – 9:15 am: Present PowerPoint slides 5-29
Slide 10 – Demonstrate ulnar grasp using rattle
Slide 11 – Demonstrate palmar grasp using rattle
Slide 12 – Demonstrate radial-palmar grasp
Slide 13- Demonstrate radial-digital grasp
Slide 21 – Discussion/Show of hands on who has received any undergraduate training in regards to handwriting skills.
9:15 - 9:20 am: 5-minute stretch break
9:20 –10:55 am: Present PowerPoint slides 31- 66
Slide 35 and 36: Discussion - Ask what is wrong with the picture?
In all of the following slides, ask learner to use it to write their name.
Slide 39 – Demonstrate radial cross palmar grasp
Slide 40- Demonstrate palmar supinate grasp
Slide 41 – Demonstrate digital pronate grasp
Slide 42 – Demonstrate brush grasp and grasp with extended fingers
Slide 43 – Demonstrate cross thumb grasp
Slide 44 – Demonstrate four fingers grasp
Slide 45 – Demonstrate static tripod grasp
Slide 46 - Demonstrate lateral tripod grasp
Slide 47 - Demonstrate dynamic tripod grasp
Slide 48 - Demonstrate hook grasp in your left hand and the alternate grasp (dominant)
Slide 62-66 Hands-on activities: Discussion of how the activities will help build hands.
(This will take approximately 30 minutes depending on activities offered).

- Taking items out of zip-lock bags
- Shaking dice with hands only, forming arches
- Rolling small clay or play-dough balls
- Flipping pennies over
- Picking pennies up one at a time and squirreling them away in hand and then placing them on table one at a time
- Flipping a pencil end-to-end, 10x in a row
- Spinning tops (small plastic ones)
- Turning a nut onto a bolt
- Turning two marbles in hand
- Spring-loaded clothespins
- Turn two marbles around in hand

- Activities for stabilizing the wrist will be set up on a table off to the side:
- To include table top easels, floor easel, games placed vertically, such as, Lite-Brite or Magna-Doodle.

10:55 – 11:05 am: Break
11:05 – 11:10 am: Questions regarding materials covered. Reminder that there is a program evaluation to complete
11:10 –12:10 am: Present PowerPoint slides 68 – 110

Slide 70: ALERTING: Activity of "Pass the Can". Start at one end of the table and pass a weighted object from one end to the other or several of them if you have time. This is an alerting activity.

Slide 75: PROPRIOCEPTION: Close your eyes: Can you tell exactly where your arms are right now? Can you tell how your legs are positioned?
Pick a partner: One person closes their eyes. The partner takes one arm and positions it in a unique fashion, make sure you move shoulder joint, elbow joint, wrist, thumb and fingers. The player (with closed eyes) is to position the other arm in the mirror image of the first arm moved.

Slide 80: TACTILE: Instructor uses a fake spider or a feather duster to get a reaction from one of the learners in the front row. Could use cold spaghetti in a covered container. Other learners will pull out several items and one learner puts hand in and touches cold spaghetti – "Fight or flight" response for tactile.

Slide 86 and 87: MOTOR PLANNING ACTIVITY: Write the words, Handwriting is Fun! (slide 86). Time audience. Ask them to move to their non-dominant hand and have them write same sentence in Chinese! (slide 87). Discussion follows.

Slide 92: Learning Task: Ask learners to close their eyes and draw the cursive alphabet from memory connecting all of the letters.

Slide 104: Left-handed set-up for paper placement. Learners are given or tear off two pieces of masking tape and place on table. Practice paper placement.

Ask for questions at the end.
Reminder of evaluation to be turned in.
Finish up at approximately 12:30 pm.

Appendix D

Program Evaluation

Handwriting A-Z Program Evaluation

Please fill in the evaluation below: 1-Strongly disagree, 2- Disagree, 3 – Neutral, 4 – Agree and 5- Strongly agree.

1. The instructor presented information in a clear and logical manner.		1 2 3 4 5
2. The amount of information in each of the areas listed below was adequate:		
Fine motor skill development with infants and toddlers		1 2 3 4 5
Fine motor skills in the schools		1 2 3 4 5
Teachers' surveys on how they teach handwriting		1 2 3 4 5
Mechanics of the hand: Muscles, in-hand manipulation skills		1 2 3 4 5
Components of handwriting: Posture, sensory components, visual –motor, visual-perceptual, motor memory		1 2 3 4 5
Teaching left handers		1 2 3 4 5
Occupational therapy in school		1 2 3 4 5
3. The hands-on activities were useful in helping me to learn the material.		1 2 3 4 5
Additional Feedback:		