

## **Underlying difficulties affecting handwriting in children with specific diagnoses.**

(Updated 10-19)

Children spend 30-60% of their school days performing fine motor tasks<sup>14</sup>, including handwriting. Fine motor behavior, hence handwriting, requires an integrated, highly efficient brain network to feed online sensory information from multiple sensory cortices to the motor cortex rapidly<sup>4</sup>.

Handwriting difficulties are common among children with neurological disorders such as ASD, ADHD, CDC, Fetal Alcohol Syndrome and other conditions. Some children have co-occurring conditions within these categories. Based on a review of recent research, we list some of the typical challenges and characteristics of performance a student might have if they possess one or more of these diagnoses.

*\* Indicates suggested specific **Schoodles** tasks for observation of the classroom or supporting skill related to the specific challenge, along with other supporting tests and evidence.*

### **Austim Spectrum Disorders**

**Decreased proprioception/kinesthesia-** this impairment affects muscle grading and the ability to develop fluid automated movements. It is needed for automation of movements for handwriting and the decrease of visually guided movements. Poor performance in the area may interfere with ongoing error correction while writing and improving performance over time. Visual monitoring needed when this area is delayed, may slow a child down. Evidence is inconsistent in this being a problem for children with ASD. In fact, children with ASD may at times rely more heavily on their body sense than their visual sense for motor output.

*\*Sometimes observed in muscle testing (awareness and recruitment of muscles), proprioception activities and handwriting sampling.*

**Visual focus differences-** a child with ASD may focus on specific or fine details of letters and words rather than the whole or global aspects of what is being viewed. Typically developing children tend to 'see the forest for the trees' children with ASD 'see the trees at the expense of the forest'.

*\*May be observed in the puzzle assembly activity or handwriting activities child may focus on strokes rather than spacing, letter to line or sizing.*

**Decreased visual-motor skills-** The coordination between visual perception and hand/finger skills is impaired. Research suggests there is a strong correlation with an ASD diagnosis and a deficit in this area, specifically an impairment with paper pencil tasks as opposed to block design or object assembly tasks. The delay may originate

from poor perception or motor control or the integration of both with the more likely being poor motor control.

***\*Design imitation and design copy, coloring.***

**Decreased manual dexterity-** may manifest in decreased legibility due to alignment and formation of letters.

***\*Finger coordination activities.***

**Decreased motor planning-** may affect timing, sizing and spacing of letters.

***\*Motor planning differences often observed in large movements in the hop, jump, gallop, skip sequence.***

**Decreased muscle tone-** increased effort in holding the pencil resulting in alternative grasp patterns or decrease in quality of writing over time.

***\*Observation of tone.***

**Decreased strength-** may also result in decreased quality over time and hand fatigue.

***\*Muscle testing.***

## **ADD/ADHD**

Studies examining children with ADD/ADHD were somewhat conflicting, but overall, children with this diagnosis tend not to have motor deficits that impact written outcomes. We include findings here as they may be somewhat helpful when considering services.

**Inattention affecting motor performance-** A study done in 2013 found that there were no motor proficiency differences between typically developing children and those who had ADHD with no co-morbid diagnoses of autism. Decreased motor performance was attributed to inattention. Issues with; maintaining train of thought, keeping big picture in mind, increased time needed to complete work, rushing and resulting appearance of carelessness, inconsistent sizing in written work, may all result from challenges with attention.

***\*Handwriting sample.***

**Effects of medication on handwriting-** Another study reported that fluency decreased for children on medication, possibly due to increased attention on the task and increased carefulness. Children with ADHD asked to write faster with eyes closed, including those on medication, increased their fluency and automation. Conversely another study found that manual dexterity and overall quality of handwriting and drawing improved after methylphenidate (Ritalin) use, but not to the level of the control group. They concluded children with ADHD may benefit from motor intervention as some children may still have delayed or impaired motor skills.

**\*Handwriting sample, try eyes open and eyes closed, draw a person.**

**Hand movement-** Still another study found children with ADHD tend to perform handwriting skills at age level and with automation. Confirmation of age level skilled eye-hand movements speaks to inattention as the cause for reduced proficiency for children with this diagnosis.

**\*Finger coordination, design imitation and design copy.**

\*\*As OT's we should consider how possible traumatic events may influence performance outcomes. This deserves another category heading, but research based information as it relates to handwriting was not available at the time this document was assembled. American Academy of Pediatrics. (2014, May 6). Study finds ADHD and trauma often go hand in hand. *ScienceDaily*.

## **Developmental Coordination Disorder**

5-6% of the population. There are a variety of reasons children may have difficulty taking in, processing and/or using sensory and motor information. We can use some of Schoodles tasks to make informed guesses about these children's motor patterns and use this information to plan intervention.

Poor handwriting has become an important diagnostic criteria for DCD. Children with DCD may have any or all of the below impairments.

**Decreased postural control-** Fatigue issues sitting in a classroom chair or on the floor.

**\*Prone extension, supine flexion, plank.**

**Decreased body awareness and proprioception-** Over use of visual information to complete tasks.

**\*Romberg test.**

**Decreased motor planning-** decreased ability to create a plan and used it for; shoe tying, dressing, eating, using a scissors, coloring and automated movement for handwriting. Some children only have difficulty with only gross or fine motor activities.

**\*Often observed in large movements in the hop, jump, gallop, skip sequences.**

**Decreased balance-** Balance issues on a chair or sitting on the floor.

**\*Often observed in large movements in the hop, jump, gallop, skip sequences and Romberg's test.**

**Decreased processing speed/timing-** Timing for handwriting throwing, kicking catching activities.

**\*Eye hand activities, muscle testing.**

**Decreased ability to learn new motor actions-**

***\*Observed in any novel motor task. This is individual to each child.***

\*The CO-OP learning method has been shown to be a very effective intervention for this particular challenge. <http://co-opacademy.ca/about-co-op/the-co-op-approach/>

## **Fetal Alcohol Syndrome**

**Decreased visual-motor skills-** Legibility and speed were found to be well below average for children with FAS for sentence and paragraph writing. Single letter production from memory was below average as was near point copy. Finger coordination and tactile sensitivity were within normal ranges.

***\* Writing tasks.***

**Increased difficulty as task challenges increase** – Language and speech challenges are prevalent in this population. Self-generated sentence samples include a composition component that addresses this aspect of written performance and separates composition challenges from the visual motor aspect of writing when a child is simply copying a passage.

***\*Handwriting sample, puzzle, hop, jump, gallop, skip sequences.***

**Decrease in grading for motor control-** Especially true when visual feedback is low for students with FAS. Reduced performance in motor skills and daily living skills that require finely graded force.

***\*Muscle testing, handwriting, coloring.***

**Visual spatial processing challenges-** Children with FAS have been shown to have impaired spatial working memory. Spatial working memory requires retention and manipulation of visuospatial information.

***\*Health records and birth history, puzzle task, handwriting tasks.***

## **Strabismus and Amblyopia**

**Postural stability and balance-** have been reported to be affected in children with strabismus. Mismatched input from each eye leads to abnormal binocular vision and lack of stereopsis which in turn lead to poor motor performance. The interplay between visual, vestibular, and proprioceptive systems is amplified with decreased binocular vision and stereopsis. Children rely on their body sense to guide movements because their depth perception is compromised.

***\*Vision history information, prone extension, supine flexion, plank, vision screen, Romberg's test and proprioception test. Additional testing with BOT-2 to support findings***

## **Very Preterm Infants <32 and Moderately Preterm Infants 32-36 weeks**

**Postural control and fine motor skills-** Among the most frequently occurring problems encountered by preterm children who do not develop cerebral palsy are impaired gross and fine motor skills. Gross motor skills and fine motor skills delays have been found to an equal degree. Increased risk factors for fine motor delays include intra-uterine growth restriction, severe infections, and bronchopulmonary dysplasia<sup>4</sup>. Prevalence is for fine motor delay is between 40-60% for mild to moderate impairment<sup>4</sup>. There is an excellent description of etiology in Bos (2013).

**\*Birth history, prone extension, supine flexion, plank, and fine motor portions of Schoodles.**

## **Extremely Preterm Infants born < 27 weeks**

**Visual motor integration and manual dexterity delays-** In a recent study a positive correlation was shown between EPT (extremely premature term) healthy 6 1/2 year olds and precentral gyrus brain volumes. Volumes of cerebellum and brainstem showed a positive correlation with fine motor skills and cortical grey matter volumes showed a negative correlation with fine motor skills. Brain volumes were taken at term equivalent age.

Visual perceptual skills have been documented to be lower in extremely preterm infants as well.

**\*Birth history, classroom skills portions of Schoodles along with finger coordination activities with corroboration with the VMI, manual dexterity portions of BOT2 or Movement ABC to support findings.**

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