



Developmental Occupational Therapy
Supporting WA Occupational Therapists working with children

Motor Dysgraphia

Clinical Practice Guidelines
for Occupational Therapists
in Western Australia



Occupational Therapists Use Only

Context

Following enquires made to the Western Australian Occupational Therapy Association (WAOTA) regarding the role of occupational therapists working with individuals whose learning and development is affected by motor difficulties, a working party was formed by members of the Developmental Occupational Therapy WA (Inc) – DOT(WA). This working party was established to create clinical guidelines for the identification, assessment and intervention of Motor Dysgraphia and Developmental Coordination Disorder (DCD).

Two working party sub-groups were created at the beginning of 2016; one to address guidelines for Motor Dysgraphia and another separate group to address guidelines for Developmental Coordination Disorder (DCD) and Dyspraxia.

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Purpose of Motor Dysgraphia Clinical Practice Guidelines

The purpose of the motor dysgraphia clinical practice guidelines is to assist and support occupational therapists in their understanding of the features of motor dysgraphia and to inform occupational therapists about evidenced-based assessment and intervention for this disorder. Whilst these guidelines are predominantly for clinical use by occupational therapists, they have also been developed to inform other disciplines about the role of occupational therapists in the assessment and intervention of children and adolescents with motor dysgraphia.

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Section 1: Definition and Description of Motor Dysgraphia

Introduction

One of the most common reasons children and adolescents are referred to an occupational therapist is because of difficulties with handwriting (Hoy, Egan & Feder, 2011). Children and adolescents spend approximately 30-60% of their day performing fine motor activities, with handwriting tasks accounting for most of this time (Hoy et al., 2011). Referrals for handwriting difficulties can range from problems with legibility that are affecting the teacher's ability to read and accurately mark a student's handwriting, difficulty with speed and output of handwriting (the amount a student can write under timed conditions) and/or difficulties with pencil grasp and pencil control.

Not all students with handwriting difficulties have motor dysgraphia. Students with motor dysgraphia specifically have more difficulty with sub-word letter formation than their same age peers, that is, producing legible letters others can recognize and doing so automatically and in a consistent way that does not drain the student's working memory resources. The impaired handwriting may interfere with the student's spelling and/or written composition (Berninger, 2016).

Overview of Handwriting Development

Handwriting is a complex skill that requires perceptual-motor performance components to be gained and integrated. These performance components include fine motor control, bilateral coordination, visual-motor skills, motor planning and sequencing, visual perceptual skills, eye-hand coordination, sensory awareness in the hands and fingers (proprioception and kinesthesia), established hand dominance, suitable hand and finger strength, the ability to maintain attention and adequate postural control as well as shoulder stability (Feder & Majnemer, 2007). In-hand manipulation also has a significant association with handwriting skill and development (Case-Smith & Cornhill, 1996).

The developmental stages of writing are not discrete, sequential stages, rather they are a dynamic process. Typically, however, a child begins with early scribbling which becomes intentional with time (Feder &

Majnemer, 2007). A child learns to create letters by first imitating geometric shapes from about age 2 years. An indication of writing readiness in a child is the ability to copy geometric shapes, particularly the drawing of the oblique cross shape as it requires the child to cross the body midline (Feder & Majnemer, 2007; Dinehart, 2015). Inability to cross the midline has been implicated as the root problem in many letter reversal difficulties (Feder & Majnemer, 2007).

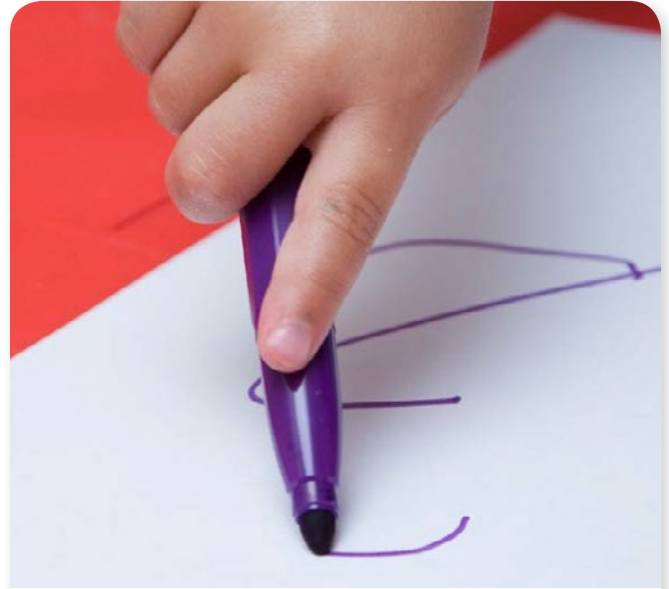
To become proficient at handwriting, a child needs to have an adequate pencil grasp. Typically, the development of a pencil grasp occurs in the following stages:

- Palmar supinate grasp starts to develop approximately 1 to 1 ½ years of age
- Digital pronate grasp starts to develop approximately 2 to 3 years of age
- Static tripod grasp starts to develop approximately 3 ½ to 4 years of age
- Dynamic tripod grasp starts to develop approximately 4 ½ to 5 years of age

It is generally agreed that both dynamic tripod and dynamic quadrupod grasps are efficient grasp patterns, with the other grasp patterns being considered less efficient. A dynamic grasp occurs when fingers move independently and the web space (space between the thumb and index finger) is open and becomes circular, see diagrams below. Less efficient static grasps tend to use larger body movements of the shoulder and/or arm and the hands moves as a single static unit. Summers, Marian & Korn (1998) state that the pencil should be held between the pads of partially flexed and 'relatively' opposed thumb and index finger with the web space open. They suggest that the distal interphalangeal joint (DIP) of the index finger may be hyperextended.



An early grasp pattern is the full fist grasp or palmar supinate grasp.



The child then starts to hold the pen with fingers in this digital pronate grasp.



With development the child starts to hold the pencil between the thumb and index and middle fingers in a static quadrupod grasp.



An example of a mature pencil grasp is the dynamic tripod where the pencil is held between an opposed thumb and index finger and uses small, dynamic movements.

Photos printed with permission from DOT(WA) Learning to Hold a Pencil handout

By the age of 5 years, a child will usually have developed an upright seated posture at a desk with shoulders relaxed. Bonney (1992) identifies ideal posture for writing as having feet flat on the floor, forearms on the table at a comfortable height without changing height of the shoulders, the non-writing arm supporting the child's weight, and the paper positioned slightly to the left or right of the midline depending on the child's hand dominance. Principles of biomechanics guide ideas on optimal posture for handwriting and suggest trunk, core and shoulder stability, as well as gross motor upper limb control are needed for functional distal activity. It is therefore the recommendation that the child has proximal stability as a foundation for handwriting which is a predominantly distal activity (Bonney, 1992). The child should be moving towards a dynamic tripod or quadrupod pencil grasp pattern and pencil movements should be generated by isolated finger movements rather than movements from the shoulder, elbow or wrist. Pencil movements should be dynamic. Dynamic pencil movements consist of linear movements, translation movements and rotation. Linear movement is seen once the pencil is grasped, it must be shifted to adjust the tool (pen or pencil) for writing. Translation movements are the ability to move an object from fingers to palm and palm to finger tips and this is required for pushing the fingers towards or away from the pencil's point during handwriting to create effective letter formations. Rotation is the movement of the pencil around an axis which is required for turning the pencil from grasp position to placement to start writing or erasing (Feder & Majnemer, 2007).

Writing development in the young child requires the complex, dynamic interaction of the following performance components:

- Fine motor coordination
- Established hand dominance
- Appropriate pencil grasp
- Appropriate letter and number formation
- Visual memory of letters and shapes
- Paper placement and awareness of their hand, arm and sitting positions
- Smooth and coordinated movements that form the basis of future automatic processes in handwriting
- Understand the purpose of writing and the difference between drawing and writing

- Awareness of concepts related to writing such as spaces, words, letters and direction
- The ability to correctly identify and form lower-case and upper-case letters

During the primary years (Years 3-5) the following further developments typically occur:

- Identify and correctly form 26 lower-case and upper-case letters
- Begin to develop automaticity with letter patterns
- Develop sufficient legibility and fluency to enable the child to focus on the story or purpose of the writing
- Show consistent use of slope, size, spacing and letter alignment

In the middle years (Years 6-9) a child should continue to develop their handwriting by:

- Developing a personal writing style which is legible, fluent and durable
- Developing and/or practicing speed loops as used in cursive script
- Experimenting with different writing instruments

Dinehart (2015) outlines that writing letters requires a child to identify each letter of the alphabet through visual representation, recognise the line segments that form those letters and then be able to reproduce the letter sequence and direction correctly.

In a study of typically developing children in grades one to five (ages 6-11 years) Overvelde and Hulstijn (2011) found that handwriting quality develops quickly throughout grade one (ages 6-7 years) and reaches plateau by grade 2 (ages 7-8 years). Development of handwriting continues in grade 3 (ages 8-9 years), in that handwriting automaticity develops, handwriting becomes more organized and therefore the child can focus of the development of their ideas rather than focusing on letter formation. Overvelde and Hulstijn (2011) suggest that significant, ongoing improvements in handwriting quality can continue during grade 2 and into the first half of grade 3, with stability of handwriting skills most often being reached by the end of grade 3.

Speed of handwriting develops in a more linear fashion during the primary years and as a result, handwriting continues to improve throughout this time (Feder & Majnemer, 2007). Van Hoom, Maathuis and Hadders-Algra (2013) suggest two critical factors in handwriting performance, these being legibility and

speed. Legibility may be affected by difficulties with letter formation, spacing, size, slant and/or alignment. Speed is important for the child to cope with the demands of the classroom and is dependent on the context, instructions given, and whether the task requires copying, dictation or free writing.

Development of handwriting is considered an essential ingredient for success at school and important in building self-esteem in a child or adolescent.

Definition and Description of Motor Dysgraphia

Dysgraphia is a deficiency in the ability to write. The term *dysgraphia* comes from the Greek “*dys*” meaning “*impaired*” and “*graphia*” meaning “*making letter forms by hand*”. Fundamentally, dysgraphia is a disorder of writing ability, which covers writing at any level including letter illegibility, slow rate of writing, difficulty spelling and problems with syntax and composition of writing. Dysgraphia is a learning disorder where the individual’s writing skills are below the level expected for their age and cognitive level (Chung & Patel, 2015).

There are multiple classifications of dysgraphia and a variety of terms used for dysgraphia. Some of the terms cited in the literature include:

- dysorthography
- language based dysgraphia
- linguistic dysgraphia
- higher level cognitive dysgraphia (can be sub grouped into psycholinguistic and executive)
- dyslexic dysgraphia
- motor dysgraphia
- spatial dysgraphia
- peripheral dysgraphia
- phonological dysgraphia
- surface dysgraphia
- emotional dysgraphia
- graphemic buffer disorder
- acquired dysgraphia (due to a trauma or acquired brain injury)

For the purpose of these guidelines, the two broad categories to be discussed are language-based dysgraphia and motor-based dysgraphia.

Language Based Dysgraphia

In the Diagnostic and Statistical Manual of Mental Disorders 5th Edition (DSM-5) the term dysgraphia is not used. The DSM-5 uses the terminology “an impairment in written expression” under the category of specific learning disorder (SLD), which incorporates language-based dysgraphia signs and symptoms. This is the term used by psychologists and medical practitioners.

In the DSM-5, Specific Learning Disorder with an impairment in written expression includes deficits in:

- Spelling accuracy
- Grammar and punctuation
- Clarity or organization of written expression

The code used in the DSM-5 is: *315.2 (F81.81) with impairment in written expression.*

Symptoms of a “Specific Learning Disorder (SLD) with an impairment in written expression include:

- Difficulty with writing skills, as measured by individually administered standardized tests (or functional assessment of written skills), which are substantially below those expected given the person’s chronological age, measured intelligence and age-appropriate education.
- The disturbance in the first category significantly interferes with academic achievement or activities of daily living that require the composition of written texts (e.g. writing grammatically correct sentences and organized paragraphs).
- If a sensory deficit is present, the difficulties in writing skills are more than those usually associated with it.” (DSM-5)

Deuel (1994) explains that an individual with a language-based dysgraphia can generally copy written text accurately with relatively well-formed letters and words, and that the child or adolescent often has oral spelling skills at the same level as their written spelling skills. Deuel (1994) goes on to state that children or adolescents with language-based dysgraphia often show misspelling of words and have extra or deleted syllables or letters in their handwriting as well as some symbols inserted that do not resemble any letter of the alphabet. It is also described as being related to difficulty in processing and sequencing ideas in writing (SPELD, 2016).

An impairment in written expression under the category of specific learning disorder is assessed by a psychologist.

Motor Based Dysgraphia

As occupational therapists, our focus is on assessment and treatment of motor-based dysgraphia; the motor and physical components of handwriting and functional output of writing. All other categories of dysgraphia should be referred on for suitable assessment, diagnosis and appropriate treatment with a suitably qualified educational and developmental or clinical psychologist.

Motor dysgraphia is a difficulty with the fine motor skills needed to produce letters or numbers. The individual can see the graphic symbols, but cannot create the motor movements required. Motor dysgraphia affects the shape and quality of letters and writing, rather than the symbolization of writing. Motor dysgraphia includes impairment to the process involved in accessing the appropriate allographs (letter shapes) and to the motor programs responsible for letters being written or typed. This difficulty or hesitation in accessing appropriate letter shapes can affect the functional output of writing and the writing speed.

Motor dysgraphia can primarily involve difficulties which the child or adolescent experiences in coordinating movements to write letters. These deficits can stem from difficulties with fine motor development, visual-motor skills and sensory processing, resulting in slow and/or poorly formed letters. Case-Smith and Cornhill (1996) along with Feder and Majnemer (2007) suggest that the performance components associated with handwriting include kinesthesia (includes proprioception), motor planning, hand-eye coordination, fine motor skills, sensory awareness of the fingers, visual-motor integration and in-hand manipulation skills. It is also noted that there is strong association between in-hand manipulation and handwriting skills.

Overvelde and Hulstjin (2011) state that handwriting is a complex activity in which lower-level perceptual motor processes (motor planning and execution) and higher level cognitive (psycholinguistic and executive) processes continually interact. In these discussions, the lower level skills are a requirement to interact and further develop the higher-level cognitive processes. In other words, as soon as the lower level

motor processes have become relatively automatic, the higher-level processes (for example planning, language generation, reading and editing) can be activated concurrently. Therefore, motor skills are intrinsic to overall handwriting skills and development.

A paper by Dohla and Heim (2016) reports that the limitation for children and adolescents with motor dysgraphia is that given they have not fully automatized their letter production they have an increased demand on their memory and attention when writing. This in turn means that their higher-level cognitive processes are constrained, and they are likely to forget the writing plan or story they held in their memory before they can write it down.

Chung and Patel (2015) suggest that while there is no consensus regarding criteria for dysgraphia, the recommendation is that it includes illegible handwriting, decreased writing speed, discrepancy between oral and written output, and processing deficits (in orthographic awareness and/or graphomotor planning). Simner and Eidlitz (2000) suggest that dysgraphia includes distortions in the overall shape of letters, distortions in the size of the letter parts, irregular spacing between letters and between words. Paz-Villagran, Danna and Velay (2014) along with Engel-Yeger, Nagauker-Yanuv and Rosenblum (2009) describe the two main parameters used to assess and define dysgraphia as legibility and performance time (speed). They go on to explain that children and adolescents with dysgraphia display handwriting that is slow, consists of long and frequent pen lifts, lacking continuity and fluency, and present with instability and lack of regularity. Feder & Majnemer (2007) state that labored, slow, jerky writing or conversely, rapid, haphazard writing is usually a sign of difficulty with timing movements that affect the rhythm and flow of handwriting and is seen in children and adolescents with dysgraphia. A paper by Prunty and Barnett (2017) also reports that individuals with motor dysgraphia have difficulties with speed, legibility and the handwriting processes of pausing and letter formation.

The International Dyslexia Association (2000) states that in all cases of dysgraphia, writing requires inordinate amounts of energy, stamina and time.

Indicators of motor dysgraphia that occupational therapists commonly see in children and adolescents within the practice setting include:

- **Poor fine motor skills** – difficulties are seen with tracing, cutting food, tying shoe laces, doing puzzles, colouring in the lines, texting and keyboarding, difficulties drawing or reproducing shapes.

- Poor pencil grasp – holds pencil with an awkward or immature grasp, holds the pencil tightly, locking fingers into extension or fists into flexion to stabilise the pencil, presses overly hard with the pencil on paper. See Section 6: Appendices for some examples of poor pencil grasp patterns.
- Poor posture – holds wrist, arm, body or paper in an awkward position when writing and often the writing movement come from the shoulder or elbow and not the fingers or hand.
- Inconsistencies in handwriting – inconsistent sequences of strokes to create the same letter or number, inconsistencies with spacing between letters and words, letters are written in all directions including reversals, and letters and words run together on the page. See Section 6: Appendices for examples of average and below average handwriting samples.
- Difficulties with organization – difficulty organizing words on the page from left to right, difficulty writing on the lines and inside the page margins, frequent erasing of handwriting, poor sentence structure, difficulty planning assignments and ordering information in a logical manner. See Section 6: Appendices for examples of average and below average handwriting samples.
- Reduced handwriting speed – copies text slowly or writes very slowly, writes less than peers in timed settings, conversely handwriting may be rushed and haphazard.
- Illegible handwriting – writing is illegible or hard to read and making it difficult to assess content of the work due to an assessor being unable to read the content.
- Ideas conveyed when speaking stronger than ideas conveyed in writing and discrepancy between IQ or knowledge and written output, and difficulties thinking about what to write despite having good ideas when speaking.
- Avoidance of writing tasks – refuses to participate in writing tasks or shows anxiety when presented with writing tasks, rushes work to get it 'over with', complains about pain and fatigue in the hand or arm, and often does not complete homework tasks.

Chung and Patel (2015) also suggest that symptoms of motor dysgraphia can vary depending on the age of the child or adolescent. For example, a preschool child may be hesitant to draw or write and may say they dislike colouring in tasks. They may have an awkward pencil grip, position their bodies in an unusual way

and tire easily with writing or drawing tasks. School-age children may have illegible handwriting with difficulties staying on the baseline and writing letters of uneven height and size. Adolescents may write simple, brief sentences only and may have more mistakes than their same age and grade peers. They may demonstrate difficulties with written organization and display discrepancies between oral task and written task output.

Motor dysgraphia is more than just “poor handwriting”.

Dysgraphia is chronic, persistent, affects function and is a significant long-term problem for children and adolescents. Dysgraphia persists despite treatment and affects the child or adolescent’s ability to perform on an equal level to their peers despite their knowledge and understanding of a subject, which can result in poor outcomes for the child or adolescent.

Van Hoorn, Maathuis and Hadders-Algra (2013) state that the prevalence of motor dysgraphia at school age varies from 5-27%. Another study by Karlsdotter and Stefansson (2002) suggested that 27% of children had dysgraphic handwriting at the end of Grade 1 and at the end of Grade 5 this dropped to 17%. Hoy et al (2011) state that an estimated 10-30% of school-aged children experience handwriting difficulties of some type with Feder and Majnemer (2007) also reporting a prevalence of 10-30% of school aged children having handwriting difficulties that do not resolve without intervention. It should also be noted that a study by Karlsdottir and Stefansson (2002) reports that dysgraphia is more prevalent in males with between 66%-88% of those identified with dysfunctional handwriting to be male.

Chung and Patel (2015) state that at all ages, children and adolescents with isolated motor dysgraphia may not be as readily noted as children and adolescents with more obvious learning difficulties such as dyslexia. Engel-Yeger et al (2009) summarize in their study that teachers tend to give higher marks for neatly written work than for those where legibility is poor. It is important that, as occupational therapists, we look for and appropriately assess for motor dysgraphia in our client groups and support education staff, child health care professionals, carers and other health professionals to look for and refer children and adolescents who may be displaying signs of motor dysgraphia.

It is important to note that as occupational therapists, we are focused on assessing and treating the

functional limitations raised by motor dysgraphia and the difficulties the child or adolescent is experiencing in their occupations. Occupational therapists use a task analysis approach to identify difficulties and treat these accordingly. Therefore, it is not always essential to identify the neurological process or component behind each individual's motor dysgraphia as it may be a stand-alone difficulty or part of a co-morbid diagnosis or other condition, although identifying other diagnoses may be beneficial to the child or adolescent and family in accessing appropriate services for the individual's other needs. Signs and symptoms of dysgraphia should be treated according to a thorough assessment process and, where appropriate, other professionals such as an educational psychologist, speech pathologist or paediatrician, should be engaged to assess the child as a whole.

Dysgraphia can have a significant impact on a child or adolescent's life academically and can also impact on their social and emotional development. Feder and Majnemer (2007) state that the development of writing is not only important in building self-esteem but also an essential part of school success. It is therefore important to identify and treat dysgraphia so that the individual can perform to their potential and fully participate in their occupational roles.

Comorbidities

Motor dysgraphia can commonly occur with neurodevelopmental or other developmental disorders. These comorbidities do not necessarily exclude the diagnosis of motor dysgraphia. However, comorbidities make assessment and differential diagnosis more challenging because there is often overlap between the diagnoses. In these cases, clinical reasoning is required to attribute such impairments to motor dysgraphia independent from other diagnoses.

Comorbidities commonly seen with motor dysgraphia include:

- Developmental coordination disorder (DCD)
- Attention deficit hyperactivity disorder (ADHD)
- Specific learning disorder with impairment in reading (dyslexia)
- Specific learning disorder with impairment in written expression (language-based dysgraphia)
- Specific learning disorder with impairment in mathematics (dyscalculia)
- Autism spectrum disorder (ASD)
- Cerebral palsy
- Joint hypermobility syndrome
- Depression
- Anxiety
- Communication disorders
- Intellectual disabilities
- Learning difficulties due to neurological or sensory disorders (for example, paediatric stroke, traumatic brain injuries, hearing impairment or vision impairment)
- Neurocognitive disorders or neurodegenerative disorders
- Psychotic disorders (for example, schizophrenia or psychosis)

Section 2: Assessment Process for Motor Dysgraphia

In the first instance, it is important to note that much of the literature and research uses the word 'dysgraphia', but in many instances the authors are referring to 'specific learning disorder with impairment in written expression' or language-based dysgraphia, as described in Section 1 above. As occupational therapists, we are called upon and qualified to assess motor dysgraphia.

After review of the current literature the following guidance has been developed to assist occupational therapists in the assessment process for motor dysgraphia.

Referring Information

The first key step in the assessment process is obtaining clear information from the referrer as to the reasons the child or adolescent has been referred for an assessment for motor dysgraphia. For example; is the referral due to slow writing speed? Is it due to poor legibility? Is it due to poor pencil grasp? Is the child or adolescent experiencing pain when writing? It is also important to gather information on how the child or adolescent is functioning within the school environment, for example is the child or adolescent managing well in the classroom? Is the child or adolescent functioning at a similar level to their peers? Are their assignments and exams in timed conditions legible to the teachers marking them? This information is also important in helping to formulate client-centred Occupational Therapy goals and to support clinical decision making in the intervention process. See example questions in Section 6: Appendices, Motor Dysgraphia Checklist.

Background Information

In addition to information from the referrer, it is also important to obtain information from the child or adolescent's parent, teachers, carers or other involved professionals regarding a history of fine motor difficulties or issues with letter formations and handwriting. It is very important to obtain a comprehensive history of how long the handwriting concerns have been going on for and what assessment and/or treatment the child or adolescent has previously received.

A parent questionnaire can be helpful in obtaining comprehensive background information prior to the

formal assessment process begins. This information can guide and support later assessment decisions. Refer to Section 6: Appendices, Motor Dysgraphia Checklist, for appropriate questions and information that can be obtained from families, teachers, carers and the child or adolescent themselves.

Of particular importance in the assessment of motor dysgraphia is obtaining handwriting samples. Samples from timed assessments are especially useful in the clinical decision-making process and supporting the assessment and reporting process as samples provide accurate examples from the classroom or examination context which are difficult to obtain in a clinical environment.

Formal Assessments Currently Used by Occupational Therapists When Assessing for Motor Dysgraphia

Essential:

- The Detailed Assessment of Speed of Handwriting (DASH) by Barnett, Henderson, Scheib & Schulz (2007) or Detailed Assessment of Speed of Handwriting 17+ (DASH 17+) by Barnett, Henderson, Scheib & Schulz (2010)
- The Handwriting Speed Test (HST) by Wallen, Bonney & Lennox (1996)
- Typing Speed Test (if laptop is being requested or considered for special provision in examination situations)
- Clinical Observations by Curtin University of Technology (1997)
- Examples of written work completed in class, preferably under timed conditions for evaluation of handwriting legibility and written output (if the writing task was timed).

A recent study by Francis, Wallen & Bundy (2016) suggests that normative data presented in the Handwriting Speed Test (HST) and the Detailed Assessment of Speed of Handwriting (DASH) may reflect average handwriting speeds for current Australian school students, even though the DASH is originally based on data from children and adolescents from outside of Australia.

Optional:

If the referrer, parent or teacher is reporting that the child or adolescent is experiencing underlying difficulties with fine and/or gross motor skills, in addition to their handwriting concerns, it is pertinent to also carry out one or more of the following assessments to ensure a thorough assessment of the whole child or adolescent. One or a combination of the following assessments may be carried out as clinically indicated and as part of each occupational therapist's clinical assessment process.

The choice of optional assessments will assist in later intervention and treatment decisions as they can identify specific prerequisite skill discrepancies for the child or adolescent.

Optional assessments for motor dysgraphia may include, but are not limited to, the following:

- The Beery-Buktenica Developmental Test of Visual Motor Integration – Sixth Edition (VMI) (Beery & Beery, 2010)
- The Beery VMI Developmental Test of Motor Coordination – Sixth Edition (Beery & Beery, 2010)
- The Beery VMI Developmental Test of Visual Perception – Sixth Edition (Beery & Beery, 2010)
- Developmental Test of Visual Perception – Second Edition (DTVP-2) (Hammill, Pearson & Voress, 1993) or Developmental Test of Visual Perception – Adolescents and Adults (DTVP-A) (Reynolds, Pearson & Voress, 2002).
- Test of Visual Perceptual Skills – Third Edition (TVPS-3) (Martin, 2006).
- Movement ABC-2 (Henderson & Sugden, 2007).
- Bruininks-Oseretsky Test of Motor Proficiency – Second Edition (BOT-2) (Bruininks & Bruininks, 2005).
- Developmental Coordination Disorder Questionnaire 2007 (DCDQ'07) (Wilson & Crawford, 2007)
- Pain Scale (Huskisson, 1974)
- Jamar dynamometer (Fullwood, 1986)
- Pinch strength tests (Ager, Olivett & Johnson, 1984)

Key Indicators for Motor Dysgraphia

As outlined in the literature discussed in Section 1, motor dysgraphia includes illegible handwriting, decreased writing speed, discrepancy between verbal and written output as well as processing deficits (in orthographic awareness, and/or graphomotor planning). Therefore, it is important to look at the assessment results with this in mind.

Handwriting Readability or Legibility

For the content of a child or adolescent's work to be accurately marked, the expectation is that 85% of their writing needs to be readable. Readability scores of 85% and below, suggest that 15% or more of the child or adolescent's handwriting is not readable and therefore content cannot be accurately marked (Chapparo, 2006). Readability scores can be calculated using the following formula:

Number of words not easily readable ÷ total number of words written x 100

This formula will create a percentage readability score (Chapparo, 2006). An example of the readability formula would look like this:

7 (words not easily readable) ÷ 60 (total number of words written) x 100 = 88.3% readability.

Handwriting Speed

Clinical observations of handwriting speed during the administration of standardised measures provide valuable information, in addition to the quantitative scores (Missiuna et al., 2006). It is useful to note that both the DASH & HST are short, timed responses and do not show reliable correlation with longer timed examination situations (where exams can range from 30 minutes to 3 hours) and therefore it is recommended to obtain writing samples from actual examinations for the child or adolescent, or gain information through discussion with the child, family, teachers to gain an accurate functional picture that is relevant to the classroom context and longer timed examination situations.

Recommendations for cut off vary however the literature supports that the cut-off point should be applied to performance at or below the 5th percentile when reviewing handwriting speed alone. On the Wallen, Bonney & Lennox Handwriting Speed Test (1996) a scaled score of 3 or below, equivalent to a percentile rank of 1 and 2 1/3 standard deviations below the mean denotes a significantly impaired handwriting speed. A scaled score of 9 or below,

equivalent to a percentile rank of 9 and 1 1/3 standard deviations below the mean, denotes a mildly impaired handwriting speed. In a clinical setting, often a percentile rank of 9 or below is considered to be significant if there are other assessment findings and functional limitations suggesting motor dysgraphia. It is important to review the handwriting speed within the full context of the child or adolescent's handwriting assessment, history and function.

On the Detailed Assessment of Speed of Handwriting (DASH), a percentile rank at or below the 5th percentile denotes "slow handwriting, requires intervention" and a percentile rank between 6 and 15 equates to "moderately slow handwriting, requires monitoring/further investigation" (Barnett, Henderson, Scheib & Schulz, 2010, p. 50). Therefore, as with the Wallen, Bonney & Lennox Handwriting Speed Test (1996), a handwriting speed percentile rank of 15 or below would be significant within the context of the full handwriting assessment process and the child's or adolescent's functional difficulties.

Writing Speed/Written Output

Written output in timed tests and examinations that involve extended responses can indicate how many words a student writes in a set time, otherwise known as their writing speed or written output. This is the total words produced in the assessment divided by the time allocated for the task.

An example of the writing speed or written output formula would be:

$$785 \text{ total words} \div 60 \text{ minutes writing time} = 13.1 \text{ words per minute writing speed}$$

There is currently no normative data available regarding writing speed when constructing written expression that includes a cognitive load while writing for longer timed testing situations. The Detailed Assessment of Speed of Handwriting (DASH) does include a free writing subtest which requires cognitive load, but this does not provide normative data for longer timed tests of 1-3 hours which Year 10-12 examinations generally require. However, a student's writing speed (number of words per minute) can be compared to estimates based on research findings. In a variety of studies, handwriting speed has been found to increase steadily during the school years, with handwriting speed leveling off at about 13 to 14 years of age (Graham et al, 1998). In a study by Hedderly (1996) a range of writing speeds between 10 - 20 words per minute (wpm) was given for students aged 15 years and it is suggested that those students writing at a speed of 8 words per minute will almost certainly be disadvantaged in timed test situations. In another study by Ashton (1997) it was reported that the average rate of writing in a secondary school English paper is approximately 10-12 wpm; Connor (1995) has reported that 17-year-old students write 11.5 wpm on average when completing a self-generated writing task in response to a simulated examination question. Dutton (1992) suggests that a 17-year-old student writes 18.5 wpm on average when completing a 20-30-minute self-generated writing task.

A study by Allcock (2001) predicted that the average handwriting speed of high school students in the United Kingdom when writing on a chosen subject for 20 minutes were as follows:

School Year (United Kingdom)	Average Handwriting Speed – Words Per Minute (wpm)	Australian School Year Equivalent
7	13.9	6
8	14.6	7
9	15.7	8
10	16.3	9
11	16.9	10
12	17.8 *	11
13	18.6 *	12

* Projected score, based on Allcock's 2001 data

Pain

Children and adolescents with motor dysgraphia often experience pain with their handwriting due to inefficient or restricted pen/pencil grasp, holding the pen/pencil too tightly, applying excessive pressure on the paper when writing or when movements are initiated from the arm or wrist rather than the thumb or fingers (static grasp rather than dynamic grasp). Pain can be recorded using a 1-10 pain scale where 1 = no pain and 10 = pain such that the child or adolescent must stop writing to rest, stretch, shake or massage their hand before they can continue their writing task (Huskinsson, 1974).

When all this information is collated there may be a clear pattern of issues which emerge, which makes it easier to ascertain if the child or adolescent has motor dysgraphia. The pattern can be clearer for adolescents but it can be a more complicated process for a younger child. Motor dysgraphia tends to be something that becomes more evident as the child becomes older and may have had several years of handwriting difficulties. It is important that remediation for handwriting difficulties has occurred as this can also help in identifying whether a child has a chronic, persistent motor dysgraphia rather than a handwriting problem alone, as there may have been little to no change in their handwriting skill despite therapy input.

It is recommended that occupational therapists use caution in labelling a young child under the age of 8 (grade 3) as having motor dysgraphia. In their study, Overvelde & Hulstijn (2011) argue that children continue to improve their handwriting quality during grade 2 and into the first half of grade 3 with handwriting stability being reached by the end of grade 3. Furthermore, as stated in Section 1, motor dysgraphia is more than just "poor handwriting"; motor dysgraphia is chronic, persistent and affects the child's or adolescent's ability to perform on an equal level to their peers despite their knowledge and understanding of a subject. Therefore, the child or adolescent needs to have received at least six months of targeted handwriting intervention before the label of motor dysgraphia should be used.

When to Refer to Other Professionals to Assist in Identifying Comorbid Conditions Associated with Motor Dysgraphia

- Registered Psychologist – Refer if there are concerns with a child or adolescent's spelling and/or written expression. Other considerations for referral would include concerns with attention and/or mental health issues such as anxiety or depression
- Paediatrician – Referral is warranted if Autism Spectrum Disorder, Developmental Coordination Disorder, Attention Deficit Hyperactivity Disorder or other developmental or neurological concerns are identified for further investigation. For adolescents in Year 11 or 12 it may be more challenging to access a paediatrician given their age and current waiting times for appointments, therefore further investigation by other medical professionals such as a Psychiatrist or Developmental Neurologist could be considered.
- Psychiatrist – Consider a referral if issues with attention, anxiety or depression are impacting on the child or adolescent's abilities or if there are more significant concerns with mental health issues.
- Rheumatologist – Consider referral if the child or adolescent has concerns with joint hypermobility and/or Ehlers Danlos Syndrome.
- Speech Pathologist – Referral is warranted if there are concerns with speech and language.
- Physiotherapist – Consider a referral if core postural difficulties, concerns with musculo-skeletal function, strength, endurance, fitness and/or pain which are impacting on the child or adolescent's function.
- Specialist Hand Therapist – Referral should be considered if Repetitive Strain Injuries (RSI) or carpal tunnel syndrome is suspected.

Section 3: Occupational Therapy Management for Motor Dysgraphia

Occupational therapy management for children and adolescents with motor dysgraphia needs to be multidimensional, and therefore viewed and approached as follows:

- Intervention directly with the individual
- Modification of tasks and/or environment
- Accommodation
- Advocacy, information sharing and collaboration

Intervention

Occupational therapy intervention for motor dysgraphia, as in other areas of occupational therapy practice, needs to be occupation-based, evidence-based and needs to promote occupational performance (The Occupational Therapy Guide to Good Practice: Working with Children, 2016). Intervention needs to start with clear goals which are client-centred and functional.

Individuals with motor dysgraphia have difficulty with handwriting legibility and readability and/or speed (Berninger & Wolf, 2009) which may or may not be interfering with their spelling and written composition (Berninger & Amtmann, 2003). Therefore, the extent of difficulty that the individual experiences with the different processes of writing should guide occupational therapy intervention (Chung & Patel, 2015). As handwriting difficulties do not go away without intervention (Hamestra-Bletz, 1993; Smits-Engelsman & van Galen, 1997), it is essential that occupational therapists use interventions which the evidence suggests are the most effective in improving quality of handwriting in children and adolescents experiencing difficulty learning this skill (Graham & Weintraub, 1996; Zwicker & Hadwin, 2007).

Research shows that explicit teaching and instruction of handwriting is most effective and intervention with handwriting needs to automate basic, lower level skills first before adding higher level skills (Graham & Weintraub, 1996). For example, once legible letter formations have been learned children and adolescents benefit from intervention that helps develop automatic letter writing, which in turn transfers to writing output (compositional fluency).

As well as learning to form letters automatically, children and adolescents need to learn to retrieve the 26 letter formations automatically from their long-term memory (Berninger & Wolf, 2009). Berninger & Wolf (2009) describe the before and after letter game, where the child is asked to tell or write the letter that comes before or after another letter in alphabetical order, as helping to develop automatic letter retrieval. Research by Berninger et al (1997) using the following instructional sequence with each of the 26 letters has been found to be effective in improving automatic letter writing that transferred to compositional fluency (amount written within a set time frame). The sequence is as follows:

- The child or adolescent studies numbered arrow cues in a model letter which provides a consistent plan to form the letter
- The child or adolescent covers the letter and creates a visual picture of the letter in their mind for a few seconds
- The child or adolescent writes the letter from memory using the plan containing numbered arrow cues seen in the model letter
- The child or adolescent compares the letter they wrote to the model letter

“Cross-disciplinary research shows that handwriting is critical to teach from preschool to high school, but targeted skills for instruction and periodic review change as the students develop: Modes refer to each kind of handwriting (pen, pencil or marker) or technology (index finger, stylus or keyboard) used for letter production.” (Berninger, 2013, p. 2-3). Below is a table with a summary of Berninger’s recommendations for skill development. It is important to note that different countries and different states in Australia have differing grade names and expectations for each grade and therefore the following should be used as a guide only.

School Year/Grade	Developmental Stepping Stones
Kindergarten	Develop hand strength and fine motor skills through play-based activities such as peg-boards, playdoh or beading. Use markers to complete maze activities and carry out dot-to-dot tasks.
Preschool	Teachers model letter formation, children trace letters and name letters, copy letters in both upper and lower case and use dominant hand for writing.
First Grade	Practice writing letters from memory and using capitals for first letters and begin self-generated composing.
Second Grade	Same as First Grade, but focus on both legibility and automaticity.
Third Grade	Same as First Grade, but begin teaching cursive script. Focus should be on legibility.
Fourth Grade	Same as Second Grade, but start using cursive script in both upper and lower case alone and within words.
Fifth to Eighth Grades	Introduce keyboard instruction particularly introducing touch typing tuition.
Fifth to Twelfth Grades	Focus is on teaching composing skills such as listening and note-taking. Teachers should provide specific “tune-up” review for letters that are illegible.

(Berninger, 2013, p. 2-3).

Wallen, Duff, Goyen and Froude (2013) advocate that systems theory and motor learning theories are particularly suitable for handwriting intervention and recommend that occupational therapists move away from an impairment or deficit-orientated approach to intervention. They recommend providing handwriting interventions that involve explicit handwriting instruction and practice, which Hoy et al (2011) have identified as being necessary and most effective in optimizing outcomes for children and adolescents with handwriting difficulties.

One approach, which is based on systems and motor learning theories, that Wallen et al. (2013) state holds promise for effective intervention to address handwriting difficulties, is Cognitive Orientation to Daily Occupational Performance (Missiuna, Mandich, Polatajko & Malloy-Miller, 2001 p. 368). Cognitive interventions for handwriting, based on learning theories, that include self-instruction, verbal mediation, learning strategies of imitation, practice, self-evaluation and feedback have also been found to be effective in the research (Zwicker & Hadwin, 2007).

Multisensory interventions have been proven to be effective in improving handwriting readiness for children who differed by 15 points or more in their verbal and performance IQ scores, but not effective for children with average IQ scores (Zwicker & Hadwin, 2007)

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Goldstand et al (2013) strongly recommends the importance of the child or adolescent's involvement in handwriting remediation, from initial stages of occupational therapy assessment right through to intervention. Engel-Yeger et al (2009) also state that the child or adolescent's involvement in the goal-setting process should be a high priority for handwriting interventions. It is an important feature in building motivation so that they begin to value handwriting and can see what it can do for them, so they can be full partners in the process of self-assessment and in the setting of educationally relevant goals collaboratively with the occupational therapist. This is likely to increase the child or adolescent's motivation to learn, thereby promoting achievement. Occupational therapists also need to collaborate with educators and individuals in identifying handwriting strengths and weaknesses, and effectively integrating handwriting instruction and practice as part of a comprehensive handwriting treatment program.

Most studies of handwriting intervention support its effectiveness, even though these interventions have varied in relation to treatment approaches used, duration of intervention and frequency of intervention (Feder & Majnemer, 2007). More recently, a systematic review of nine randomised control trials and two non-randomised control trials of interventions to improve handwriting by Hoy et al. (2011) outline that a practice component in handwriting interventions is necessary for improvement. Hoy et al. (2011) systematic review recommends that a handwriting practice program with a minimum of two sessions per week and at least 20 sessions in total is effective in improving handwriting. It has been shown that handwriting interventions that do not include handwriting practice are ineffective. Berninger, Nagy, Tanimoto, Thompson & Abbott (2015) state that children and adolescents with dysgraphia were robust responders to handwriting instruction.

Printing and cursive handwriting have unique processing requirements, as does keyboarding (computer use) (Berninger, Abbott, Jones et al, 2006). Therefore, if a child or adolescent has not mastered printing, the transition to cursive writing may be very difficult for them. Furthermore, keyboarding may not be any more advantageous than handwriting (Berninger & Wolf, 2009). Dinehart (2015) reports that there is often a significant correlation between handwriting speed and typing speed, that is if a child or adolescent has slow handwriting, they are also likely to have slow typing skills as both require fine motor skill coordination. Dinehart (2015) goes on to say that explicit keyboarding instruction is likely to improve keyboarding skills and speed, just as specific

handwriting instruction helps improve handwriting skills. Deuel (1994) explains that keyboarding generally requires only a single movement (although at times two movements for capitalisation) to create a legible letter or an accurate space and therefore once keyboarding is learned, it demands a much smaller extent of cerebral activation than controlling a pen. Decisions regarding which style of writing is best for a child or adolescent and/or whether keyboarding should be used for written work needs to be considered carefully following thorough assessment and consultation with the child or adolescent, parents, teachers and other professionals. When recommending computer use for written work the child or adolescent should receive explicit keyboard instruction (Berninger & Wolf, 2009).

Whilst keyboarding and typing can be a useful alternative for children with motor dysgraphia, it should be remembered that writing letters by hand, as stated by Dinehart (2015) activates areas of the brain identified in the 'reading circuit' and writing activates these areas more than other forms of sensorimotor training such as tracing and typing. This means that children and adolescents should be encouraged to continue with some handwriting, alongside their typing and keyboarding, to support skill development in other areas.

Modification of Task and/or Environment

Modifications for handwriting difficulties in the classroom and at home may include:

- **Postural supports** – desk type, chair type, size and dimensions of desk and chair, angled writing boards, hand or finger splints which may be of relevance if the child or adolescent is experiencing joint hypermobility and/or pain when writing.
- **Change of tools** – types of pen or pencil or pencil grips to assist with manipulation, pressure on paper and writing flow; types of paper such as those with raised lines, dotted thirds lined paper or graph paper etc.
- **Adjustments to the amount of handwriting** – reduce copying aspects of written work, provide electronic copies of notes, allow photographing of notes or presentations, reduce the length of written requirements on written assignments, limit the need for draft copies, allow typing of assignments and classwork.
- **Adjustment of writing rate demands** – allowing

more time for note taking, copying, tests etc.;
allowing typing of some assignments and projects,
allow the use of a digital recorder, allowing rest and
movement breaks when writing if there is pain,
fatigue or reduced endurance.

- **Change of format of written work** – allow oral presentations or testing, allow visual or diagrammatic presentation of projects.
- **Allow use of technologies** – for example word processing, voice activated software, digital recording etc.

(Addy, 2013; DSF Literacy Services, 2014; Sutherland, 2012)

Occupational therapists need to support the child or adolescent to identify modifications to support their ability to learn within the classroom. Modifications need to assist the individual in accessing the curriculum and occupational therapists need to liaise with the school or educational institution to support them in providing appropriate modifications for the individual child or adolescent to improve their functioning within the classroom.

Accommodations and Special Provisions

When recommending accommodations or special provisions for students in the classroom, especially in timed assessments, it is imperative that occupational therapists familiarize themselves with the School Curriculum and Standards Authority (SCSA) Guidelines for Disability Adjustments for Timed Assessments (2015). These guidelines are updated regularly therefore the SCSA website should be checked regularly to ensure the most current guidance is being utilized.

It is recommended that the SCSA guidelines be reviewed thoroughly for each application so that accurate and appropriate recommendations are being made based on the assessment outcomes and the functional impact for the child or adolescent. The SCSA Guidelines for Disability Adjustments for Time Assessments (2015) are relevant to assessments including National Assessment Program – Literacy & Numeracy (NAPLAN), Online Literacy and Numeracy Assessment (OLNA), Externally Set Tasks (ESTs), Australian Tertiary Admissions Rank (ATAR) course examinations and school-based assessments for Western Australian Certificate of Education (WACE) courses. The School Curriculum and Standards Authority (SCSA) Guidelines for Disability Adjustments for Timed Assessments (2015), which was last updated

in March 2018, states that the following types of adjustments may be applied for, for students with disabilities, depending on the outcomes of thorough assessment and functional limitations:

1. Rest breaks

Rest breaks are appropriate when a child or adolescent is unable, physically or psychologically, to complete an assessment in a continuous manner, as per the requirement of the assessment.

“The effectiveness of rest breaks will generally be evident from the child or adolescent’s use of that adjustment in classwork and internal assessment task of a similar length to the assessment. It should be clear to teachers that the student is more focused, alert or productive after taking a break.” (School Curriculum and Standards Authority, 2015, p. 3-4).

2. Extra working time

Extra working time is appropriate for a student whose access to an assessment is impeded by:

- a diagnosed learning disorder who demonstrates a very low reading comprehension score, very low written expression score or very low ability to process number concepts when assessed with standardised assessments
- physical disabilities that significantly affect handwriting or use of keyboard or tablet
- vision impairment where standard adjustments will not provide reasonable access
- working with a scribe or support person.

“Generally, it is recommended that schools grant no more than five minutes of extra time per half hour of assessment time.” (School Curriculum and Standards Authority, 2015, p. 4-5.)

3. Extra time at student’s discretion

Extra time at a student’s discretion is appropriate for a student who has a complex medical condition that requires extra management, or multiple conditions that inhibit the student’s ability to complete a task at the expected rate.

“Up to 10 minutes per hour may be available in the ATAR course examinations where the student’s need is demonstrated not to be reasonably met by rest breaks, but requires more flexibility than extra working time, or requires a combination of working and non-working time.” (School Curriculum and Standards Authority, 2015, p. 5.)

4. Special format assessment

This may include large print, Braille or black & white print and is generally an accommodation reserved for those with vision impairment. (School Curriculum and Standards Authority, 2015, p. 5-6).

5. Oral/sign support

This support is appropriate for those students who are deaf or have a hearing impairment. (School Curriculum and Standards Authority, 2015, p. 6).

6. Support Person (scribe or reader)

Students with a physical disability who are unable to write or use a keyboard can be supported by a scribe. Use of a scribe is a learned skill and requires different cognitive processes than those required to handwrite or type, for example the student needs to pace dictation and be conscious of adding punctuation and structure to the work, so this needs to be considered if this is being requested. (School Curriculum and Standards Authority, 2015, p. 7-8).

A reader or recorded test is a special provision that can be considered for a student with a reading disorder or vision impairment when the student's disability does not permit them to access a conventional written assessment. (School Curriculum and Standards Authority, 2015, p. 7-8).

7. Use of computer or assistive technology

"Students with a permanent disability who have been using the accommodation of a computer for school-based assessments over several years, may

be granted the use of a computer. Spelling and grammar checks are not allowed. Additional working time is not usually allowed. Poor handwriting alone is not considered a disability that necessitates a computer unless it results from a diagnosed disabling condition. A computer is not suited to examinations requiring equations or calculations." (School Curriculum and Standards Authority, 2015, p. 8-9). The student needs to have undergone thorough assessments with clearly outlined functional limitations that require computer use before this accommodation should be recommended.

8. Modification to the environment

There may be approval for modifications to the student's environment, such as separate supervision, furniture modifications, changes to lighting or other environmental conditions (School Curriculum and Standards Authority, 2015, p. 10).

9. Access to medication

Students who need to take medication for medical conditions such as diabetes or ADHD/ADD can be granted permission to take medication during examinations, however no additional time is given to take the medication. (School Curriculum and Standards Authority, 2015, p. 10.).

On Page 14 of the School Curriculum and Standards Authority Guidelines for Disability Adjustments for Timed Assessments (2015) the following provisions are available to students with Dysgraphia (motor-based) in timed assessments, dependent on the functional impact of the condition:

Possible difficulty/impairment in timed assessment		Possible provisions available (dependent on functional impact of condition)	Minimum documentation
Dysgraphia (motor based)	Difficulties with handwriting	<ul style="list-style-type: none"> • Dotted thirds paper for essays • Rest breaks • Extra working time • Use of computer/scribe 	<ul style="list-style-type: none"> • Specialist medical report (Occupational Therapist) • School case management comments

https://senior-secondary.scsa.wa.edu.au/_data/assets/pdf_file/0007/76174/Guidelines-for-disability-adjustments-for-timed-assessments.pdf

Advocacy, Information Sharing and Collaboration

Collaboration between occupational therapist and parents, teachers, educational specialists and other professionals involved with the child or adolescent ensures understanding of the diagnoses, difficulties, appropriate intervention and outcomes, and access to key resources useful for improving the child or adolescent's occupational performance and quality of life (Wallen et al 2013; Missiuna et al, 2007). Occupational therapists also have a role to play in advocating for and informing educational authorities on the importance of, and evidence for, handwriting instruction as part of the educational curriculum (Wallen et al, 2013). Hoy et al (2011) suggest that it may be better to advocate for more handwriting practice for all children. Therapy then would be offered only for children who continue to have difficulty even after regular practice has been provided. Hoy et al (2011) also state that 'writer's clubs' have demonstrated effectiveness and therefore this could be an option for schools to support students finding handwriting an ongoing challenge prior to seeking therapeutic intervention.

A key role of the occupational therapist is also to manage expectations of the child or adolescent, parents and teachers. Whilst recommendations for classroom supports and school-based modifications are important to assist the child or adolescent to reach their academic potentials and learning goals, it is vital to be clear with all parties that special examination provisions made by SCSA for WACE and ATAR examinations may be different. For example, a child may be finding a computer useful for their classroom work and for school-based testing, but special provisions for computer use in the WACE or ATAR examinations may not be granted as decided by SCSA. The child or adolescent's school make the decisions for classroom-based accommodations and provisions for school-based testing but SCSA are the decision makers for the ATAR/WACE examination situations. Being clear with all involved during the assessment process regarding this means that the right support and intervention can be provided.

Occupational therapists should also be clear that children and adolescents with motor dysgraphia should be involved in targeted handwriting interventions prior to Year 12 if they want to be considered for SCSA determined special provisions for WACE & ATAR examinations. The current recommendations are that the child or adolescent have been involved in intervention for at least 6 months at some point previously, although there is no current guidance on the frequency of the intervention during the 6-month period.

Section 4: Reporting

The main recipients of occupational therapy reports for children and adolescents presenting with motor dysgraphia are:

- Parents and families
- Schools – teachers, school psychologists or counsellors
- Other professionals – for example, to assist in the diagnosis of co-morbid conditions
- School Curriculum and Standards Authority (SCSA)

Occupational therapy reports should include the following information:

A clear statement as to the purpose or intent of the report, reason for the assessment, concerns of the child or adolescent, family and/or referring professional.

- Information about the child or adolescent including family, medical, developmental and educational history, assessment and intervention history, for example previous assessments carried out and history of intervention.
- Samples of handwriting from various years can be very beneficial to include in reports to demonstrate the extent of the functional challenges and the difficulties over time.
- Occupational profile of the child or adolescent, including priorities and goals of the child or adolescent and family, the child or adolescent's occupational strengths and areas hindering their participation in occupations.
- Assessment process including list of assessment tools and evaluation methods used, for example interviews, observations, standardized assessments; and the key assessment findings.
- Occupational performance and interpretation including direct information about the contextual relevance in the summary and recommendations, for example ensuring these relate to goals and focus on participation and least-restrictive alternatives for the child or adolescent.
- Outlining the impact of the diagnosis on the student's participation at school and within other occupational areas. Highlight the extent of the functional impact, consider the amount of effort required for tasks and impact on other areas of the child or adolescent's daily life, including effects of

pain and fatigue.

- Photographs of handwriting samples and pencil grasp can also be added to support assessment findings.
- Goals that are occupation focused; child or adolescent and family centered; as well as being specific measurable, achievable, realistic and timely.
- Occupational therapy reports also need to be clearly titled: Confidential Occupational Therapy Assessment Report/Summary; dated, signed and contain page numbers and a clear dissemination list.

(Occupational Therapy Guide to Good Practice: Working with Children, 2016)

Reports for School Curriculum and Standards Authority (SCSA)

In addition to the information regarding general occupational therapy reports outlined above, occupational therapy reports written to substantiate and support the request for provision of special examination arrangements in ATAR course and WACE examinations need to be comprehensive and must include:

- Clear statements as to the reason(s) the adolescent is experiencing difficulty accessing the curriculum, for example statements such as "The assessment results indicate that (name) meets the criteria for motor dysgraphia. Special examination arrangements are warranted....." or "The occupational therapy assessment results together with the functional limitations show (name) has motor dysgraphia...." or "motor dysgraphia best explains the difficulties (name) is experiencing in...."
- **Clear description of the functional impact the motor dysgraphia is having on the adolescent's performance in examinations. This is a vital part of reporting for SCSA as this will support their decision-making process, as significant functional impacts for the adolescent are more relevant than a specific diagnosis.**

- Clear descriptions of the social and/or emotional impact motor dysgraphia is having on the adolescent.
- Clear recommendation(s) regarding special provisions in WACE examinations being applied for as per the SCSA documentation of available provisions.

Occupational therapy assessments and reports for the School Curriculum and Standards Authority (SCSA) need to be completed in the year of application, so that the functional impacts necessitating the special provisions being applied for are current. This means that the assessment and report need to occur at the beginning of Year 12. The current SCSA application form for special examination arrangements, available on the SCSA website, needs to be accessed to obtain the closing date for applications each year. <https://senior-secondary.scsa.wa.edu.au/assessment/examinations/special-provisions>

Although a current occupational therapy report is important for SCSA to assess the option of special provisions for ATAR and WACE examinations, a child or adolescent should already have a diagnosis of motor dysgraphia and have had intervention specifically targeted at their handwriting prior to the beginning of Year 12.

Examples of conclusions that can be used in occupational therapy reports for SCSA include:

- “The assessment results indicate that (name) meets the criteria for motor dysgraphia. Special examination arrangements are warranted to address the significant functional impact...”
- “These assessment results coupled with (name)’s long term, chronic functional difficulties with handwriting and fine motor skills despite therapy interventions, indicate he/she has motor dysgraphia. The following recommendations are made to provide fair and equitable assessment for (name) in test and examination situations...”
- “The assessments completed and (name)’s profile suggest the presence of motor dysgraphia. It is recommended that the following special provisions be implemented to assist (name) in addressing the significant functional impact...”
- “(Name)’s overall performance on standardised assessments and functional profile indicate that he/she is presenting with motor dysgraphia, which is affecting his/her ability to produce legible letter formations and handwriting speed at a level expected for his/her age and academic abilities. Therefore, the following recommendations for test and examination situations are being made...”

Section 5: Conclusion

Motor dysgraphia is a difficulty with the fine motor skills necessary for writing. It includes illegible handwriting, reduced writing speed, discrepancy between verbal and written outputs and processing deficits in orthographic awareness and/or graphomotor planning.

Motor dysgraphia is more than just poor handwriting and is chronic, persistent, affects function and is a significant long-term problem for children and adolescents.

It is important that occupational therapists thoroughly assess for motor dysgraphia and provide intervention to meet the needs of the individual child or adolescent to reduce the functional limitations of long term social, emotional and educational challenges. It is also important that occupational therapists support teachers, carers and educational organisations to identify and refer children and adolescents with motor dysgraphia to an occupational therapist for appropriate assessment, intervention and modifications.

Occupational therapists have a vital role in liaising and setting clear expectations when supporting children and adolescents, and their families and educators to appropriately access learning, as well as navigating the assessment and reporting processes for special provisions.

Section 6: Further Resources

DSF Literacy and Clinical Services (The Dyslexia-SPELD Foundation of WA Inc.) provides support to children and adults with learning disabilities and works to enhance the community's understanding of specific learning disabilities. DSF also provides advice and support to families and educators on successful literacy acquisition, evidence-based practice, and the strategies most likely to improve literacy outcomes for all students. The DSF website provides information about specific learning disabilities such as dyslexia, dysgraphia and dyscalculia, assessment services, tutors, professional learning opportunities, information evenings/workshops for parents and students, and also have a library and a bookshop. <https://dsf.net.au/>

The School Curriculum and Standards Authority (SCSA) website <https://www.scsa.wa.edu.au/> provides the following information of importance to Occupational Therapists:

- Guidelines for Disability Adjustments for Timed Assessments (2015), which was last updated in March 2018, which provides a summary of the adjustments which may be applied for, for students with a specific learning disorder and/or disability, when completing the National Assessment Program – Literacy and Numeracy (NAPLAN), Online Literacy and Numeracy Assessment (OLNA), Externally Set Tasks (ESTs), school-based timed assessments for courses and ATAR course examinations. https://senior-secondary.scsa.wa.edu.au/_data/assets/pdf_file/0007/76174/Guidelines-for-disability-adjustments-for-timed-assessments.pdf
- Information regarding 'special provisions', including the most current application for special examination arrangements. <https://senior-secondary.scsa.wa.edu.au/assessment/examinations/special-provisions>
- Examination information for ATAR courses. <https://senior-secondary.scsa.wa.edu.au/assessment/examinations/examination-information>

- Examination front covers (2018) which provide information regarding WACE examinations such as time allowed for examinations, materials required/recommended for examinations, structure of examinations and instructions to candidates. <https://senior-secondary.scsa.wa.edu.au/assessment/examinations/2018-examination-front-covers>
- Past WACE examinations. <https://senior-secondary.scsa.wa.edu.au/further-resources/past-wace-examinations>

The **CanChild** website provides information regarding evidence-based resources, such as, **To Type or Write – That is the Question!**, which provides answers to the following frequently asked questions: "When to type or write?"; "Printing versus cursive writing?"; "When to introduce keyboarding?"; "Best method of instruction?". <https://canchild.ca/en/resources/128-to-write-or-to-type-that-is-the-question>

The Independent Living Centre of WA (ILC)

Technology and Communication Service provides information and advice about assistive technologies for communication, learning, recreation and work, and is staffed by occupational therapists and speech pathologists who have extensive experience, knowledge and skill in working with the latest assistive technologies and communication aids. <https://ilc.com.au/services/ilc-technology/>

The following research article provides interesting reading about pencil grasps and their relationship to handwriting speed and legibility:

Schwellnus, H.; Carnahan, H.; Kushki, A.; Polatajko, H.; Missiuna, C., & Chau, T. (2012). Effect of Pencil Grasp on the Speed and Legibility of Handwriting in Children. *American Journal of Occupational Therapy*, 66, 718-726. <https://ajot.aota.org/article.aspx?articleid=1851631>

Section 7: Appendices

Appendix 1: Motor Dysgraphia Checklist

Symptoms/Functional Issues	Past History of this?	Current Problem?	N/A	Comments
Poor pencil grasp (include grasp type, web space, division of hand, use of pencil grips)				
Fine motor difficulties (particularly difficulties with shoelace tying, cutlery use, buttons, zips etc.)				
Poor letter formations (include letter reversals, line use, spacing between letters and words, organization over page)				
Poor legibility/readability				
Poor handwriting speed				
Pain during writing				
Typing skills Is typing being used as a handwriting alternative? Can they touch type? Can they type faster than they can handwrite?				
History of 'giving up' when writing? Or history of avoiding handwriting or drawing tasks?				
History of less written output than peers?				
Is handwriting affecting academic performance?				
Intervention received by OT or tutor or other? If so, what type? How long?				
If previous OT intervention, what issues identified in assessments? List these:				

Appendix 2: Occupational Therapy Report Template

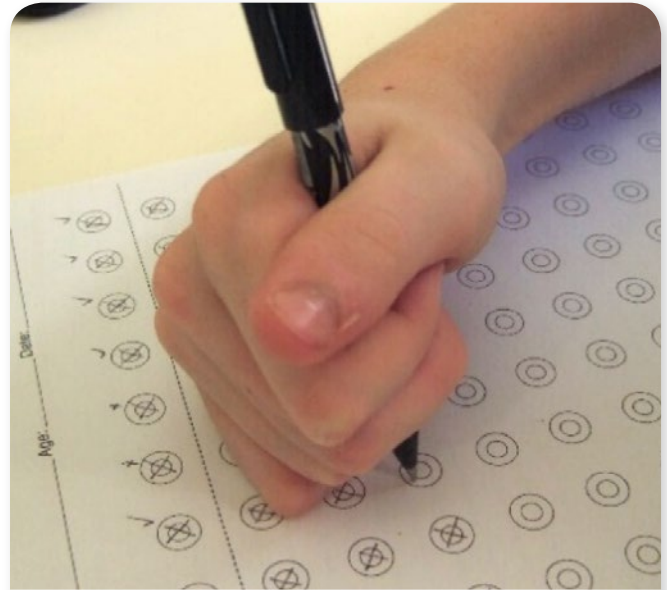
Example of an Occupational Therapy Assessment Report suitable for use for the School Curriculum and Standards Authority (SCSA) or for general occupational therapy assessment for motor dysgraphia.

<p>CONFIDENTIAL AND WITHOUT PREJUDICE This report must not be transferred without permission of author</p> <p><u>OCCUPATIONAL THERAPY ASSESSMENT REPORT</u></p>
NAME:
DATE OF BIRTH:
CHRONOLOGICAL AGE:
ADDRESS:
TELEPHONE:
DATE(S) OF ASSESSMENT:
REASON FOR REFERRAL:
<p>Occupational Profile:</p> <p>Presentation at Assessment:</p> <p>Assessments Used:</p> <p>Occupational Therapy Assessment Results:</p> <ul style="list-style-type: none">• Clinical Observations• Standardised Assessments• Typing Speed (if computer access is being requested or considered)• Evaluation of timed assessments (3-hour examinations and in-class testing) <p>SUMMARY OF ASSESSMENT RESULTS</p> <p>CONCLUSION</p> <p>For example:</p> <p>“The assessment results indicate that (name) meets the criteria for motor dysgraphia. Special examination arrangements are warranted to address the significant functional impact...”</p> <p>RECOMMENDATIONS</p> <ul style="list-style-type: none">• Intervention• Modification• Accommodation
Name of Occupational Therapist:
Date:
cc:

Appendix 3: Examples of Poor Pencil Grasp Patterns Seen in a Clinic Setting (2017)



This picture shows an immature palmar supinate grasp pattern. The thumb is also wrapped around the fingers and the web-space is almost closed. This grasp does not allow the fingers to make dynamic movements and therefore all movement comes from the arm and shoulder.



This example shows a finger and thumb wrap grasp. It does not have a web-space and therefore the fingers and thumb are unable to move in a dynamic way which means all movement is coming from the forearm, arm or shoulder.



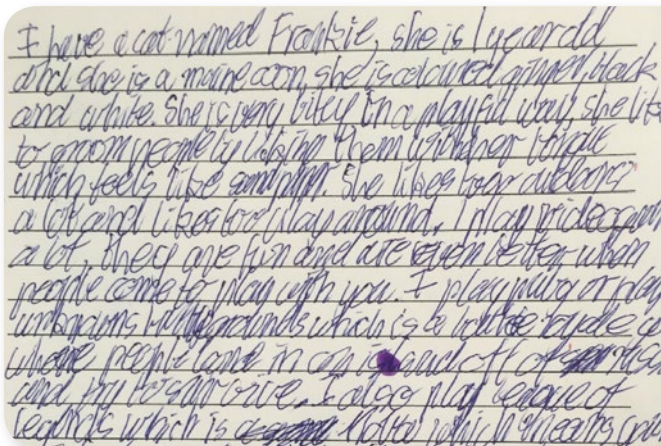
This grasp pattern is a quadropod grasp but the index finger is wrapped around the thumb locking it in position and limiting the movement the fingers can make in a dynamic and efficient manner. The wrist position is also not in a midline position meaning more movement will be occurring at the arm and shoulder.



This picture shows a lateral tripod grasp but the wrist position is flexed meaning movement in the fingers will be limited. The web-space is also tear drop shaped given the thumb is not sitting opposed to the index finger on the thumb which limits the translation movements made by the thumb and fingers.

Appendix 4a: Examples of students' handwriting seen in a clinic setting

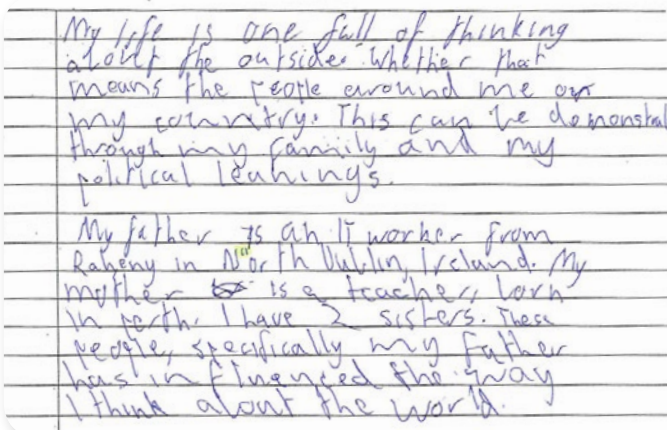
Example of Below Average Handwriting Samples seen in a Clinic Setting (2017)



I have a cat named Frankie, she is 1 year old and she is a Maine coon, she is coloured ginger, black and white. She is very nice in a playful way, she likes to groom people by licking them with her tongue which feels like sand paper. She likes to go outdoors a lot and likes to play around. I play video games a lot, these are fun and are even better when people come to play with you. I play video or play with games which is to be better by the whole people come in on is back off of some and try to get over. I also play league of legends which is a game which is really cool.

This sample of below average writing shows the inconsistencies with spacing between words and letters, which makes differentiating between the words difficult and affects the readability of the sample. Sizing between lower and upper-case letters is also inconsistent, meaning it is hard to identify each letter shape. The sample also shows poor organization with words being squashed on to the end of the line when it would be more appropriate to write the word on the next line. It also shows frequent "going" over or re-writing of letters and scribbling out letters or words.

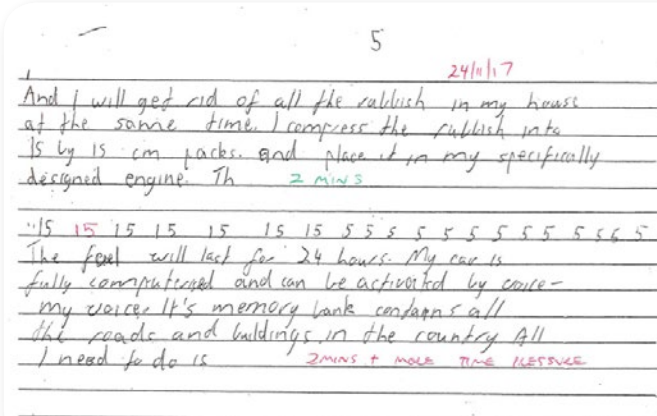
Example of Pre and Post Intervention Handwriting Samples for a Student in a Clinic Setting (2017)



My life is one full of thinking about the outside. Whether that means the people around me or my country. This can be demonstrated through my family and my political leanings.

My father is an IT worker from Raheny in North Dublin, Ireland. My mother is a teacher, born in Perth. I have 2 sisters. These people, specifically my father has influenced the way I think about the world.

This sample shows inconsistencies in the slant of the letters from upright printing to leaning to the left and the right. There is poor organisation across the lines with some lines squeezing words right across and others leaving large gaps before the end of the line. Inconsistencies with spacing between letters and words is seen. If you look at the same letter throughout the work, such as the letter 'm' you see it is formed differently each time demonstrating that the child is having to consider the formation of the letter and completing it slightly differently each time.



5
24/11/17

And I will get rid of all the rubbish in my house at the same time. I compress the rubbish into 15 by 15 cm packs and place it in my specifically designed engine. Th 2 mins

15 15 15 15 15 15 5 5 5 5 5 5 5 5 5 5 5
The fuel will last for 24 hours. My car is fully computerised and can be activated by voice - my voice. It's memory bank contains all the roads and buildings in the country. All I need to do is 2 mins + more time left over.

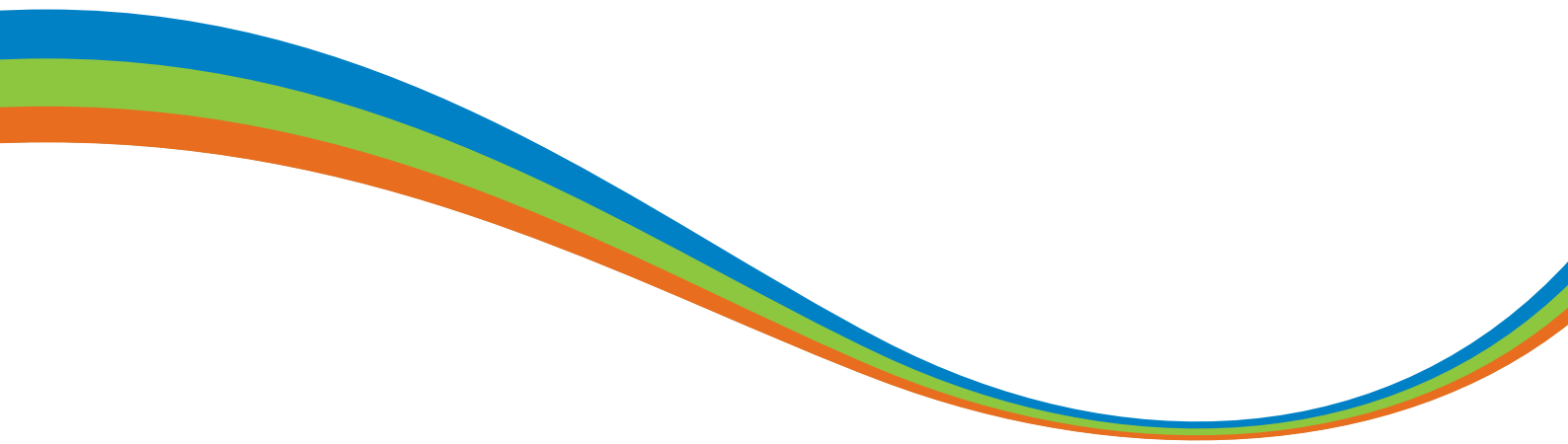
This post intervention sample shows the same child as above. This sample shows more consistent slant in the letters with them all going in the same direction. There are consistencies with organisation across the page and consistencies with spacing between letters and words. Letter formation appears to be more consistent which shows automaticity in the letter formation and will improve the child's ability to write at increased speed.

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