## Individual intervention plan

Concentrate on problematic tasks, focusing on relearning, learning or adjustment

**Consultation:**
Report findings to the child, parents, teacher, care providers, including the PPT
Diagnosis with a well-founded decision regarding starting an intervention yes or no

**Education:**
Insight into handwriting learning phase and problem areas
How to reach desired goals, and who plays a role
Specific-Measurable-Acceptable-Realistic-Timely-Inspiring (SMARTI) goals
Task division between child, parents, teacher, other relevant persons
Time path that enables intensive learning and repetition
Insight into the task demands that can be handled by the child
Evaluation date and criteria

**Intervention:**
Overview of difficulties in handwriting tasks
SMARTI goals with concrete subgoals at the task level with task load and time path
Agreements made with parents and other relevant persons
Evaluation dates and criteria on the level of goals and subgoals

Evaluation plan: (sub)goals handwriting, timing, criteria

Profiles A, D or E: indication for PPT; Profile B: no indication for PPT
profiles C and D: possible short-term support for schooling

## Diagnosis / prognosis

Profile A: motor performance problems and handwriting problems
Profile B: handwriting problems based on cognitive and/or behavioural problems
Profile C: didactic problems at school
Profile D: combination of motor, cognitive and/or behavioural and handwriting problems
Profile E: handwriting problems, motor problems and underlying pathology

Profiles A, B, C, D or E

## Goal: paediatric physiotherapy (PPT) diagnosis, including answer to request for help and profiling

**Overview of the findings:**
Determine whether handwriting is a problem for the child, parents or teacher
Overview of the handwriting problems identified
Overview of the motor performance problems identified
Overview of problems in visual perception and/or integration
At what level is the child able to perform tasks?
At what level is the child unable to perform tasks?
Which contextual factors constrain/ facilitate performance?
What are the child's strengths/weaknesses (motor, behavioural, cognitive)?
What are the advantages/limitations of the environment (school, parents)?

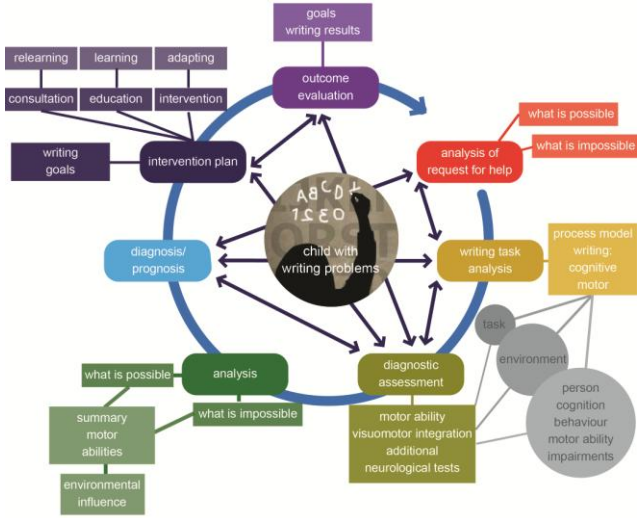
**Based on the analysis, a conclusion is drawn regarding:**
Which of the profiles A, B, C, D or E is relevant.
Level of mastery of the (provisional) handwriting tasks, e.g. finger dexterity, and the letter forms that have/have not been mastered
If relevant visual perception and visuomotor integration level
Prognosis based on an estimation of the learning ability of the child and the support available from the environment
Child, task and contextual factors that can be used within the intervention to teach the child to write
Overview of consultation questions for other involved persons

Profiles C, D: discuss findings/intervention plan and strategy with teacher; Profile E: further diagnostic tests

## Goal: establish handwriting result / handwriting dexterity

Have the goals of the intervention been achieved?
Do some handwriting problems still exist?
Has the request for help been addressed?
Have the necessary tests/task analyses been conducted?

If negative: repeat analysis




Profiles A, D: MABC – and/or MABC manual training – and/or Beery VMI – and/or finger dexterity – and problems with accuracy, speed, fluency of movement
Profiles A and D: motor ability testing
Profile E: indications of functional disability and/or pathology

## Goal: motor performance testing

Are there any problems with performing fine-motor tasks?
Are there any problems with performing gross-motor tasks?
What is the influence of visual perception or visual-motor planning on the handwriting problems?
Are any behavioural or cognitive problems observed during performance of the motor tasks?
Are there any functional disabilities that are negatively influencing handwriting ability?

### Tools

Parents: CVO, MABC1 or 2 check-list
Teachers: MABC1 or 2 check-list, GMO
Analysis: MABC 1 or 2, finger succession task, translation and in-hand manipulation (KOEK), classification of pen grip (Schneck & Henderson)
Beery VMI
Task manipulations: accuracy, speed, complexity, Functional disabilities

Profile C: MABC +, finger dexterity +, Beery VMI +, non- letter-related tasks +, simple tasks +. Increasing complexity: accuracy and speed +/–, Dual-tasking +/–, letter forms +/–
**Advice at school:**
Further tests (behaviour, learning problem), practice especially problematical letters
Evaluation plan: monitor progress

## Goal: objectify the request for help

Who has a problem?
What is the problem?
When and where do problems occur?
Indications of functional / structural disabilities?
First impression of the child's handwriting problem.

### Tools

Child: *how I think I'm getting on* questionnaire;
Interview parent/child,
Teacher, perhaps SQT, analysis exercise books /reports from school, observation during handwriting the name, address, drawing stick-figures, colouring

No indication of handwriting problems

handwriting problems
Yes, profile A, B, C, D or E?

## Goal: objectify the handwriting problem

Is there a problem?
Analysis of handwriting results/product analysis
Observation of handwriting movements during task execution
Which conditions are necessary to accomplish the task?

### Tools

Tests: BHK, SOS
Handwriting observation list
VAS, NRS in case of pain, fatigue

BHK quality and speed + Fatigue/pain – handwriting movements +

BHK quality – or speed –, or fatigue/pain + and/or letter form, trace, motion –
A? B? C? D? E?

Profile A, C, D, E: errors in letter programming, variability in and/or incorrect tracing size, direction, pressure, speed also in non-letter -related tasks, no isolated finger movements, difficulty with complexity and dual-tasking and/or fatigue/pain/cramp +, fluency –, inadequate movements,
Profiles A, C and D: test motor abilities
Profile E: indications of functional disability and/or pathology

## Goal: discriminate between motor and/or cognitive

**Is there a motor problem?**
letter orientation, letter trace, letter joins
variation in size, movement direction, pressure, speed
isolated finger movements, posture
handwriting materials and/or execution of movements in different contexts
fatigue, cramp, co-contraction, fluency
variation in movements, degrees of freedom
indications of functional disabilities

**Is there a cognitive problem?**
unclear story, problems in understanding, attention and motivation
errors in word- and letter sequences, and spelling
letter sound confusion (auditory, visual)
reversals in letter order, letter sound- and letter form coupling
letter trace and letter connection

Which actions have positive/negative effects on results, task execution and child?

### Tools: Task manipulations

letter-related versus non-letter-related (drawing, colouring, forms)
accuracy: error matrices, assisting/guide lines
speed
alphabet task, problematic letters
spelling complexity: tracing, copying, dictation, free text
handwriting materials, paper position, sitting posture, pen pressure, pen grip, simple/complex tasks

Profile B: errors in letter sound- and letter form coupling, composition and spelling, non-letter-related tasks +, fatigue/pain –, movement +,attention or motivation or understanding of handwriting tasks –
Educational setting/referral

# KNGF Evidence Statement / Motor handwriting problems in children / Consult the full Evidence Statement at www.kngfguidelines.nl [Dutch]
# Conclusions and advice from the project group based on the literature

## Relation between motor and cognitive processes

When teaching children to write the letters of the alphabet, it is important to combine the letter sound, letter form and handwriting trace (multimodal learning technique) in accordance with the school teaching method.

Learning to read should be supported by learning to write and vice versa.

Making strict demands during multi-tasking, e.g. dictation, must wait until handwriting has become sufficiently automated, which means that learning to write **well** is helpful to children with combined reading and handwriting problems.

Owing to the connection between handwriting, spelling and composition, it is important to determine the academic ability of a child. Working in cooperation with the child's school is particularly important during the phase of learning to write.

In children with handwriting problems, it is important to observe whether the stages of handwriting development: letter for letter, then letter sound group for letter sound group and ultimately according to orthographic format, are age-appropriate.

When learning to write, the ability to perform isolated finger movements has positive effects on learning the skill. In older children, this influence weakens as the effect of language increases.

It is recommended for children to continue to practice handwriting at school with increasing complexity until automation has been achieved in school years 5 to 6.

It can be concluded that it is not an option to replace learning to write by learning to type.

It can be concluded that typing has to be learnt (starting in school years 7- 8) and practiced until it becomes an automated skill before it can adequately be used to produce texts. The project group recommends that children continue to write manually as long as their handwriting speed is faster than their typing speed.

Also in children with dysgraphia the project group advises that the focus of therapy should be on improving their handwriting. If the legibility of the handwriting is no longer sufficiently influenceable, advice can be given to learn to type. Typing must then become automated before a child can benefit substantially from composing texts by typing.

The project group recommends that during diagnostic assessment, attention should be paid to the possible presence of feelings of failure and demotivation in relation to the handwriting problems and to include these issues in the analysis.

## Differences between children with good and poor handwriting

Children with poor handwriting show greater variability in speed and accuracy than children with good handwriting and they have greater difficulty adapting to changes in task demands. During diagnostic testing and intervention, different tasks should be administered to detect which can be performed successfully and which cannot (yet).

While learning to write, children with poor handwriting not only show more variable performance, but they also have greater difficulty with learning: 1) the correct movements (motor programming), 2) the correct position and 3) the correct spatial characteristics of a letter. Thus, they are at greater risk of lapsing into incorrect letter formation and tracing. This requires attention during diagnostic assessment and the intervention, particularly with regard to complex letters.

If children complain of pain and fatigue while writing, it is important to analyse when these complaints occur. Diagnostic assessment should measure the influence of prolonged writing on symptoms (e.g. pain), frequent rests and deterioration in the handwriting product.

As the handwriting difficulties are a combination of child-related factors and the way in which handwriting is presented to the child, the teaching method should be included as a factor in the analysis.

The judgements of teachers and objective test scores on the quality of handwriting do not always agree. It is not clear on which criteria teachers base their judgements. It is therefore important to objectify handwriting problems with valid tests when a child is referred.

It is important to develop good handwriting screening instruments for children that can be used in educational settings.

Handwriting problems are common when children start learning to write, these occur in about one third of children . In about half of these children, the problems resolve spontaneously. A small number of children develop problems after the early school years. Therefore, it is important to carefully analyse the course of handwriting development during history taking.

Extra individual instruction at school aimed at problematic letter formation can lead to considerable improvement. The project group recommends that all children with handwriting problems should first receive a period of extra tuition at school. Focus points for this individual-based teaching can be jointly based on paediatric physiotherapy (PPT) or Occupational Therapy (OT) examination.

## Diagnostics

No valid and reliable instrument is available to measure motor ability within the skill of handwriting in children. Therefore, it is always important to ask the child how he/she is experiencing the handwriting problems.

It is only on the suspicion of handwriting problems combined with other motor problems that the Motor Competence Experience Scale for Children (CBSK-M) or the questionnaire *How I think I'm getting on* should be used.

In the future, a Dutch translation of the CHaP could prove to be an useful questionnaire to measure the feeling of motor competence within handwriting.

No valid and reliable questionnaire is available to measure the opinion of the parents about the handwriting of their child.

It is only on the suspicion of handwriting problems combined with other motor problems that the DCDQ and Movement ABC-2-NL checklist should be used to gain insight into the daily problems experienced by the child.

The project group advises that on the suspicion of handwriting problems during primary education, the "*School questionnaire for teachers to detect handwriting problems*" should be used to establish whether PPT assessment is worthwhile.

It is only on the suspicion of handwriting problems combined with other motor skill problems that the GMO and Movement ABC-2-NL checklist should be used by teachers to gain insight into the daily problems experienced by the children.

The project group advises that the quality and the speed of the handwriting product should be measured in a combined handwriting task. Presently, the BHK is the best instrument available to make simultaneous measurements of legibility and handwriting speed in the Dutch situation.

The project group advises that the BHK should also be used as an evaluation instrument after a physiotherapeutic intervention .

No instruments are available to measure pen grip, handwriting posture and handwriting movements. The project group advises that the standardised observation list should be used from the book *Paediatric Physiotherapy* (p. 724-725).

To measure pen grip, the project group recommends the 10-pen-grip scale developed by Schneck & Henderson.

It is not important how the pen is being held, but whether the child is able to adapt the movements to comply with all the different demands in the handwriting task.

The analysis should include manipulation tasks as well as manipulations of the context (materials, paper position, sitting height, etc.).

With the aid of manipulations in the task and context, careful analysis can be made of the influence of the handwriting materials, the paper position, etc., on the execution of the task. If a child is unable to maintain a stable posture for a sufficient period while handwriting, it is important to present the correct context.

In the task manipulations, the child can be asked to colour in, draw or write so that variety is introduced into the movement segments (shoulder, elbow, wrist, thumb-finger movements) to test whether the child adapts his/her movements to the different task demands. The qualitative aspects of the execution of the movements should be recorded.

There is no direct relation between the handwriting materials used and the handwriting product.

There is no direct evidence that making changes to the pen automatically leads to a more dynamic grip in poor writers, in contrast with good writers. This seems to be related to the fact that children must firstly be able to adapt their motor skills to the task. Making changes to the handwriting material is not the correct manner to approach the cause of the handwriting problem, although it might lead to a better result, but this needs to be measured carefully.

The project group recommends caution regarding advice about correcting/changing the pen grip: correction is only of importance if it improves the handwriting product.

If there are reasons to assume that the handwriting problems are related to fine motor problems, the successive finger-thumb-opposition task can be used in children aged 5-18 years in conformity with the Largo method; the translation movements can best be measured as described in the KOEK.

The project group recommends that a "copy the trace" task should be included in the analysis of the handwriting problem. It is best to present this task in combination with the Movement ABC-2 and/or the Beery VMI. The choice between these two tests depends on the hypothesis in the clinical reasoning see flow-chart.

There are no instruments to measure pain or fatigue during handwriting tasks.

When there are reasons to assume that pain or fatigue are playing a role, the project group recommends use of a VAS or the NRS to measure pain and/or fatigue during handwriting tasks.

In the case of pain and/or fatigue during handwriting tasks, it is important to include task manipulations as well as contextual manipulations (materials, paper positioning, sitting height, etc.), with specific attention to the length of the task, to objectify the influence of pain/fatigue.

The Movement ABC-1 and 2 are presently the most effective and convenient tests for the paediatric physiotherapist to detect fine motor and gross motor problems when fine and/or gross motor problems are suspected.

Owing to the composition of the items in the Movement ABC-1 and 2 and the calculation method of the total score, children with specific handwriting problems alone will not fail the manual control skill category. Instead, specific handwriting tests will need to be used.

The project group advises that the Beery VMI should be administered when the history-taking and handwriting analysis suggest that there are problems with visuomotor integration or problems with learning the letter characters.

The project group recommends that the Beery VMI should not be used as a screening instrument to detect handwriting problems. Instead, an instrument should be used that measures handwriting skills.

This means that the Beery VMI does not belong to the standard test battery for children with handwriting problems. The project group recommends that the administration of the Beery VMI should always include the subtests visual perception (VP) and motor coordination (MC).

Based on the knowledge that in older children, language skills are of increasing influence on handwriting and the influence of motor skills decreases, standard administration of the Beery VMI in poor writers from year 4 onwards is only indicated in the case of multiple letter forming errors and spacing errors.

## What is of importance when learning to write and relevant to diagnostics and intervention

It is important to teach children to write the *letters of the alphabet* and to reinforce the learning process with explicit optical tracking instructions (e.g. arrows or a moving computer track or a demonstration) and as a further part of the task, to perform the movement from memory.

It is important not to wait too long before administering a variety of assignments in which the child can practice a limited number of different letters per session. In addition, it is recommended that the child uses the letters for their intended purpose: to write words.

There is a transfer effect when letters with similar shapes are practiced. Therefore, it is recommended to include such combinations of letters in the varied practice sessions.

Developments in speed, fluency and the ability to perform complex handwriting patterns are age-dependent. Therefore, in the diagnosis and treatment, these findings must be interpreted in relation to the child's age.

The instructions are of importance when learning to write: when learning to perform a movement fluently, it is important not to place too much emphasis on accuracy. A combined instruction aimed at speed and accuracy has proved to be a good method in children without handwriting problems.

When learning to write manuscript letters in school years 1 and 2, it is important that the children have an adequate level of visuomotor perception.

If children in year 2 are having difficulties handwriting manuscript letters, then there is a risk that the problems will persist. It is recommended that the progress of these children is closely monitored.

The literature is inconsistent regarding the use of lined or unlined paper at the start of learning to write in school year 3 .

Over the course of time, the handwriting product changes in relation to increasing control of handwriting movements. These changes should be included in the analysis: if a child is unable to gradually produce smaller and more consistent handwriting (measurable with the BHK) , this may be the result of insufficient mastery of the movements required for handwriting.

As the legibility of handwriting depends partly on good mastery of the most common letters, it is important to start with these letters when learning to write.

Handwriting is often illegible due to a small number of poorly written letters. It is important to detect these letters and to aim intervention at improving the problematic letters (e.g. movements). Particularly the improvement of very common letters produces results rapidly and efficiently.

The increase in handwriting speed is largest in school year 3. In this phase, the number of correctly written letters increases as well as the quality. In some of children, the increase is less rapid, but progress is made steadily over the subsequent years. Evaluation of slow e.g. poor writers in school year 3 is recommended, to monitor whether they improve spontaneously.

There is a weak relation between quality and speed in handwriting. At school, it is important to achieve sufficient tempo, to keep up with classmates. If the tempo is too slow, it is recommended to perform an analysis to determine the cause.

Cursive handwriting with rounded letter joins leads to a faster handwriting tempo than other handwriting styles and is therefore the preferred style to teach.

To learn this style, a child must have good motor and perceptual abilities. Normally, these are present at the start of school year 3.

If a child is unable to produce joined-up handwriting after a focused intervention period, it must be checked whether the basic requirements are adequate. Children with severe motor, intellectual and/or perceptual problems might only be able to learn to write manuscript letters, not jointed-up handwriting. However, this applies to a very small proportion of the population.

The quality of handwriting is lower in boys than in girls, but no studies were found that reported specific norm tables for boys and girls.

Differences in quality or speed between right-handed and left-handed handwriting are not very large. Analyses can therefore be performed in the same manner.

## Intervention incentives

The project group recommends that the standard goal of a handwriting intervention should be the improvement of legibility and the speed of handwriting letters, words and sentences.

The project group recommends that diagnostic testing should be used to make an inventory of the problematic handwriting tasks. The intervention should then be aimed at the problematical tasks per individual.

The project group recommends that the intervention should aim at the highest possible time on task with many repetitions, so that even a brief intensive focused training will rapidly have effects.

The project group does not recommend the training of sensory-motor stimuli that are unrelated to specific handwriting tasks, because they do not have any additional value and do not show any effects on handwriting.

In novice writers in the learning phase (school year 3), the project group offers for consideration that dexterity skills necessary for handwriting should be trained in combination with (preparatory) handwriting exercises.

The project group offers for consideration that in combination with learning to write, a child should be stimulated to know and recognise each letter of the alphabet. Various letter-related sensory modalities can be used for this purpose.

The project group recommends that starting in school year 4, use should be made of a task-specific instruction method with self-evaluation during learning and practice (preparatory) handwriting.

In the task-oriented approach, self-instruction should be aimed at the required effect: if the aim is accuracy, then accuracy should be practiced; if the aim is faster speed, then speed should be practiced.

The project group advises that when learning to write, optical letter tracing instructions (in the form of arrows combined with prompting the child's memory, or in the form of a demonstration, e.g. on a computer screen) should be combined with motor execution. This presentation method supports the learning process of alphabet mastery.

The project group acknowledges that learning to write **well** supports learning to read and spelling and vice versa.

The project group acknowledges that in children with and without handwriting problems, a task-oriented approach is the most useful method, taking into account the age and school class. The difference between the two groups only lies in the magnitude of the problem and thus in the duration of the training period.

The project group recommends the use of blocked practice to learn the letters of the alphabet. Once the letter forms have been mastered, random practice is recommended to further improve speed and accuracy. Only a limited number of letters should be presented simultaneously (3 to 4).

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