

# Teaching handwriting skills to children with intellectual disabilities using an adapted handwriting programme

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Children with intellectual disabilities often struggle with handwriting, but there is very little research to inform intervention approaches. In this study, we developed a teaching manual based on Handwriting Without Tears®, a comprehensive handwriting programme designed for typically developing children. Three children with intellectual disabilities participated in the study and received handwriting instruction based on the manual three times a week over a 32-week period. Our aims were to explore whether Handwriting Without Tears® can be used as a comprehensive handwriting curriculum for children with intellectual disabilities and to evaluate improvement in handwriting skills. We found that the intervention was successfully incorporated into small group teaching sessions within the child's regular classroom, and that all three children made improvements. Our data show promising results and support the need for larger evaluation studies.

**Key words:** handwriting, Handwriting without Tears®, intellectual disability.

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## Background

Handwriting is an important and functional life skill. Legible handwriting is a life-long skill used in many important areas including completing examinations, job applications, writing cheques, taking notes, and compiling shopping lists (Feder and Majnemer, 2007). Fine motor tasks including handwriting take up a substantial proportion of children's time at school every day (Marr, Cermak, Cohn, and Henderson, 2003, McHale and Cermak, 1992), and being able to form coherent and legible writing is crucial for most forms of assessment and demonstrations of learning outcomes (Donica, Goins, and Wagner, 2013). By the end of primary school (age 11), children in England are expected to write 'legibly and fluently' (Department for Education, 2013, p.36).

For children who have handwriting difficulties, wider implications for their academic performance and more general development can be significant. Poor handwriting skills may reflect an underlying difficulty with fine motor control that may manifest in difficulties with other important tasks, such as tying shoelaces and doing up buttons (David *et al.*, 2009). Poor handwriting may also lead to lower academic attainment; children who find handwriting more difficult and effortful may become fatigued more quickly than their peers, and may be less able to demonstrate their knowledge and comprehension through written assignments (Donica, Goins, and Wagner, 2013). Indeed, research suggests that poor handwriting is a predictor of lower future academic attainment (Cahill, 2009). Additionally, studies have shown that when two pieces of writing containing identical content are graded, but one is written in poor handwriting, it will be graded more harshly than the one in legible writing (Chase, 1968; Sweedler-Brown, 1992). Later in life, employers may also judge a job application more harshly if it is written with poor handwriting (Cahill, 2009). Handwriting difficulties, then, may severely limit a child's opportunities in later life.

Children diagnosed with autism and/or an intellectual disability may be particularly at-risk for developing motor impairments and subsequently experiencing

handwriting problems. Up to 90% of individuals with an intellectual disability may present with handwriting and/or fine motor difficulties (e.g., Tarnopol and Tarnopol, 1977). A diagnosis of an intellectual disability often involves specific motor impairments, which are likely to contribute to deficits in handwriting skills. For example, David *et al.* (2009) found that children with an intellectual disability demonstrated poor co-ordination of fine motor movement and tended to use a tighter or stronger grip than was required when using a precision grip. Conversely, children with autism have been shown to have weaker grip strength than typically developing peers, and this difference has been shown to increase with age (Alaniz, Galit, Necesito, and Rosario, 2015). Additionally, some studies have found that children with autism demonstrate poorer handwriting, according to standardized tests of handwriting, than typically developing children (e.g., Fuentes, Mostofsky and Bastian, 2009).

Following the introduction of the new Children and Families Act in 2014 (UK), statutory guidance to those providing educational services to children with special educational needs placed a very strong emphasis on preparation for adulthood as the guiding principle for selecting outcomes for improvement (Department for Education, 2014). Given that handwriting is an important functional skill, and that many children with an intellectual disability and/or a diagnosis of autism demonstrate poor handwriting, these children may require targeted intervention to improve handwriting skills.

While many advocate keyboarding as an alternative writing strategy for those with handwriting difficulties, there are several benefits of handwriting instruction over typing. Children who practise spelling using handwriting may acquire spellings faster than those using typing (Cunningham and Stanovich, 1990). Additionally, teaching children to spell through handwriting may support letter recognition and subsequent reading skills; this has not been shown in those taught through typing (Longcamp, Zerbato-Poudou, and Velay, 2005). Direct handwriting instruction has also been shown to improve subsequent word reading level with year one students who had been identified as having difficulties in reading (Berninger *et al.*, 2006). Finally, a programme to support writing skills in children with handwriting difficulties may also lead to increases in self-confidence and thereby improve general academic attainment (Erhardt and Meade, 2005).

If we accept the argument that good handwriting skills is beneficial, the important question is what is the evidence on how best to teach these skills to children with moderate to severe intellectual disabilities? We could find no examples of

specific programmes or curricula that have been developed and evaluated for this population. Neither could we find many examples of comprehensive curricula that offer a systematic and gradual approach to teaching that would be necessary for successful learning with a population of children with diverse learning needs. One solution to this dearth is to adapt a mainstream evidence-based programme. However, such a curriculum would need to feature several key components that would predict successful adaptation to this population. It would have to be: (1) designed for young children in the first years of school, so that it would be suitable even for a child with little or no handwriting skills; (2) informed by extensive research on how children construct their handwriting knowledge; (3) evidenced-based (i.e., data available on the programme in peer reviewed research showing it to be effective with typically developing children); and (4) usable for individualised teaching, adaptable to each child's needs, a necessity stemming from the wide variation of ability levels within the intellectual disability population. The Handwriting Without Tears® (HWT) programme fulfills all of these key requirements.

The HWT programme was developed by occupational therapist Jan Olsen and is increasingly being used in schools as a curriculum to teach handwriting skills, mostly to typical learners (Olsen and Knapton, 2013). This comprehensive approach covers handwriting instruction from the initial stages of pencil grip at preschool level to cursive writing and grammatical concepts in year six. The stages of the curriculum follow a developmental sequence of fine motor skills, beginning with scribbling and colouring, simple lines and shapes, capital letters, and lower-case letters. Stages are taught through imitation (modelling), then copying, and finally independent writing. Following this teaching order, the demands on the child become progressively more difficult. For example, capital letters, which are the same size and consist mainly of simple lines and curves, are taught before more complex lower-case letters. There is also a focus on a multi-sensory approach with tactile activities, such as manipulating wooden shapes to form letters, and music as core components of HWT lessons.

HWT utilises a number of evidence-based teaching strategies to teach handwriting. For example, a task analysis, which involves the breaking down of skills into individual units and teaching these sequentially, has also been used to teach skills such as self-help (Stokes, Cameron, Dorsey, and Fleming, 2004; Veazey, Valentino, Low, McElroy, and LeBlanc, 2016), leisure (Libby, Weiss, Bancroft, and Ahearn, 2008; Schleien, Wehman, and Kiernan, 1981) and social skills

(Neurnberger, Ringdahl, Vargo, Crumpecker, and Gunnarsson, 2013). In HWT, a task analysis is provided for each letter to provide a consistent verbal cue. For example, 'big line down, little line across, little line across' for a capital letter F. A modelling, or imitation, procedure is also used extensively in the HWT approach. Modelling is also well documented as an evidence-based teaching strategy for social skills (Argott, Townsend, and Poulson, 2017; Whitehill, Hersen, and Bellack, 1980) and functional life skills (Garcia, Dukes, Brady, Scott, and Wilson, 2016).

There is some evidence for using HWT with typically developing children. For example, Owens (2004) demonstrated the positive effects of HWT with students in Key Stage One classrooms. Students from this study demonstrated statistically significant improvement in the areas of letter size and spacing compared to students receiving traditional handwriting instruction. Teachers involved in this study were satisfied with the curriculum's effectiveness and usability and continued to use the curriculum after the study was completed. In an urban year one classroom (Hape *et al.*, 2014), pre and post test results showed significant improvements in letter orientation, placement, size and spacing of letters after children had been on the programme. Overall, research exploring the effectiveness of HWT with typically developing children has shown that Olsen's curriculum can improve handwriting skills (Marr and Dimeo, 2006). Moreover, HWT has also been shown to be more effective than other approaches such as teacher-directed instruction (Roberts, Derkach-Ferguson, Siever, and Rose, 2014), Head Start teaching (Lust and Donica, 2011), the Peterson Directed Handwriting programme (Salls, Benson, Hansen, Coles, and Pielielek, 2013), and the Fine Motor and Early Writing Curriculum (Donica, Goins, and Wagner, 2013). These studies have mostly included up to 20-minute instructional sessions (consistent with Olsen and Knapton's, 2013) recommendation of 15-minute teaching sessions) and the use of standardized motor skill and handwriting assessments in order to measure outcomes.

Although most of the evidence base for using HWT is from typically developing children, there is some preliminary research on using HWT with children with a diagnosis of autism and/or an intellectual disability (Thompson *et al.*, 2012; Coussen *et al.*, 2012; Cosby, McLaughlin, and Derby, 2009). There are, however, a number of limitations to this research:

- (1) Evaluations of HWT with children with an intellectual disability have not yet been carried out in the UK;

- (2) The vast majority of studies have focused on 1:1 instruction, despite the fact that most special education settings in the UK are often not adequately staffed to provide this type of teaching;
- (3) The children studied so far have been between 4- and 6-years old, and so the use of HWT with older children with intellectual disabilities has not been adequately explored;
- (4) These studies, mostly with a focus on teaching the child how to write their name, have also utilised a very limited sample of the curriculum as outlined by HWT (Olsen, 2003; Olsen and Knapton, 2013), in spite of its recommendation as a full comprehensive curriculum that can teach a range of writing skills following the developmental sequence of letters;
- (5) It is also unfortunate that teaching sessions in most research studies have lasted just 5–10 minutes; Olsen and Knapton (2013) recommend 15-minute lessons in order to implement HWT. Additionally, in a systematic review of interventions to improve handwriting, Hoy, Egan and Feder (2011) concluded that handwriting instruction should take place for no less than 20 minutes three times per week to be effective;
- (6) Much research carried out has relied on non-standardized assessments of handwriting proficiency such as teacher ratings.

The primary aim of the present study was to investigate the feasibility of adapting the HWT curriculum to use with three older children with a diagnosis of autism and intellectual disability (11+ years of age) in a UK school context where small group handwriting instruction was utilized three times a week during 20 minute teaching sessions. We developed a detailed teaching manual (available upon request from the first author) to ensure fidelity of teaching. The second aim was to investigate, using a standardized assessment of handwriting proficiency, whether the teaching sessions using the adapted HWT curriculum was able to improve the handwriting skills of the children in this study.

## **Children, and school context**

### ***Children***

Children in this study were one girl and two boys; two of the children (the boys) had a diagnosis of autism, the girl had a combined diagnosis of ADHD, epilepsy and MoyaMoya syndrome (a progressive disorder where arteries in the brain are constricted, blocking blood flow). At the time of the study Craig was

aged 11 years 1 month, Trevor was 14 years 1 month and Leila was 14 years 10 months (these names are pseudonyms).

To be eligible to participate in the study, the children had to be performing below the level expected for their chronological age in handwriting and to have the following prerequisite skills considered necessary for them to benefit from the adapted HWT programme: Sitting willingly to engage in learning activities for short periods of time (up to 10 minutes), accepting feedback (praise, or correction), receptive and expressive labelling of at least 50 objects and pictures, following one or two-step teacher instructions (e.g., ‘clap hands, and turn around’), matching and sorting of pictures and cards depicting individual letters; and receptive and/or expressive labelling of at least 5 letters using either the corresponding letter sound or name of the letter. In addition, so that motor prompts could be utilized throughout teaching, the children had to be able to imitate gross and fine motor movements. All children were capable of self-initiated speech (typically, communicating using at least three word sentences).

### ***School and classroom setting***

The children attended a mixed special school in the UK for pupils with severe and profound multiple learning disabilities. At the time of the study, there were approximately 120 pupils in the school aged 2–19. The three children in this study were all in the same class at school (age range 11–15 years). In total, there were 9 pupils in the class who were supported by one qualified class teacher and three classroom assistants. Teaching sessions were mostly conducted in the children’s regular classroom. The three children sat at a rectangular table together with the classroom assistant or teacher. The six other children in the class did not participate in the study. Some of these pupils worked at the same table (on other tasks) or on other tables in the classroom, but did not participate in the HWT teaching session.

### **Handwriting programme**

To promote a systematic approach to teaching handwriting to children with an intellectual disability, we developed a teaching manual based on the HWT Teachers’ Guides (Olsen and Knapton, 2008). The adapted teaching manual (the Handwriting without Tears – Intellectual Disability version) depicted teaching programmes recommended for preschool children (from the HWT ‘get set for

school' curriculum), for reception age children (from the HWT Kindergarten Curriculum, and for children in Year One (from the HWT 1<sup>st</sup> Grade Printing curriculum). There was an emphasis on teaching handwriting readiness skills in the preschool curriculum, on teaching printing of capital letters in the reception curriculum and printing lower case letters in the year one curriculum. Our manual did not extend to the later stages of the HWT curriculum (year two and above where there was more of an emphasis on teaching cursive handwriting and the writing of sentences). As the children had already developed the necessary handwriting readiness skills from the preschool curriculum, we decided to use the reception phase of the manual for teaching. This focused on teaching correct formation of capital letters, a skill lacking in the children.

There were some elements of the HWT Teachers Guide that we felt were essential to include: (1) For all the letters taught, the same standardized instructional language was used to describe the right way to write the letter as in the original HWT Teachers Guide and student workbooks (e.g., for the letter 'F', the teacher would model writing the letter at the same time as saying, 'big line down, little line across, and little line across'); (2) All lesson plans described how to use teacher modelling, as one of the main components of teaching. Modelling strategies included writing the letter on the child's worksheet for them to copy (and modelling the language as they were writing the letter), or writing the letter on a white board.

Despite these similarities, however, there were several adaptations to the original programme that we made that were reflected in our adapted HWT (a- HWT) teaching manual:

- (1) Because each phase of the HWT curriculum (preschool, reception, year one, etc.) is developmentally sequenced to fit around a 9–12 month school year and we were working with children with an intellectual disability of secondary school age where it could potentially take longer to teach the full curriculum, we provided a more condensed 'catch-up' version of the HWT curriculum which focused predominantly on 'printing' with fewer sensory motor activities. To help us decide what should be included in the manual we considered only the non-negotiable and age appropriate features of the training that we judged were necessary for children to learn how to print their letters. Subsequently, some multi-sensory activities like using play-doh or putting wooden pieces together to make letters were omitted from the adapted HWT (a-HWT) manual.



- (2) There were also some differences in the order in which the letters were recommended to be taught and the subsequent order of lesson plans in the adapted manual. For example, as recommended by HWT for the reception phase, all children learnt ‘Frog Jump’ capitals first (e.g., F, E, D, P, B, R, N, M). These letters start at the top left corner with a big line on the left. When the first line is on the left, the next part of the letter is on the right side. This prevents reversals and teaches good stroke habits. HWT recommend that next teachers focus on ‘Starting Corner Capitals’ (e.g., H, K, L, etc) before moving to Centre Starting Capitals (e.g., C, O, Q, etc). For our condensed catch-up on a-HWT curriculum, we recommended that, after teaching the Frog Jump Capitals, teachers move to the Starting Corner Capitals but that they target first those that have the same formation as lowercase letters but only bigger (e.g., K, V, W, X, Z), followed by the Centre Starting Capitals that have the same formation as lower case letters (e.g., C, O, S) before moving onto any other letters (e.g., A, I, T). This modification was considered necessary so teachers could work concurrently on the lower case letters immediately after they had mastered the capital letter (e.g., the letter formation was the same but smaller). It was thought that, if the teaching curriculum for printing lower case letters started with the letters that were the same as their capital partners, children would have been prepared for writing half of the lower case letters through their upper case letter practice. This methodology has similarities to the ‘general case’ order of teaching recommended by the Direct Instruction teaching approach (e.g., Engelmann and Carnine, 1991).
- (3) We also conducted task analyses on the more complex skills (i.e. broke down complex skills into smaller steps for learning). For example, for teaching the letter F, the teacher first demonstrated writing the letter, saying out loud the instructions as they wrote with the child attending, ‘*Watch me write F, Starting at the corner, Big line down, frog jump up. Little line across the top, Little line across the middle*’ before moving through a number of teaching steps until the child was able to self instruct as they wrote the letters and then finally complete the worksheet accurately without self instruction.
- (4) We also provided some suggestions for prompting and prompt-fading strategies for each step of the target skill. These strategies corresponded to different levels of assistance so that the teacher could adapt the teaching procedure to individual children’s needs. For example, in the task of

writing the letter 'F', visual prompting strategies suggested included teachers using an adapted worksheet with larger examples to copy or rather than having a blank space for students to copy a letter, the teachers wrote the letter with a highlighted pen for the student to overwrite and this prompt was gradually faded.

- (5) Because children with a diagnosis of autism and intellectual disability do not always generalize skills taught, we added a generalization step to every programme to ensure the child could be successful with the task in different environments, with a variety of materials or with a different teacher. For example, asking the child to write a letter with a variety of different writing tools, writing in the school handwriting workbooks and not just on the HWT worksheets, and performing the task with different members of staff.
- (6) To help keep children motivated to work through new, difficult tasks, instructions for differential reinforcement were included. It was suggested that unprompted and accurate handwriting efforts be rewarded with tokens which would later be exchanged for a favourite activity. If the child needed assistance, it was recommended that they receive verbal praise but no token be delivered.
- (7) The goals for learning were clearly specified so that they would be observable and measurable. We also described a mastery criterion as a way of objectively determining whether the goal had been achieved. Instructions for data collection were included.

We recommended to teachers that they use a variety of materials from HWT as part of their delivery of the programme, such as the HWT Teachers' Guide for reference and the student workbooks. The resources needed for delivery of the HWT programme were listed in the manual with details of from where the resources could be sourced. We also created some resources for generalization of skills (e.g., different worksheets and handwriting writing games), which were also described in the manual.

For letters that children were currently learning, children used the standard handwriting pencils provided by the class teacher and the HWT student workbooks. For generalization, teaching resources were extended to using a variety of writing tools (crayons, chalk felt tip pens, etc.) and different handwriting media (wipe boards, different handwriting worksheets, handwriting workbooks provided by the school).

Token systems and a variety of reinforcing items and/or activities were used during the initial stages of teaching for each child. For example, a child would be working on their handwriting tasks for ten minutes and, during this time, the teacher provided ticks on a chart or tokens that could later be exchanged for preferred objects or other rewards. The handwriting sessions quickly (i.e., in 1 or 2 sessions) became a highly preferred activity. Once handwriting was established as an enjoyable activity, it was possible to fade the token systems.

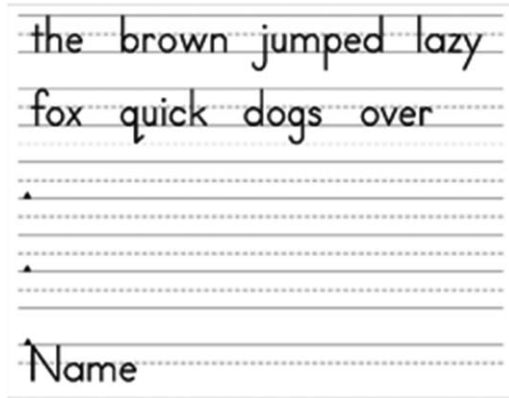
## Measurement of handwriting skills

The primary outcome measure administered was the Minnesota Handwriting Assessment (Reisman, 1999). This assessment was chosen because of its validity (e.g., Feder & Majnemer, 2003; Roston, Hinojosa and Kaplan, 2008), because it has a short administration time of 2.5 minutes, and because it is a widely used measure in handwriting research.

The MHA is a norm-referenced evaluation tool that assesses manuscript handwriting for year one and year two students including the five quality categories of legibility, form, alignment, size, and spacing, along with assessing the students' rate of handwriting. The protocol provides clear criteria for how to score each quality category. Alignment, size and space are judged on the basis of ruler measurement; legibility and form require a subjective measurement. The MHA has been used to determine students' progress by comparing scores of multiple tests over time to show the effectiveness of instructional programmes, interventions, or students' maturation (Cornhill and Case-Smith, 1996; Feder and Majnemer, 2003; Reisman, 1999; Roston *et al.*, 2008).

In this study, the children were administered the manuscript version of the MHA (see Figure 1). The children were required to copy words from a printed stimulus sheet that depicts the following words: 'The brown jumped lazy fox quick dogs over' (see Figure 1 for example). This phrase is intentionally short in length and contains all letters of the alphabet. The words are scrambled to reduce any memory advantage of more fluent readers (Reisman, 1993).

At the beginning of the rating process, a total of 34 points were given to each of the 5 qualitative categories (one point per letter). During rating, the total number of scores in each category are subtracted from this total. The rate score was determined based on the number of letters completed in the 2.5 minutes.



**Figure 1.** The Minnesota Handwriting Assessment

Combining the 5 qualitative scores with the rate score, each of the 34 letters could earn up to 6 points, for a maximum total score of 204. For the purpose of this study the norms for year one were used as all students had significant difficulties in handwriting.

The scores are then used to classify students as ‘performing like peers’ (Legibility: 33–34; Form: 30–34; Alignment: 29–34; Size: 27–34; Spacing: 30–34; Rate: 18–34). ‘performing somewhat below their peers’ (Legibility: 32; Form: 25–29; Alignment: 20–28; Size: 15–26; Spacing: 26–29; Rate: 11–17) and ‘performing well below their peers’ (Legibility 31 or fewer; Form: 24 or fewer; Alignment: 19 or fewer; Size: 14 or fewer; Spacing: 25 or fewer; Rate: 10 or fewer). We administered the MHA twice: before the beginning, and at the end of the intervention period.

Data were recorded for each letter written on the worksheet using a data sheet developed for this study (see Figure 2). The teacher scored for each letter whether the letter was correct or incorrect according to four quality criteria from the MHA (legibility, form, alignment, and size). Operational definitions for the quality criterion were provided on the worksheet to help teachers score accurately. Thus, for legibility the correct letter needed to be present, it needed to be instantly recognizable as the target letter and not look like any other letter, and all parts of the letters needed to be complete. If any of these components was missing then the letter would be scored as incorrect.

Legibility	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total	Percentage	
The letter is present	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
The letter is recognisable	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
The letter does not look like any other letter	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
All parts of the letter are complete	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Form	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
There are no gaps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
There is no extension	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
Correct formation of the letter	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
There are no extra lines	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
There is no exaggeration in size	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Alignment	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
The letter rests above or below the baseline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Size	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
The letter is not too big or too small	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
The letter does not float between the lines	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Total																							
Percentage																							

Legibility	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total	Percentage	
Legibility	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Form	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Alignment	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Size	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Total																							
Percentage																							

Figure 2. Data sheet for handwriting

The mastery criterion for each letter was 80% of letters correct (across each of the four dimensions) per worksheet across three consecutive sessions (worksheets). Typically, the child needed to complete at least 10 letters correct per worksheet. This data collection procedure allowed the teachers to identify if there was a particular area of quality of handwriting that the child was consistently struggling with. For example, if a child was regularly scoring incorrectly for size, but was correct for the other areas, then the teachers would discuss this with the child and provide extra practice for size. Typically the extra practice would involve teaching component responses before composite ones (i.e., teaching the child to ‘discriminate before they operate’, Calkin, 2003). Thus, if a child was frequently writing a letter that was too large, they would be taught to discriminate between samples that were too big/too small or just right before practising writing the letter again.

## Delivery of the handwriting programme

Immediately before starting the intervention, the children were assessed using the Check for Readiness Skills from Handwriting Without Tears. This assesses certain prerequisite skills that HWT recommend children have to be able to benefit from the HWT curriculum: That the child uses a variety of strokes for colouring, that they can grip a crayon correctly and leave a mark on the paper, that

they can hold a piece of paper steady on the table using a helping hand, that they can trace and copy shapes and that they can draw a rough approximation of each main part of a person's body. All children completed this test to the required proficiency level to be able to proceed with the handwriting intervention.

As required by school policy, Health and Safety Risk Assessments and where necessary Behaviour Risk assessments and Support Plans were in place for all pupils. Engagement in the intervention did not pose any further risks, as the teaching methods used were standard practice within the class and school setting. Teaching took place approximately three times a week for 32 weeks in a 20–30 minute session at the start of the day. No other specific handwriting teaching occurred during the duration of this study. On average, each student received 60–90 minutes of group based handwriting instruction each week. Teachers/classroom assistants who normally worked with the child carried out the sessions. At the start of each handwriting session all children were asked to complete together a handwriting exercise that they could perform easily and without help (i.e., they performed a mastered handwriting task for example, practice at picking up the pencil correctly, colouring exercises).

Following this warm up, the teacher delivered approximately five minutes of individualized teaching to each child in turn. Individualized teaching was considered necessary because the children were learning target letters at different rates and so had different targets on acquisition. For example, Craig was working on learning how to write lower case letters correctly when the other two children were learning upper case letters. The session was concluded by all children working in the group again on a mastered handwriting task or on generalization activities that they could complete independently. When the child was not receiving individualized instruction they either continued with mastered worksheets or generalization activities (if they had not yet received their individualized instruction for that session), or they continued for the remainder of the time practising their target letters that had been covered in the individualized session.

In keeping with the recommendation from HWT, modelling was a key component of individualized teaching (Olsen and Knapton, 2013; Olsen, 2003). A small specification, however, was to use the Model, Lead, Test teaching procedure to give clear guidelines for modeling and the fading of modeling prompts (e.g., Bechtolt, McLaughlin, Derby and Blecher, 2014). Here, teaching began

with the teacher modelling on a wipe board or worksheet how to write the letter using the correct letter formation, and saying out loud the standardised instructions for writing the letter as they did so. Next, for the lead component, the child was encouraged to say out loud the standardised instructions for forming the letter as the teacher continued modelling the letter on the wipe board or worksheet. Finally, for the test component, the students were given a HWT worksheet to write their own letters using the correct letter formation. If necessary, the teachers provided the child with the verbal instruction to prompt correct letter formation, but this was faded as soon as possible, until the child was writing the letter using correct letter formation without any verbal cues from the teacher. Correct responding was reinforced by providing, for example, praise, or a token which could later be exchanged for preferred activities. Initially prompted responses were reinforced but this was gradually faded until only unprompted correct letters were followed with reinforcement.

To increase the children's independence with their handwriting, a few weeks into the study they were taught a self-monitoring procedure (Reid, 1996). Self-monitoring involved having the children keep track themselves of whether or not each letter that they wrote was meeting the quality criterion on which they were being scored. It was hoped that this skill would ultimately teach the children to be able to self-correct their own handwriting independently whenever they made errors.

For each letter, the child had to circle a tick or a cross regarding whether it was 'clear' (this corresponded to the legibility domain of the MHA), the right 'shape' (form from the MHA), 'on the line' (alignment from the MHA) or the right 'size' (size from the MHA). For each quality criterion, the key word (clear, shape, line or size) was written next to tick or cross with a corresponding symbol to aid understanding (see Figure 3). These key words were chosen as it was believed that they would be easier for the children to understand than the words from the MHA.

Teacher prompts were gradually faded until the child was able to self-monitor independently and accurately:

- (1) First, the teacher sat with the child and showed a model of what the correct letter should look like; then, as the child completed each letter, for that letter the teacher presented in turn the questions that corresponded to the rules for correct handwriting depicted on the score card. For example,





Name: _____		Date: _____						
Letter: _____								
	✓	✓	✓	✓	✓	✓	✓	✓
<b>Clear</b>	✗	✗	✗	✗	✗	✗	✗	✗
	✓	✓	✓	✓	✓	✓	✓	✓
<b>Shape</b>	✗	✗	✗	✗	✗	✗	✗	✗
	✓	✓	✓	✓	✓	✓	✓	✓
<b>Line</b>	✗	✗	✗	✗	✗	✗	✗	✗
	✓	✓	✓	✓	✓	✓	✓	✓
<b>Size</b>	✗	✗	✗	✗	✗	✗	✗	✗

Figure 3. Self-monitoring checklist [Colour figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

‘Does your K look like this K?’ (for legibility/clarity), ‘Is your K the same shape as this one?’ (for form/shape), ‘Is your K on the line like this one?’ (for alignment/line), ‘Is your K the same size as this one – not too big and not too small?’ After each question the teacher would discuss with the child the accuracy of the child’s letter and then encourage them to score their letter by ticking or crossing on the score card which was on the table in front of them.

- (2) Next, the teacher placed the self-monitoring card and an example of the correct model of the letter on the table in front of the child and gradually faded asking their questions. The teacher prompted the child to stop after writing each letter, to say the rule (‘Is it the right size?’ etc.) and then to highlight the tick or cross on the sheet. The teacher then discussed with the child whether or not they agreed with their scoring and the reasons why.
- (3) In step three, the student independently stopped after each letter, saying the rule and highlighting the tick or cross on the sheet. The teacher only provided feedback when the child had scored all of the letters on their worksheet.
- (4) In step four, the score sheet was faded. The child independently paused after writing each letter, they said the rules and then self-corrected their handwriting on the sheet.
- (5) In step five, the child no longer needed to ask themselves the questions, they self-corrected their letters as and when necessary while they were



writing. An additional outcome of teaching self-monitoring to the children was that they were able to check each others' work by saying the rules out loud, and then correct their letters together. This was an aspect of the procedure that they all enjoyed.

Prior to the beginning of the intervention, we conducted one 1-hour training session on the adapted HWR programme with two teachers (classroom assistants) who were responsible for the delivery of the programme throughout the intervention. During this training, the HWT manual was described completely, including suggested teaching strategies, directions for data collection and a list of teaching materials that would be needed to deliver the programme. After this initial training, ongoing supervision of staff was provided by the first and second author during regular overlap sessions (at least 5% of teaching sessions). Each observation lasted approximately 10–20 minutes. Using observational judgement, the first and second authors noted if teachers were following the teaching manual (fidelity of intervention) and in particular, if there were any concerns regarding the organization of the session, delivery of instructions, prompting procedures and evidence of the child's learning throughout the study. During and after each session, the observer provided feedback on any relevant issues. In this study, data were not collected directly on intervention fidelity. This level of training helped to ensure a consistent approach in the teaching of handwriting skills and similar expectations about how each child should respond. Fortnightly staff meetings were conducted to discuss individual children's progress. Any issues around HWT targets were discussed alongside the other areas of each child's learning.

For data collection fidelity, the teachers delivering the intervention and the second and third authors retrospectively scored completed handwriting worksheets using the criteria described previously. During the fortnightly staff meetings the teachers and the first, second, and third authors compared their scores and discussed reasons for any disagreements. This process was continued until such time that there was a minimum of 80% agreement in scores whenever handwriting sheets were retrospectively scored.

## Study findings

All children spent 32 weeks on the handwriting programme. The summary data for the number of lower case and upper case letters mastered in this time are

**Table 1.** Number of letters mastered

<i>Child</i>	<i>Age (years, months)</i>	<i>Number of letters mastered</i>	
		<i>Upper case</i>	<i>Lower case</i>
Craig	11,1	26	26
Leila	14, 10	16	2
Trevor	14, 1	16	1

presented in Table 1. Craig mastered all upper case and lower case letters when the criteria for legibility, size, alignment and form were taken into consideration. Leila and Trevor mastered 16 upper case letters but, in accordance with working through the developmental trajectory for teaching handwriting, had received minimal instruction on lower case letters. Subsequently, they did not have the opportunity to master many of these letters within the time frame of the study.

Pre-and post-intervention scores for each child on the Minnesota Handwriting Assessment (MHA) are presented in Table 2. All children made gains on this test by the end of the Handwriting Intervention.

Craig made an improvement in scores for all the domains in the MHA. Leila and Trevor improved in three domains, but decreased or remained the same for two of the domains (i.e., alignment and size).

**Table 2.** MHA test results pre-and post-adapted Handwriting without Tears intervention

<i>Participants</i>	<i>MHA domains</i>	<i>Pre-test</i>	<i>Post-test</i>
Craig	Legibility	24	29
	Form	22	<u>25</u>
	Alignment	4	<u>12</u>
	Size	1	<u>19</u>
	Spacing	12	<u>23</u>
Leila	Legibility	18	27
	Form	16	<u>25</u>
	Alignment	0	<u>0</u>
	Size	1	0
	Spacing	17	25
Trevor	Legibility	19	28
	Form	17	<u>28</u>
	Alignment	6	<u>0</u>
	Size	4	0
	Spacing	18	<u>28</u>

*Note.* Underlined scores in bold text show where the child has moved from the ‘performing well below peers’ category on the MHA to ‘performing somewhat like peers’ (Reisman, 1999)

On the MHA, children's scores can be categorized as performing like peers, performing somewhat like peers and performing well below peers. At baseline, the children's scores across all of the handwriting domains were assessed to be 'well below peers'. At post-test, 33% of the children's scores had improved such that their performance was judged to be 'somewhat below peers'. For all children this change in category status was evidenced for the form domain.

## Conclusions

This pilot study presents an adaptation of the HWT programme for children with intellectual disabilities. It describes in detail how the standard HWT procedure can be adapted to become a comprehensive handwriting curriculum that is effective at improving the handwriting skills for children with intellectual disabilities.

The results of this pilot study are promising and demonstrate the feasibility of adapting the HWT programme for children with intellectual disabilities. It showed how the students could be taught handwriting skills in a small group alongside their peers in a typical special education classroom, which has implications for the costs of programme implementation. As part of the programme, the children were also taught to self-check their handwriting performance and this was an important factor in their ability to work independently in groups. The study also demonstrates that the programme can be incorporated into children's daily educational curriculum.

Although no social validity data was collected following the intervention, the adapted programme was regarded positively by the children and other stakeholders. The children reported that they liked the handwriting lessons and were excited to show staff and other pupils their completed handwriting worksheets. In addition, teaching staff reported that they felt positively towards the programme. They noted improvement in handwriting on school literacy tests, and made display boards in the classroom of children's handwriting sheets.

The relatively older age of the children is another point to mention. The three children were aged 11–14 years at the start of the programme and this is older than children in previous studies in mainstream (e.g., Hape, 2014; Owens, 2004) and special education (Cosby *et al.*, 2009; Coussens *et al.* (2012)). This raises the upper limit of starting the intervention and challenges often unstated

presumption that if older children haven't learned handwriting skills when young, they will never do so.

In relation to the pre-post data, the children made most progress in the 'form' category of the Minnesota Handwriting Assessment (MHA). This is of interest because research has suggested that children with autism find learning to make the 'form' (i.e., shape) of letters (as opposed to their size, alignment and positioning) particularly difficult when compared to age and intelligence matched controls (Fuentes, Mostofsky and Bastian, 2009).

Conversely least progress was made on the size and alignment categories, with Trevor even showing a loss of skills for both categories. The most likely possibility for this finding is the confusion caused by the three lines in the MHA stimulus sheet (top line, middle dotted line and base line). Even with reminders children did not always know where to place their letters in relation to these lines (e.g., they used the dotted middle line as their baseline) and it is important to note that Handwriting without Tears does not teach children to write their letters using a dotted middle line (only a solid baseline). According to the scoring guidelines for the MHA error points are scored for size and alignment if children do not line their letters up correctly using the stimulus sheet lines. Additionally, there was a much greater focus in the Handwriting without Tears lessons on achieving accuracy with legibility and form than with size and alignment. For example, children could self-instruct (e.g., 'Big line down, little line across, little line across') to help achieve accuracy with formation and legibility for the letter F, but self-instruction would have little bearing on whether or not they wrote the letter the correct size (not too big, not too small) or directly on the baseline (for alignment).

While the data from this pilot study are promising and demonstrate the feasibility of adapting the HWT programme for children with intellectual disabilities, the weak 'pre-post' design and small number of participants limits the conclusions that can be made. In addition, no fidelity data was recorded during the implementation of the programme. Intervention fidelity monitors the extent to which an intervention has been implemented as planned and is critical for evaluating the reliability, validity, efficacy and effectiveness of studies Smith *et al.* (2007). Future studies in this area would benefit from collecting fidelity data so that clearer conclusions about the mediating variables at work can be drawn.

Finally, future studies could also evaluate the wider impact of the handwriting intervention by examining a wider range of outcomes in addition to handwriting. For example, evaluating whether following the HWT program leads to increases in self- confidence or greater academic attainment more generally.

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