Handwriting Assessment Battery for Adults

Administration & Scoring Manual

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A collaboration between researchers at
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Purpose of this Document

The *Handwriting Assessment Battery for Adults* (Version 1) or *HAB-v1* was developed by Australian researchers Annie McCluskey and Natasha Lannin (2003). The *HAB-v1* was developed for use by occupational therapists and others to measure change in handwriting performance in adults, particularly stroke survivors. The HAB was initially used in a series of single case studies (unpublished research, v2-5). As no adult handwriting assessments existed, the *HAB-v1-5* addressed a clinical practice gap.

The *HAB Training, Administration & Scoring Manual* (v1) accompanied the *HAB-v1 and* was developed during a 2004 honours project at the University of Western Sydney by occupational therapy student Kathrine Faddy. The *HAB-v1* and *HAB Training and Administration Manual (v1)* were revised in 2021 by Michelle Dettrick-Janes and Annie McCluskey. Version 6 was informed by several studies completed between 2008 – 2018, particularly those by Michelle Dettrick-Janes. That research is listed on the next page, available in published journal articles, and theses from the University of Sydney Digital Thesis Library.

The *HAB-v1 and v6* were developed for use by novice and experienced therapists who work in adult neurological rehabilitation. The *HAB-v1* was tested initially with brain injury survivors but was also intended for use with stroke survivors. This manual was developed to increase the reliability of HAB-v6 test administration and scoring by therapists.

The *HAB-v6* contains standardised administration instructions. Each section focuses on a different aspect of handwriting, allowing therapists to analyse a person's impairments while observing handwriting tasks.

The *HAB-v6 Administration and Scoring Manual* provides therapists with visual examples of correct and incorrect answers to assist scoring. Scoring tables increase the ease of marking by reducing calculation time.

Correct Citation for this Document

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Relevant Publications

Au, E., McCluskey, A., Lannin, N.A. (2012). The inter-rater reliability of three assessments of handwriting legibility. *Australian Occupational Therapy Journal, 59*(5), 347-354

Burger, D, & McCluskey, A (2011). Australian norms for handwriting speed in healthy adults aged 60 to 99 years. *Australian Occupational Therapy Journal, 58*(5), 355-363.

Dettrick-Janes M, McCluskey A, Lannin NA, & Scanlan JN. (2015). Handwriting legibility in healthy older adults. *Physical and Occupational Therapy in Geriatrics, 33*(3), 189-203

Dettrick-Janes M, McCluskey A, Lannin NA, & Scanlan JN. (2016). Older adults experience difficulty completing the lines and dots tasks of the Motor Assessment Scale. *Scandinavian Journal of Occupational Therapy, 24* (5), 320-328. DOI: 10.1080/11038128.2016.1187202.

Faddy, K., McCluskey, A., & Lannin, N.A. (2008). Inter-rater reliability of a new handwriting assessment battery for adults. *American Journal of Occupational Therapy, 62* (5) 587-591

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Introduction

Handwriting is an occupational task involving speed and legibility. Poor handwriting can affect a person's satisfaction, creativity and productivity in activities of daily living (Feder, Majnemer, & Synnes, 2000). The ability to master this complex task is essential because handwriting is required for daily occupations such as communicating messages and thoughts, taking notes, and completing forms. Slow or illegible handwriting can affect a person's ability to fully express their knowledge and capabilities through written language (Cornhill & Case-Smith, 1996; Feder, Majnemer & Synnes, 2000).

Handwriting often needs to be retrained after a stroke or brain injury. To evaluate writing legibility and speed, a valid and reliable measurement tool should be used. Few valid and reliable tools have been designed to measure adult handwriting performance.

The Handwriting Assessment Battery for Adults (HAB-v6)

The *HAB-v1 and HAB-v6* were designed to identify whether handwriting difficulties are due to reduced speed, legibility or pen manipulation (or all of the above). The battery of sub-tests is short and easy to administer, with a focus on the motor components of handwriting. The recently revised *HAB-v6* (2022) is intended for use with adult stroke and brain injury survivors.

The original *HAB-v1* contained eight subtests from the **Motor Assessment Scale** (Carr, Shepherd, Nordholm, & Lynne, 1985), **Jebsen-Taylor Test of Hand Function** (Jebsen, Taylor, Trieschman, Trotter, & Howard, 1969) and **Evaluation Tool of Children's Handwriting** (Amundson, 1995). The HAB-v6 now includes only six subtests. Three legibility subtests were removed (upper / lower case alphabet letters, and numerals). One new "shopping list" speed subtest was added to the HAB-v6 (Burger & McCluskey, 2011).

Section 1: Pen Control and Manipulation

Two subtests from the **Motor Assessment Scale** (MAS) are included in the HAB which assess pen control and manipulation. The **MAS** is relevant to everyday motor activities such as handwriting (Carr et al., 1985), and was designed for use with adult stroke survivors. The **MAS** has established face, criterion-related, construct and content validity. The **MAS** has acceptable reliability (inter-rater = .89-.99, intra-rater = .98, and test-retest = .87 – 1.00) when used with brain injury survivors (Lannin, 2004; Poole & Whitney, 2001). The **MAS** consists of eight subscales, with three measuring upper limb performance (sometimes referred to as the **MAS-UL**).

Two subtests from the **MAS-UL Advanced Hand Activities** subscale test pen control and are used in *HAB-v1 & HAB-v6*. These timed subtests take approximately five minutes to complete and require the person to (i) draw at least 10 horizontal lines stopping at a vertical line on the right within 20 seconds, and (ii) make at least 10 rapid consecutive dots with a pen within 5 seconds (Carr et al., 1985).

Several published studies using Rasch analysis have found that **MAS** line and dot subtests were more difficult for stroke survivors to pass compared to other **MAS** advanced hand activities (Miller et al 2010; Pickering et al 2010; Sabari et al, 2005). When the performance of 120 healthy older Australian adults was evaluated on the 'horizontal lines' and 'dots' subtests of the **MAS**, 54 participants (45%) did not achieve the requirements of the **MAS** lines activity; that is, they failed the lines subtest (Dettrick-Janes et., 2016). Furthermore, 11 participants (9%) did not achieve the requirements of the **MAS** dots sub-test; that is, they failed the dots subtest. Most participants who failed the dots subtest were aged over 90 years (n= 9).

Participants who passed the 'lines' task wrote sentences faster than participants who failed ($p<.001$). Therefore, older adults may not pass the **MAS** lines and dots subtests due to age and individual skill level, rather than motor impairments from a stroke or brain injury. Dettrick-Janes and colleagues (2016) recommend that clinicians interpret scores achieved by stroke survivors for the line and dots subtests of the **MAS**

with caution for that reason. Several modifications are recommended to scoring procedures for both lines and dots subtests and are included in this *HAB-v6* administration and scoring manual.

The first recommendation was to abandon the dichotomous scoring procedure (achieved/not achieved), or at least add a continuous measure of task performance such as the number of lines completed, since many participants failed the lines subtest. A continuous measure of performance is more useful, clinically and for research purposes to demonstrate change. For the **MAS** lines subtest, the authors recommend recording the total number of lines as well as number of 'accurate' lines produced (up to a maximum of 10), providing a continuous measure of performance that is sensitive to change. For the **MAS** dots subtest, the authors recommended recording the number of dots produced in five seconds, up to a maximum of 10 dots.

Changes to administration procedures were also recommended by Dettrick-Janes and colleagues (2016) when clinicians use the **MAS** lines subtest as part of the *HAB-v6*. Original **MAS** procedures did not state the desired length of horizontal lines, nor the space to be provided on a piece of paper for line drawing. In previous studies and in practice, the length of horizontal lines drawn has not been standardised. However, the space provided, and length of lines drawn presumably influence the number of lines an individual can produce in the 20 second timeframe. A pre-drawn sheet of paper is recommended during **MAS** and *HAB-v6* line drawing subtest administration, with two pre-marked vertical lines (each 250mm in length, 175mm apart for line drawing to occur. Future use of the 175mm space between vertical lines will enable comparison of performance with those reported by Dettrick-Janes and colleagues (2016). Two pre-marked vertical lines also accommodate choice of direction when completing the **MAS** line drawing subtest. The direction of line drawing used by participants should be noted (with an arrow) at the time of testing, allowing line accuracy to be scored using the appropriate target vertical line.

Section 2: Writing Speed

Two subtests of writing speed are included in the *HAB-v6***:** a speed copying subtest from the **Jebsen-Taylor Test of Hand Function** (Jebsen et al., 1969)**,** and a self-generated **shopping list** subtest developed specifically for the *HAB-v6* (Burger & McCluskey, 2011).

Copied Speed Writing Subtest (Jebsen)

The **Jebsen-Taylor Test of Hand Function** assesses hand function using simulated activities of daily living (Jebsen et al., 1969). In contrast to most instruments used to measure activities of daily living, the **Jebsen-Taylor Test of Hand Function** rates the time taken by a person to accomplish tasks, rather than the amount of assistance required (Dittmar & Gresham, 1997). That test was standardised many years ago for use with Australian and American populations, with ages ranging from 16 to 90 years (Agnew & Maas, 1982; Jebsen et al., 1969 respectively). Test-retest reliability was established (.006 - .99, $p<0.01$) when used with people with hand impairments (Jebsen et al., 1969), but not stroke or brain injury survivors. No data have yet been reported on inter-rater, intra-rater reliability or validity.

The original version of the **Jebsen-Taylor Test of Hand Function** consisted of seven timed subtests (Jebsen et al., 1969), while the Australian version included eight subtests (Agnew & Maas, 1982). The Australian version added hand strength, measured with a Jamar dynamometer, and provided six separate percentile norms for the ages 16 to 90 years (Agnew & Maas, 1982).

The *HAB-v1 and v6* use the writing subtest of the **Jebsen-Taylor Test of Hand Function.** The writing subtest involves the timed copying of a sentence containing 24 letters of 3rd grade reading difficulty. One pre-written printed sentence is selected randomly from three sentences (Jebsen et al., 1969).

More recently, normative data were collected from 120 older Australians as part of a cohort study (Burger & McCluskey 2011). Convenience and snowball sample were used to recruit healthy older adults aged between 60 and 100 years. The **Jebsen-**

Taylor speed subtest was completed in pen and pencil. Average speed was recorded (in seconds) of the time taken to copy a 24-letter sentence. Speed ranged from 11.97 s (2.62) for younger men to 22.35 s (7.73) for older men, and 12.05 s (2.41) for younger women to 23.60 s (8.80) for older women. Copying text with a pen was faster than with a pencil (*M* = 107.25 letters/minute vs. 99.54 letters/minute, respectively). This difference was consistent regardless of gender or age. Copied text was also written faster than self-generated text. Significant speed differences were evident when text was copied with a pen compared to a pencil ($F_{1, 112}$=44.133, p=0.001). No significant differences were found in handwriting speed between men and women. Overall, speed decreased with increasing age.

The Australian sample copied the **Jebsen-Taylor speed subtest** sentence more quickly than age-matched peers in earlier studies, suggesting that norms should be updated regularly (Burger & McCluskey, 2011).

The Shopping List Subtest

The **shopping list test** was also developed for the above-mentioned study, and completed by the same sample of 120 healthy older Australians, aged between 60 and 100 years (Burger & McCluskey 2011). Convenience and snowball sampling methods were used. Participants were asked to generate, then write, five single word items that they might include on a shopping list. They repeated the task twice, once in pen and once in pencil, writing different shopping items on each occasion.

There were no significant gender differences in handwriting speed for the **shopping list test** ($F_{1, 112}$=0.011, p=0.92). Pencil was faster than pen for the self-generated **shopping list task**; a significant speed difference was evident when writing the shopping list with a pencil compared to a pen ($F_{1, 112}$=3.980, p=0.048). Pencil was more than five seconds faster on average than a pen (*M= 91.14* letters/minute vs. *M= 85.81* letters/minute, respectively, Burger & McCluskey 2011). Participants wrote the first list in pencil, and the second list in pen, which was generally written more slowly. Perhaps when producing the second list, participants needed more time to think of items for their list and wrote more slowly. As the order of writing tools used was not alternated, that hypothesis cannot be answered using study data.

In summary, the three key findings from the study by Burger and McCluskey (2011) regarding writing speed were, first, there was no significant difference between the handwriting speeds of men compared to women. Second, there was a significant speed difference between writing tools used. Third, handwriting speed was influenced by the writing task and type of text written, with copied text being written fastest in pen, and faster than self-generated text.

Section 3: Writing legibility

As part of HAB-v6, participants are asked to write a self-generated 5-word sentence, a subtest modified from the **Evaluation Tool of Children's Handwriting** (ETCH) (Amundson, 1995). Global legibility of that 5-word sentence is then rated, in addition to individual word legibility, using a **modified Four Point Rating Scale (mFPS-v2**). Two scores are recorded, by first rating 1 (illegible) to 4 (legible), for sentence legibility. The word legibility score is obtained by rating each word contained in the 5-word sentence (1-4) and converting the number of legible words to a percentage score.

The **Evaluation Tool of Children's Handwriting** (ETCH) (Amundson, 1995) is an instrument that measures legibility and speed of a child's handwriting, in both manuscript **(ETCH-M)** and cursive **(ETCH-C)** forms of writing (Diekema, Deitz, & Amundson, 1998). The **ETCH** was designed for use with children aged six to nine with mild developmental delay, learning disabilities, and mild neuromuscular impairments (Feder & Majnemer, 2003). The modified **ETCH-M** has acceptable reliability coefficients ranging from .77 for total letter legibility, and .63 for total numeral legibility (Diekema et al., 1998; Feder & Majnemer, 2003; Koziatek & Powell, 2002; Schneck, 1998; Sudsaward, Trombly, Henderson, & Tickle-Degnen, 2001). Content validity has been established for the **ETCH**. However other validity studies are yet to be conducted (Feder & Majnemer, 2003).

The **ETCH** contains seven cursive writing tasks, and six manuscript tasks (Amundson, 1995). The *HAB-v6* includes only one of the 13 ETCH writing tasks (which we refer to as the modified ETCH or **mETCH**). The single **mETCH** task, sentence composition, obtains

a handwriting sample from participants with five words. That self-generated sentence is then rated for sentence and word legibility. Although five **mETCH** writing tasks were included in the original *HAB-v1*, inter-rater reliability was below acceptable standards for clinical use, when three independent raters used the **mETCH** to rate 60 handwriting samples from 30 healthy adults (Au et al., 2012). There was 'no agreement' when examining exact agreement in **mETCH** scores determined by multi-rater kappa (k), with the letter subtest attaining a kappa of -0.62, and the words subtests attaining a kappa of –1.03 (Au et al., 2012).

Au and colleagues (2012) concluded that this poor inter-rater reliability, combined with a lengthy scoring time, limited the clinical utility of the **mETCH.** Earlier, Faddy and colleagues (2008) had reported high inter-rater reliability (ICC = 0.71 to 0.83) when two occupational therapy raters independently rated 10 handwriting samples for legibility using the **mETCH.** These samples had been collected from 10 adults with brain injury. However, Faddy and colleagues (2008) recruited a small number of participants (n=10), fewer than the recommended sample size (n= 30) for evaluating inter-rater reliability (Peat et al., 2001).

Au and colleagues (2012) recommended a more efficient and potentially reliable modified **Four-Point Scale** (**mFPS**) for rating legibility, where sentences and individual words are rated for 'global' legibility rather than rating every letter as required by the **mETCH**. These researchers advised that rating a small number of words and complete sentences for legibility would be faster than scoring every letter in a sentence.

The **mFPS** is a ranked ordinal scale with four categories of legibility (1-4), from illegible (1) to legible (4). Descriptors for the four **mFPS** categories were revised by Dettrick-Janes and colleagues (2015) to contain the additional words, 'upon first read,' and that instrument re-named the modified Four Point Scale-Version 2 (**mFPS-v2**). This revision was made to simplify scoring decisions and help improve inter-rater agreement, which was fair to poor in earlier research (Au et al., 2012).

Inter-rater and intra-rater reliability of the **mFPS-v2** was investigated by Dettrick-Janes and colleagues (2015), to rate whole sentences (global legibility) and single words

(using the **mFPS-v2-W,** developed for the study). Two researchers rated 33 randomly selected writing samples obtained from 120 healthy older adults. Global legibility of text was rated '*upon first read'* a self-composed sentence, and an audio-taped telephone message. The self-composed sentence subtest was quick to administer, required little cognitive load for the writer, and typically produced legible text. Conversely, the audio-taped telephone message subtest was more complex, cognitively demanding, and as a result, often produced illegible text.

Single words were rated for legibility by Dettrick-Janes and colleagues (2015) using the **mFPS-v2-W,** and legible word percentages were then calculated. A pre-determined number of words were individually rated. No attempt was made to conceal adjacent words. Words were viewed within the context of the entire handwritten sample. Writing samples were independently scored by two occupational therapists with experience rating writing samples and retraining adult handwriting. For intra-rater reliability of scoring procedures, writing samples were re-rated by the same person on two occasions, with 22 months between first and second scoring.

Disappointingly, inter-rater agreement was still below acceptable levels when the **mFPS-v2** and **mFPS-v2-W** were used to rate legibility. In that study by Dettrick-Janes and colleagues (2015), one rater consistently scored legibility more severely than the other. Although inter-rater reliability of global legibility ratings when using the **mFPS-v2** was poor (for the self-composed sentence, percent exact agreement was 60.6%, p=0.19; and for the audiotaped message, percent exact agreement was 18.7; p= 0.82); percent close agreement was high and intra rater reliability was acceptable (percent close agreement was 94%; and percent close agreement for rating global legibility was 100%). Although a reliable instrument remains elusive for measuring handwriting legibility in research and clinical practice, the **mFPS-v2** method of rating global legibility is clinically useful if repeated assessments are completed by the same rater (Dettrick-Janes et al, 2015).

Investigation of inter and intra-rater reliability of the **mFPS-v2-W** showed that one rater consistently rated lower than the other (for the self-composed sentence subtest Kendall's tau = 0.91, p= 0.001; for the audio taped message Kendall's tau = 0.5,

p=0.001). Intra-rater reliability was better; for the audiotaped message, the ICC was 0.75%, however an intra-class correlation coefficient (ICC) could not be calculated for the self-composed sentence subtest.

In that study involving healthy older adults, global legibility was high across all sub-tests when one rater scored 120 self-composed 5-word sentences using the **mFPS-v2** (Dettrick-Janes et al, 2015). The majority of handwriting samples (91%) were awarded a rating of '4', that is, most or all words were legible, and the meaning of the text could be understood upon first read. A small number of samples (7%) were rated '3' where many words were legible, and the meaning of the text could be understood upon first read, and 1% of samples were rated '2' where some words were legible, and the meaning of the text was unclear upon first read. The researchers concluded that Illegible handwriting produced under test conditions is likely due to the required task or specific health conditions rather than the effects of aging (Dettrick-Janes et al, 2015).

Determining handwriting legibility and obtaining inter-rater reliability of legibility measures is challenging. Handwriting legibility relies not only on handwriting components such as letter form or letter size, but also on reading process components such as context, word prediction, word shape recognition and world knowledge. Readers use context and knowledge of words and language to predict and recognise words (Federmeiera & Kutas, 1999), reducing the need for full legibility of all words, or all letters contained in a word (Morton, 1964). Conversely, words may be rated as illegible when context is misleading, but legible when rated in isolation. Dettrick-Janes and colleagues (2015) found that some handwritten words could not be understood upon first read although some or many letters were legible. Unexpected words such as 'magazine', 'hammer' and 'prescriptions', written out of context in the middle of a food shopping list, were difficult to recognise and therefore classified as "illegible". However, had the words appeared in context along with other similar items, or in isolation, they may have been classified as "legible".

In the absence of a reliable instrument for measuring handwriting legibility, use of the **mFPS-v2** and **mFPS-v2-W** for scoring the legibility of a 5-word sentence, and the

words within that sentence, are clinically useful when repeated by the same rater over time. Therefore, the mFPS-v2 and mFPS-v2-W are used in the HAB-v6.

Of note, more than 10% of the healthy older adult participants in that 2015 study chose to print when asked to write using their 'usual writing style'. Therefore, printing should not be discouraged when assessing and retraining handwriting in older populations. Previous studies have reported that mixed print handwriting styles are more legible than cursive writing alone (Gozzard et al., 2012; van Drempt et al., 2011). Therapists involved in retraining handwriting legibility could encourage use of printed letters as a strategy to ensure that first, last and ascender/ descender letters in words are formed well, which will improve word readability.

Section 4: Handwriting Appearance and Satisfaction Index

The general aesthetic character or look of handwriting has long been considered an important aspect of handwriting (Bailey, 1988). 'Neatness' has previously been described as a legibility component and thought to affect the overall legibility of children's handwriting (Graham, 1986; Graham & Weintraub, 1980). However, Graham and colleagues (1989) suggested that neatness may not influence actual readability, but the perception of legibility. Both 'neatness' and legibility were investigated in a study of adult handwriting, with older adults scoring significantly lower for neatness than younger adults, but with no differences in legibility scores (Baxter, 2004).

In our own clinical practice as occupational therapists, we have seen individuals who are dissatisfied with their handwriting 'legibility', yet their writing could still be read and understood. The appearance of written text is often described as being messy or untidy, and different from the person's pre-stroke writing, but may not be illegible. Such individuals are often dissatisfied with the 'look' of their handwriting. The handwriting parameters of size, alignment, 'line quality' and spacing (often referred to as 'legibility components' in children's handwriting literature), probably relate more to adult handwriting aesthetics or neatness than legibility (Dettrick-Janes, 2018). Variations in handwriting legibility 'components' (space, size and alignment)

did not impact upon overall handwriting legibility in an Australian study that explored the handwriting behaviours of 30 healthy older adults and characteristics of writing such as style and legibility (van Drempt et al., 2011).

An exploratory pilot study by Simpson and colleagues (2016) recruited a small sample of seven community-dwelling stroke survivors, provided handwriting retraining at home for four weeks and rated legibility as the primary outcome. While most written text was readable and awarded high legibility scores, most of the seven participants felt that their handwriting was still untidy or of poor quality compared to their pre-stroke handwriting. Simpson and colleagues (2016) found that participants' handwriting goals reflected their concerns about handwriting quality; for example, one participant wanted to 'write a neat Christmas card'. Common changes in the 'look' of these individuals' handwriting following stroke included larger and/or inconsistent sized letters, alignment problems and 'shaky' rather than 'smooth' straight and curved letter strokes. These handwriting changes were often perceived by the writer as 'illegible', 'unsatisfactory' or 'childlike', despite the letters remaining well-formed and the handwriting rated as 'legible' (readable) by a blinded rater (Simpson et al., 2016). The researchers concluded that an additional outcome measure that can evaluate handwriting neatness or quality is recommended for future studies.

To capture important changes in handwriting over time, we developed, but have not yet pilot tested nor validated, the '**Handwriting Appearance and Satisfaction Index' (HASI)** for use with individuals who wish to improve their handwriting following stroke. The **HASI** aims to measure two distinct handwriting constructs: (a) self-rated quality of aspects of handwriting appearance (such as letter size, letter alignment, error corrections and so on) and (b) self-reported satisfaction with each aspect of handwriting following stroke. The HASI can also be used with adults who have not had a stroke, and with children by omitting section "A" of the index.

In summary, the ***HAB*-v6** includes four sections and six subtests: two subtests of pen control and manipulation (lines and dots) adapted from the **MAS-UL**, two speed subtests, one from the **Jebsen Taylor Test of Hand Function** and a new self-composed **shopping list speed subtest** developed for the *HAB-V6*, with comparative data

available from a sample of 120 healthy older adults (Burger & McCluskey, 2011; Dettrick-Janes et al, 2015; 2016); one legibility subtest where a 5-word sentence originating from the **ETCH** is rated using both the **mFPS-v2** for sentence legibility and **mFPS-W-v2** for word legibility, and a new neatness index, the **Handwriting Appearance and Satisfaction Index (HASI)** developed for the *HAB-V6* (Dettrick-Janes, 2018) to help therapists analyse handwriting and provide handwriting retraining descriptors that can be used for feedback during handwriting practice session. The **HASI** has not yet undergone any psychometric testing.

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Administration of Subtests

Administration of Subtests

Administration of the *HAB-v6* should be completed in a quiet environment, and takes approximately 15 - 20 minutes. For standardisation purposes, the assessment should be administered in the booklet order.

The following materials will be needed:

- Test manual/booklet
- Test score sheet (see test booklet)
- Writing speed sentence cards
- A transparent (see through) ruler
- A local grocery catalogue
- Sharpened HB pencil
- Pencil sharpener
- Pen
- Eraser
- Stopwatch

The HAB-v6 should be administered with the person sitting at a desk or table which is suitable for writing. The test booklet should be placed on the table in front of the participant, face-up, at their midline.

The participant may move the booklet to a comfortable position in front of them.

Administration of each of the HAB-v6 subtests will now be described.

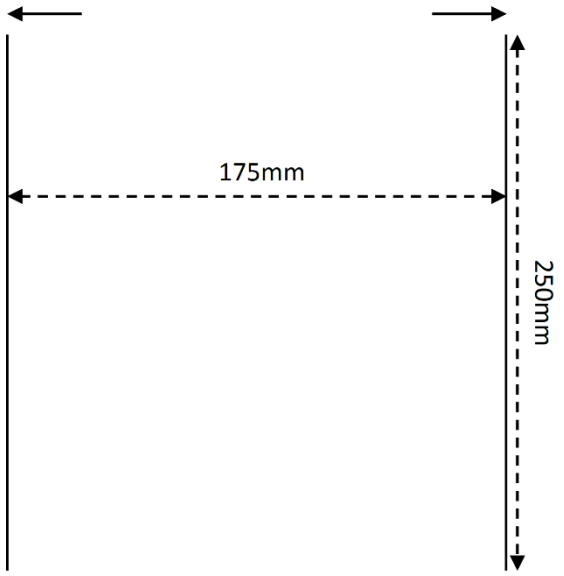
Lines task (modified)

Before an examiner is deemed competent at scoring, it Is recommended that they complete and practice scoring a minimum of six tests (Carr et al., 1985).

Task: In a 20 second time period, as many lines as possible are drawn across the pre-prepared page using a pencil. The best attempt of 3 attempts is used for scoring.

Test set up:

Prepare three sheets of plain paper with two vertical lines (each 250mm in length), spaced 175mm apart. Place arrows pointing toward each line at the top of each line. These arrows are used for noting the direction of line drawing used by the participant. A left-hand (or right-hand) dominant person may choose to draw the lines from right to left without prompting, as observed during research (Dettrick-Janes, McCluskey, Lannin, & Scanlan, 2016). Provide three sheets of paper so that the task can be repeated three times, ensuring the participants' 'best attempt' is captured. An example (not to scale) is presented below.



Equipment Required:

1. Three prepared sheets of paper (as above)
2. Pencil for line drawing (must use a pencil, not a pen)
3. Ruler for measuring line accuracy

Administration Procedure:

Verbal Instruction: 'Using a pencil, draw as many horizontal lines as possible in 20 seconds on the sheet of paper provided. Lines should be drawn between the two vertical lines and stop accurately at a vertical line. You are timed from the moment you put the pencil on the paper to start the assessment. You will be stopped once the 20 second time period has elapsed. You are able to have 3 attempts at the test, and your best attempt will be scored'.

While no instruction is given about which direction to draw the line, participants can draw from left to right or right to left (a left-handed person may choose to draw from right to left). Circle the appropriate arrow provided on the prepared page to indicate the direction of line drawing.

Offer a practice attempt (which is not timed) to draw some horizontal lines. Mark practice lines "P" next to each practice line. Provide clarification that the lines should stop accurately at a vertical line if required.

Repeat the task 3 times, using the 3 separate pieces of paper.

Scoring Procedure:

See separate section - "Scoring and Interpretation"

Dots task (modified)

Task: As many dots as possible are made during a 5 second time frame using a pencil. The person is aiming to make at least 10 dots that are considered 'dots', not 'strokes' The best attempt of 3 attempts is used for scoring.

Equipment Required:

1. Three blank sheets of plain paper
2. Pencil for dot making (Must use a pencil and not a pen)
3. Ruler for measuring diameter of dots

Administration Procedure:

Verbal Instruction: "Holding a pencil, make as many rapid consecutive dots as possible in 5 seconds on the sheet of paper provided. You must make 'dots' not 'strokes'. A dot with a 'tail' counts as a "stroke". To be considered an accurate dot, the dot must not be more than 1mm 'thick' at any point in its diameter. You must pick up the pencil and position it without assistance and hold the pencil as for writing You are able to have 3 attempts at the test, and your best attempt will be scored. Ready… Go!".".

Offer a practice attempt (which is not timed) to make some dots on the page. Circle the practice attempt and mark "P" next to the circle. Provide clarification of the definition of a dot by demonstrating making a dot, then making a 'stroke' if participant has difficulty understanding the instruction.

Count the dots and write the number down, (count up to a maximum of 10), as soon as possible, as dots may be difficult to see later due to the "light" appearance of pencil marks

Scoring Procedure:

See separate section - "Scoring and Interpretation"

SECTION 2: WRITING SPEED

24 LETTER COPIED SENTENCE SPEED WRITING TEST (JEBSEN ET AL., 1969)

Task: The time taken to copy a pre-printed sentence containing 24 letters is recorded. The person is asked to write using cursive writing, although if another style of writing is used (e.g., printing), the handwriting sample can still be scored.

Equipment Required:

1. A pencil or a pen
2. Stopwatch/timer
3. Three sentences each presented on a separate card

Each 24-letter sentence is of third grade reading difficulty. The sentences are presented on the following page for photocopying and may be glued onto cards.

Administration Procedure:

Place one of the three cards with a sentence on it, face down in front of the person.

> **Verbal Instruction: "**Take a pencil or pen in your writing hand and arrange everything so that it is comfortable for you to write. There is a sentence on the other side of the card the therapist will give you. When the therapist says 'go', copy the sentence in cursive not PRINTING. You will be timed from the word 'Go' until you have completed the sentence. If a word is misspelt or printed you will need to rewrite the sentence using a different card. Ready?... Go!".

Time from when the card is turned over and the pencil/pen touches the paper, until the person finishes writing the sentence. Record the time taken to write the sentence.

<u>Additional Information:</u>

- If the person misspells or misses a word, the mistake should be pointed out and the test item repeated using an alternative sentence. The time taken for the alternative sentence is used to score the subtest.

Scoring Procedure: See separate section "Scoring and Interpretation"

The Jebsen-Taylor Test of Hand Function – 24 letter sentences

These sentences can be photocopied and cut out for assessment use.

FISH TAKE AIR OUT OF THE WATER

JOHN SAW THE RED TRUCK COMING

THE OLD MAN SEEMED TO BE TIRED

SELF-GENERATED SHOPPING LIST TASK – SPEED TEST

Task: A self-generated, 5-item shopping list is written in the participants' usual handwriting style, (cursive or printed writing, or a mixture of both). The person may choose to write in either pencil or pen (Burger & McCluskey 2011; Dettrick-Janes et al, 2015).

Equipment Required:

1. A pencil or a pen
2. Stopwatch/timer
3. Grocery Catalogue to have available if required

Administration:

Verbal Instructions: "Think of and then write down 5 single word items that you might write on a shopping list. You can use pencil or pen. I will ask you if you are ready and if you are, you will be timed from when I say the word "Go" until you have completed writing the 5-item shopping list, Ready?... Go!"

If the person cannot think of items, prompts may be given such as *"Your list could contain food items or items you can see around the room"*. If the person continues having difficulty thinking of items, they can be offered a grocery catalogue to look through before beginning the subtest.

When the pencil/pen touches the paper, start the stopwatch and time how long it takes for the person to write the five-item list.

Record the time taken to write the five items

Additional Information:

- Examples of lists written by participants have included: "celery, cucumber, lettuce, avocado, onion" and "magazine, butter, fruit, vegetables, meat".

Scoring Procedure:

- See separate section "Scoring and Interpretation"

SECTION 3: WRITING LEGIBILITY

SELF-GENERATED SENTENCE COMPOSITION TASK

Adapted from **The Evaluation Tool Of Children's Handwriting** (Amundson, 1995)

Task: A self-generated sentence containing five words is thought of and then written down in pencil or pen in the person's usual style of handwriting.

Equipment Required:

1. A pencil or a pen

Administration:

> ***Verbal Instruction*:** "Think of a sentence containing five words. I will give you a few seconds to think of the sentence and then you can write it down, in your usual style of writing (whether that was cursive, printed or a mixture of both). You can write using a pen or pencil. Ready?... Go!"

If the person has difficulty generating a sentence, suggest a broad topic such as "outdoor activities". If the person continues to have difficulty generating a sentence, suggest a more concrete idea such as "a sentence about an animal" or "today's lunch".

If ideas have been presented to enable the client to generate a sentence and he/she is still unable to do so, skip this task. Indicate this on the client booklet and score sheet. *Do not formulate a sentence for them.*

If the person asks for help spelling words, request they spell the world the best he/she can. If the person is unable to form a certain letter, he/she can place a dot in the letters position.

If the sentence cannot be read by the examiner, ask the writer to read the sentence. Then record the intended sentence in the client's booklet next to the writing sample.

Scoring Procedure:

- See separate section "Scoring and Interpretation"

SECTION 4: NEATNESS OF HANDWRITING

HANDWRITING APPEARANCE AND SATISFACTION INDEX (HASI)

***Rated by the stroke survivor with assistance from a therapist/carer if required*. If the person being tested has not had a stroke, do not complete section A *of each item*.**

1. The overall **appearance** or 'look' of your handwriting

1A. *Compared with your pre-stroke handwriting, is the overall appearance of your handwriting now worse?*

- ☐ Not at all, the overall appearance of my handwriting is the same or better
- ☐ The appearance of my handwriting is a little worse
- ☐ The appearance of my handwriting is moderately worse
- ☐ The appearance of my handwriting is a lot worse

1B. How satisfied are you now with the overall appearance or 'look' of your handwriting?

☐	☐	☐	☐	☐	☐
Very satisfied	Moderately satisfied	Somewhat satisfied	Somewhat dissatisfied	Moderately dissatisfied	Very dissatisfied

1C. Do you want to improve the overall look of your handwriting *with advice from a therapist*?

- ☐ Yes
- ☐ No

---

2. The **size** of your handwritten **letters**

Letter sizing may seem 'too big', 'too small' or a combination of these

2A. *Compared with your pre-stroke handwriting, is the size of your handwritten letters now worse?*

- ☐ Not at all, the size of my handwritten letters is the same or better
- ☐ The size of my handwritten letters is a little worse
- ☐ The size of my handwritten letters is moderately worse
- ☐ The size of my handwritten letters is a lot worse

2B. How satisfied are you now with the size of your handwritten letters?

☐	☐	☐	☐	☐	☐
Very satisfied	Moderately satisfied	Somewhat satisfied	Somewhat dissatisfied	Moderately dissatisfied	Very dissatisfied

2C. Do you want to improve the size of your handwritten letters *with advice from a therapist*?

- ☐ Yes
- ☐ No

3. The **spacing** between your handwritten **letters**

Letters may seem too close together or may overlap, or seem too far apart, or a combination of these

3A. *Compared with your pre-stroke handwriting, is the spacing between your handwritten letters now worse?*

- ☐ Not at all, the spacing between my handwritten letters is the same or better
- ☐ The spacing between my handwritten letters is a little worse
- ☐ The spacing between my handwritten letters is moderately worse
- ☐ The spacing between my handwritten letters is a lot worse

3B. How satisfied are you now with the spacing between your handwritten letters?

☐	☐	☐	☐	☐	☐
Very satisfied	Moderately satisfied	Somewhat satisfied	Somewhat dissatisfied	Moderately dissatisfied	Very dissatisfied

3C. Do you want to improve the spacing between your handwritten letters *with advice from a therapist*?

- ☐ Yes
- ☐ No

---

4. The **spacing** between your handwritten **words**

Words may be too close together, overlapping, too far apart, or a combination of these

4A. *Compared with your pre-stroke handwriting, is the spacing between your words now worse?*

- ☐ Not at all, the spacing between my handwritten words is the same or better
- ☐ The spacing between my handwritten words is a little worse
- ☐ The spacing between my handwritten words is moderately worse
- ☐ The spacing between my handwritten words is a lot worse

4B. How satisfied are you now with the spacing between your handwritten words?

☐	☐	☐	☐	☐	☐
Very satisfied	Moderately satisfied	Somewhat satisfied	Somewhat dissatisfied	Moderately dissatisfied	Very dissatisfied

4C. Do you want to improve the spacing between your handwritten words *with advice from a therapist*?

- ☐ Yes
- ☐ No

5. The **alignment** of your handwriting

Alignment refers to the letters and words appearing 'in line' in relation to each other, regardless of whether the writing is on lined paper or blank paper. The "line of writing" may also move toward the top of the page or toward the bottom of the page.

5A. *Compared with your pre-stroke handwriting, is the alignment of your handwriting now worse?*

- ☐ Not at all, the alignment of my handwriting is the same or better
- ☐ The alignment of my handwriting is a little worse
- ☐ The alignment of my handwriting is moderately worse
- ☐ The alignment of my handwriting is a lot worse

5B. How satisfied are you now with the alignment of your letters and words?

☐	☐	☐	☐	☐	☐
Very satisfied	Moderately satisfied	Somewhat satisfied	Somewhat dissatisfied	Moderately dissatisfied	Very dissatisfied

5C. Do you want to improve the alignment of your handwriting *with advice from a therapist*?

- ☐ Yes
- ☐ No

---

6. The **slant** or **angle** of your handwriting

The letters may seem to slant too far towards a clockwise or anticlockwise direction, or the slant of the writing may not be uniform or consistent

6A. *Compared with your pre-stroke handwriting, is the slant or angle of your handwritten letters now worse?* *For example,*

- ☐ Not at all, the slant or angle of my letters is the same or better
- ☐ The slant or angle of my letters is a little worse
- ☐ The slant or angle of my letters is moderately worse
- ☐ The slant or angle of my letters is a lot worse

6B. How satisfied are you now with the slant or angle of your letters and words

☐	☐	☐	☐	☐	☐
Very satisfied	Moderately satisfied	Somewhat satisfied	Somewhat dissatisfied	Moderately dissatisfied	Very dissatisfied

6C. Do you want to improve the slant or angle of your handwritten letters *with advice from a therapist*?

- ☐ Yes
- ☐ No

7. The **quality or appearance** of the **lines and curves** of your **letters**

Letter lines and curves may appear too dark, too light, jerky / shaky or the letter curves may not appear smooth or may appear to have abrupt directional changes

7A. *Compared with your pre-stroke handwriting, is the quality of the lines and curves now worse?*

- ☐ Not at all, quality of the lines and curves of my letters is the same or better
- ☐ The quality of the lines and curves of my letters is a little worse
- ☐ The quality of the lines and curves of my letters is moderately worse
- ☐ The quality of the lines and curves of my letters is a lot worse

7B. How satisfied are you now with the quality of the lines and curves of your letters?

☐	☐	☐	☐	☐	☐
Very satisfied	Moderately satisfied	Somewhat satisfied	Somewhat dissatisfied	Moderately dissatisfied	Very dissatisfied

7C. Do you want to improve the quality of the lines and curves of your handwritten letters *with advice from a therapist*?

- ☐ Yes
- ☐ No

---

8. Extra marks around your writing

There may be extra blotches, dashes, smudges or corrections

8A. *Compared with your pre-stroke handwriting, are the number of extra pen or pencil marks on or around the writing now worse?*

- ☐ Not at all, the overall appearance of my handwriting is the same or better
- ☐ The appearance of my handwriting is a little worse
- ☐ The appearance of my handwriting is moderately worse
- ☐ The appearance of my handwriting is a lot worse

8B. How satisfied are you now with the number of extra pen or pencil marks on or around your handwriting?

☐	☐	☐	☐	☐	☐
Very satisfied	Moderately satisfied	Somewhat satisfied	Somewhat dissatisfied	Moderately dissatisfied	Very dissatisfied

8C. Do you want to reduce the number of extra pen or pencil marks on or around your writing *with advice from a therapist*?

- ☐ Yes
- ☐ No

9. The **formation** of your handwritten **letters**

Letter parts may not be joined up, letters may be incomplete, letters may appear distorted, stretched, squashed, or reversed

9A. *Compared with your pre-stroke handwriting, is the formation of your handwritten letters now worse?*

- ☐ Not at all, the formation of my handwritten letters is the same or better
- ☐ The formation of my handwritten letters is a little worse
- ☐ The formation of my handwritten letters is moderately worse
- ☐ The formation of my handwritten letters is a lot worse

9B. How satisfied are you now with the formation of your handwritten letters?

☐	☐	☐	☐	☐	☐
Very satisfied	Moderately satisfied	Somewhat satisfied	Somewhat dissatisfied	Moderately dissatisfied	Very dissatisfied

9C. Do you want to improve the formation of your letters *with advice from a therapist*?

- ☐ Yes
- ☐ No

---

10. Use of the **writing space**

For example, the writing may be squashed up to one side.

10A. Compared to your pre-stroke handwriting, is your use of the writing space now worse?

- ☐ Not at all, my use of the writing space is the same or better
- ☐ My use of the writing space is a little worse
- ☐ My use of the writing is moderately worse
- ☐ My use of the writing space is a lot worse

10B. How satisfied are you now with your use of the writing space?

☐	☐	☐	☐	☐	☐
Very satisfied	Moderately satisfied	Somewhat satisfied	Somewhat dissatisfied	Moderately dissatisfied	Very dissatisfied

10C. Do you want to improve your use of the writing space *with advice from a therapist*?

- ☐ Yes
- ☐ No

Other aspects of your handwriting

11. **Spelling** when handwriting

11A. Are you satisfied with your spelling when handwriting?

- ☐ Yes
- ☐ No

11B. Do you want to improve your spelling when handwriting *with advice from a therapist*?

- ☐ Yes
- ☐ No

---

12. Writing speed

12A. Are you satisfied with your writing speed?

- ☐ Yes
- ☐ No

12B. Do you want to improve your writing speed *with advice from a therapist*?

- ☐ Yes
- ☐ No

---

13. **Pen grip** when writing

13A. Are you satisfied with your pen grip?

- ☐ Yes
- ☐ No

13B. Do you want to improve your pen grip *with advice from a therapist*?

- ☐ Yes
- ☐ No

---

14. Is there **any other aspect of your handwriting** you are unsatisfied with and would like to improve?

- ☐ Yes
- ☐ No

PLEASE LIST:

Scoring & Interpretation of Subtests

Scoring and Interpretation of Subtests

SECTION 1: PEN CONTROL AND MANIPULATION

Adapted from **The Motor Assessment Scale** (Carr et al., 1985)

Lines Task (Modified) – Adapted from the Motor Assessment Scale (MAS)

Scoring Procedure:

1. Count and record on the page the total number of lines drawn for each attempt. Count up to 10 lines. If more than 10 lines are drawn, record '10' regardless (practice attempts are not counted).

2. Count and record on the same page the number of 'accurate' lines drawn. Lines that finish within 2mm either side of the vertical line (before or after) where the line was intended to stop are considered 'accurate'. Count up to 10 lines.

3. Record on the "score sheet" the number of total lines and accurate lines drawn for the best attempt (both up to a maximum of 10 lines). The "best attempt" is defined as the attempt producing the greatest number of accurate lines.

Dots Task (Modified) – Adapted from the Motor Assessment Scale (MAS)

Scoring Procedure:

1. Count the number of dots produced until 10 dots are tallied. To distinguish between a 'dot' and a 'stroke', use a transparent ruler to measure the diameter of each 'dot' at its widest point. If the dot diameter is 1mm or less, the dot is counted. If the dot diameter is greater than 1mm, it is considered a 'stroke' and is not counted.

2. Record on the "score sheet" the number of dots produced up to 10. If more than 10 dots were produced, record 10 regardless. (Practice attempts are not counted).

Interpretation of Performance

1. Compare the number of accurate lines and dots produced by the person, during their best attempt, with data from 120 healthy older adults (Dettrick-Janes et al 2016).

2. Determine if the person may benefit from intervention to improve performance.

   - **Need for pen control and manipulation intervention:** *If the person did not produce the expected number of lines or dots for their age group*

Table 1: *Lines and dots produced by healthy older adults*

Age Group (Tick)	Average /range of lines and dots produced by healthy adults	
60-69	Lines: 9 (Range 6-10)	Dots: 10
70-79	Lines: 8 (Range 5-10)	Dots: 8-10
80-89	Lines: 8 (Range 6-10)	Dots: 8-10
90-99	Lines: 7 (Range 2-10)	Dots: Usually produce less than 10 but greater than 1 dot

Reference: Dettrick-Janes et al, 2015

Additional descriptive data for the lines and dots task (modified)

Table 2: Number and proportion of healthy older adults (60-99 years) that achieved v failed the horizontal lines task (revised) (n=120) and statistics for total number of lines drawn (best attempt; regardless of accuracy) by those who failed the 'lines' task.

		Age groups				
	Total Sample n=120	**60-69** n=30	**70-79** n=30	**80-89** n=30	**90-99** n=30	Test statistics for subtest score among age groups
Horizontal Lines	n (%)	n (%)	n (%)	n (%)	n (%)	
Did not achieve (score = 0)	54 (45)	10 (33.3)	10 (33.3)	14 (46.7)	20 (66.7)	(Chi-square=9.02, df=3, *P*=.03)
Achieved (score = 1)	66 (55)	20 (66.7)	20 (66.7)	16 (53.3)	10 (33.3)	
The min and max number of lines drawn by those who *did not pass* the lines task		6 - 9	5-9	6-9	2-9	
Median number of lines drawn (Interquartile range)		9 (8-9)	8 (6-9)	8 (7-8.25)	7 (5.5-8)	

Reference: Dettrick-Janes et al, 2015

Table 3: Number and proportion of healthy older adults that achieved and failed the dots task (revised)

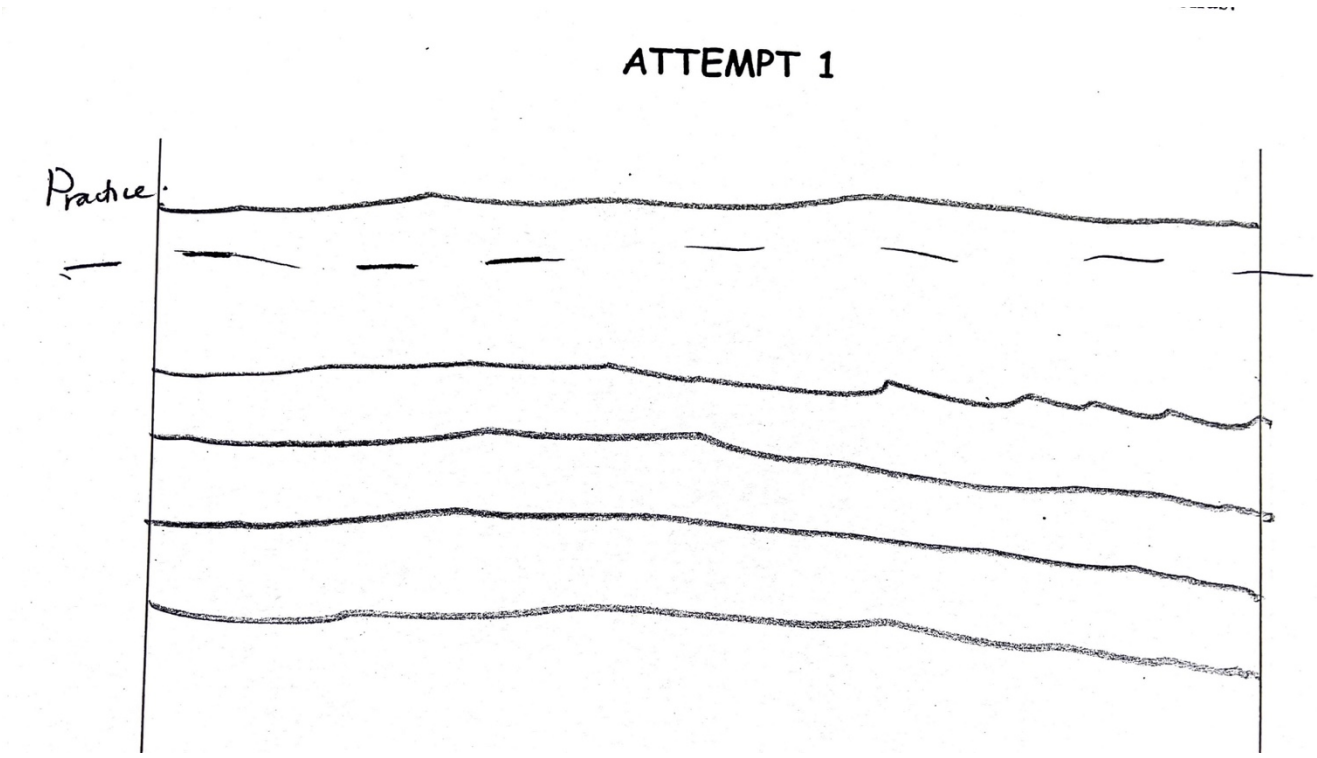
		Age groups				
Dots task	**Total Sample n=120**	**60-69 n=30**	**70-79 n=30**	**80-89 n=30**	**90-99 n=30**	**Test statistics for subtest score among age groups**
Did not achieve (score 0)	11 (9.2)	0 (0)	1 (3.3)	1 (3.3)	9 (30.0)	(Chi-square=21.12, df=3, *P*<.001)
Achieved (score 1)	109 (90.8)	30 (100)	29 (96.7)	29 (96.7)	21 (70)	

Source: Adapted from Tables 2 and 3, Dettrick-Janes et al, (2015)

Lines Task Example 1 (Below, Figure 1)

Interpretation: A person who is 65-years old produced a total of four lines drawn in 20 seconds. All four lines are considered 'accurate" and within 2mm of the right vertical line. A cohort of 60-69 year old healthy adults produced a mean of 9 lines in 20 seconds (range 6-10). Therefore, in this example, the person may need intervention t improve their pen control and manipulation. (The practice lines drawn by the participant are separated out at the top, and are not counted.)

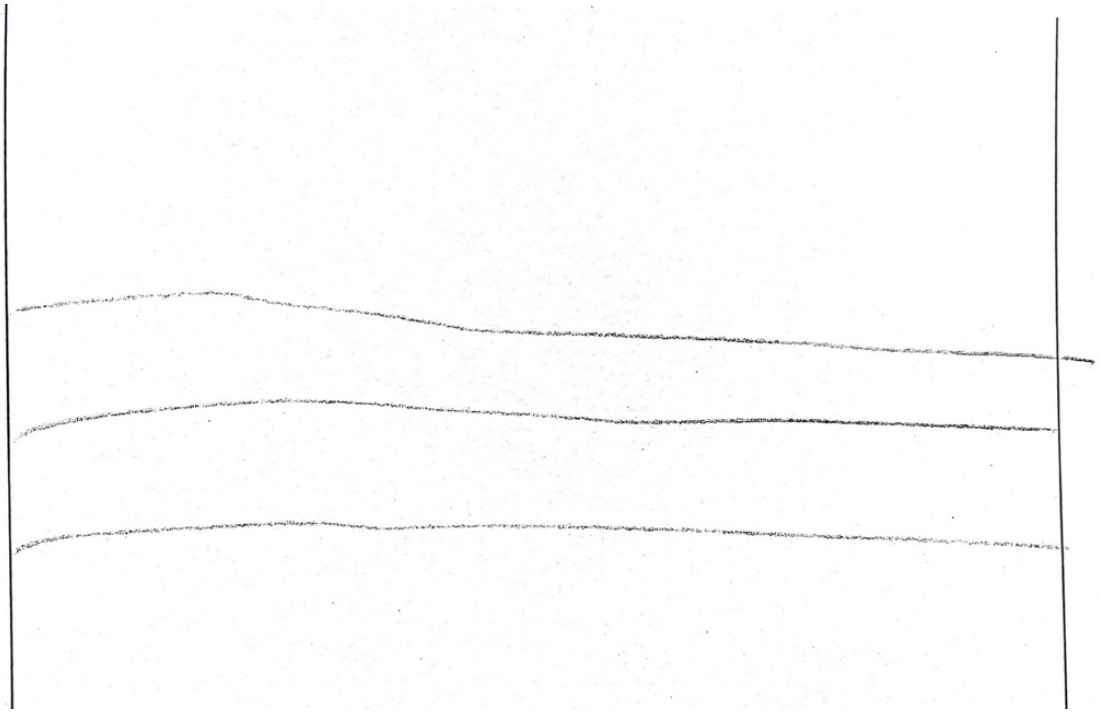
Figure 1 - Completed Lines Test - Example 1



Example 2 (Below, Figure 2)

Interpretation: A man who is 75-years of age drew three lines in 20 seconds. Only two lines are considered 'accurate" and within 2mm of the right vertical line. This person may require pen control and manipulation practice as a cohort of healthy older adults produced an average of 8 lines in 20 seconds (range 5 – 10).

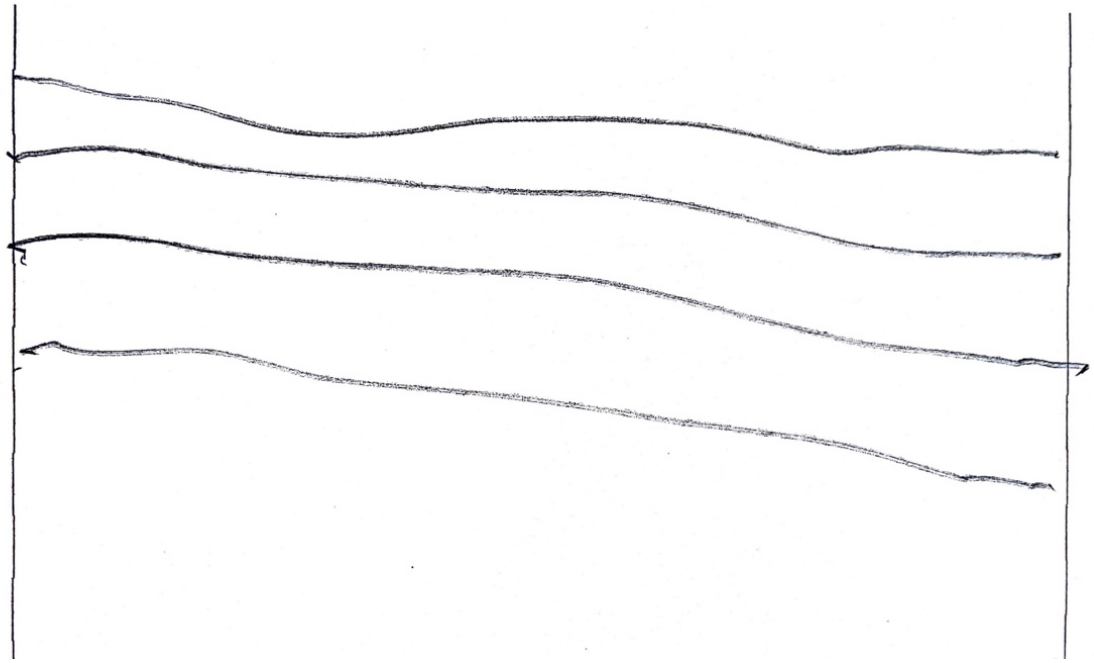
Figure 2 - Completed Lines Test – Example 2



Example 3 (Below, Figure 3)

Interpretation: A 91-year-old man produced four lines in 20 seconds. Only three lines are considered 'accurate" and within 2mm of the right vertical line. Pen control and manipulation should be further examined as 90–99-year old adults can produce 7 lines on average, although the range of lines produced by that age group was 2-10 lines.

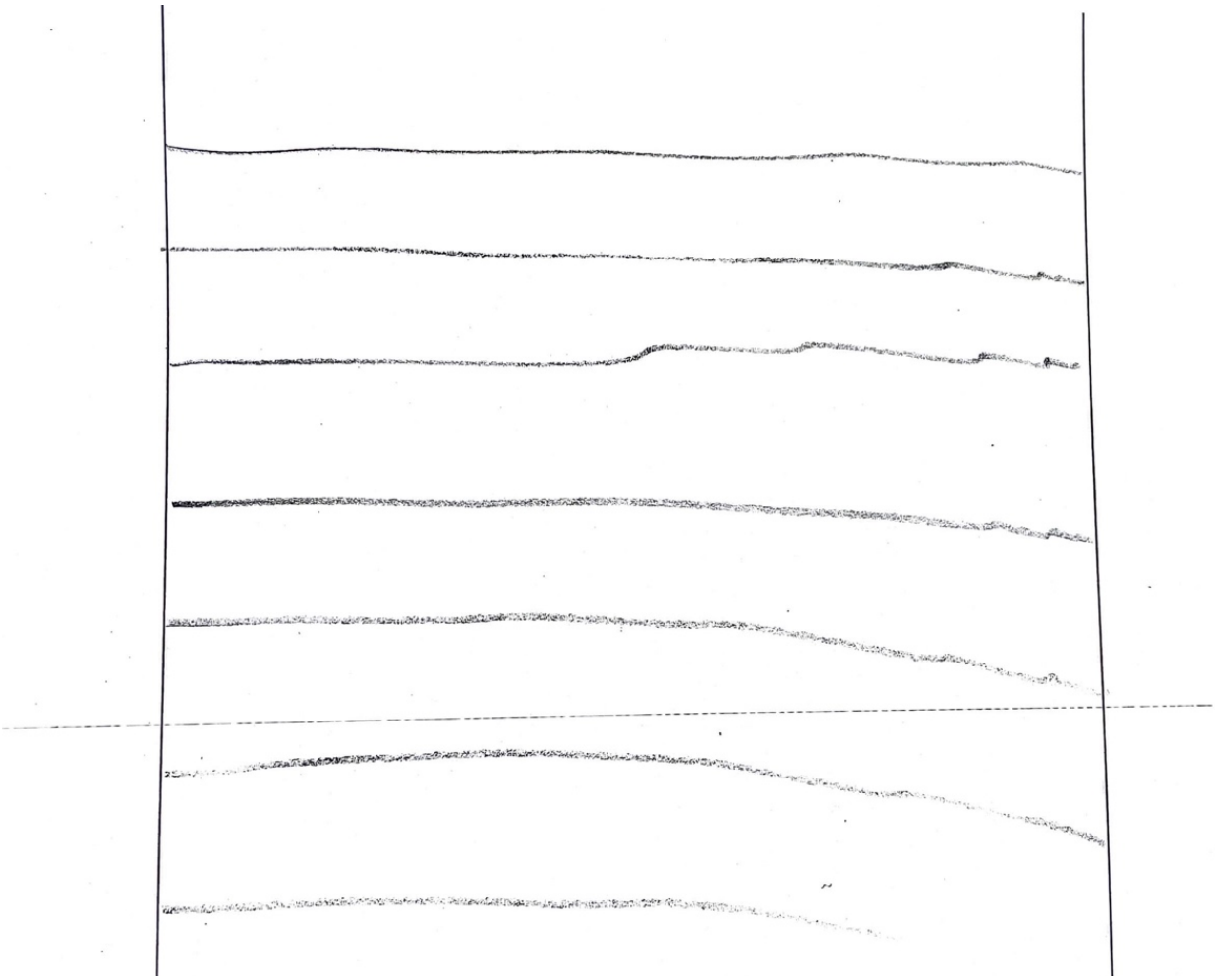
Figure 3 – Completed Lines Test – Example 3



Example 4 (Below, Figure 4)

Interpretation: A 65-year-old woman drew a total of six complete lines in 20 seconds. All six lines are considered 'accurate" and within 2mm of the right vertical line. The seventh line was not completed. Healthy older adults aged 60-69 years can draw, on average, 9 lines (range 6-10). This lady may require pen control and manipulation intervention, although further examination is warranted.

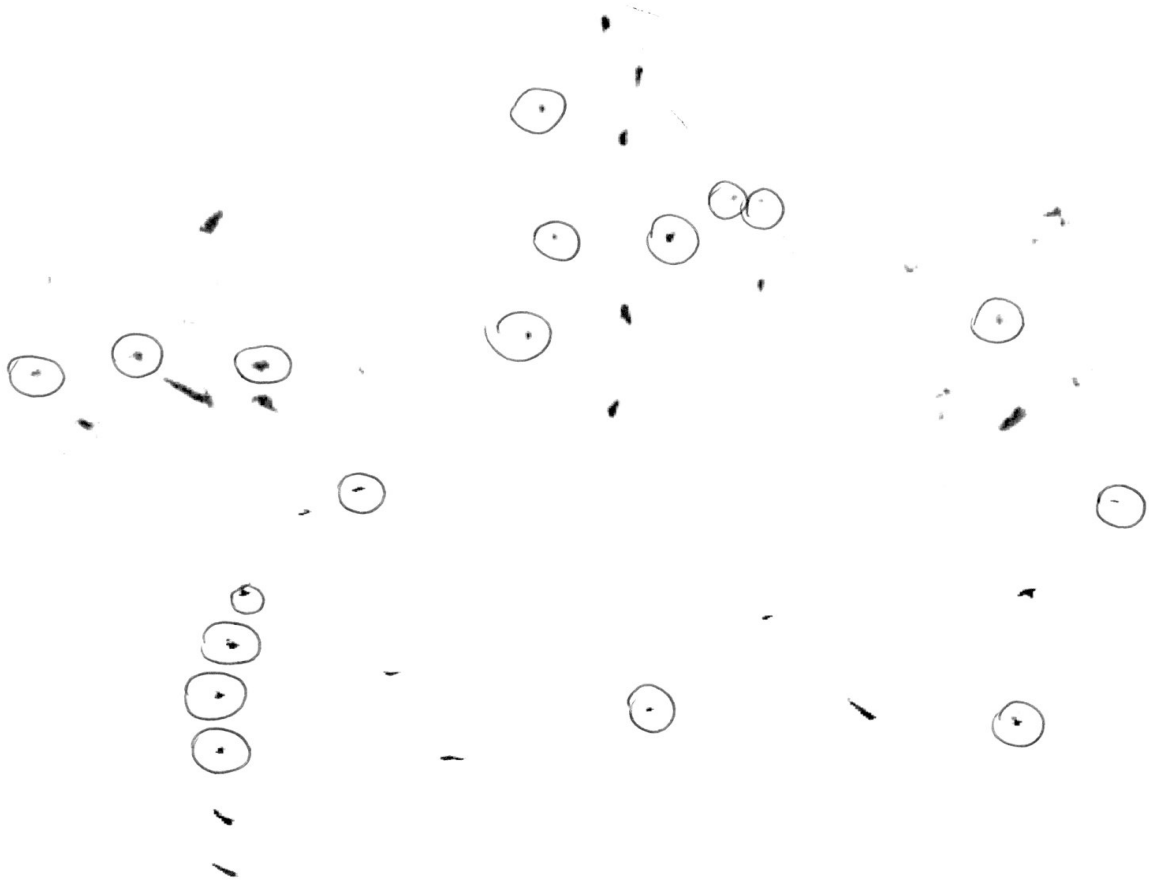
Figure 4 – Completed Lines Test – Example 4



Dots Task Example (Below, Figure 5)

Interpretation: An 80-year-old man has drawn more than 10 dots. A cohort of 80–89-year-old healthy older adults were able to draw between 8-10 dots, therefore this person has easily completed the subtest in the available time.

Figure 5: Examples of acceptable dots are circled. Any mark not circled is considered to be unacceptable.



SECTION 2: WRITING SPEED

THE 24-LETTER COPIED SENTENCE– SPEED WRITING TASK (JEBSEN ET AL., 1969)

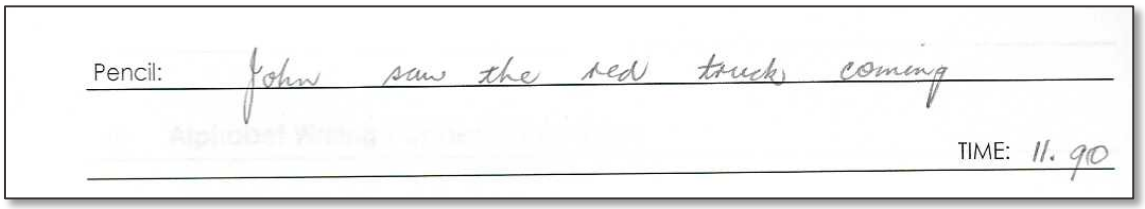
Scoring Procedure:

1) Record the amount of time taken to copy one of the 3 standardised sentences. The time is compared with normative data provided below.

2) If the client prints or misspells a word, the mistake should be pointed out and the test item repeated using an alternative sentence. The first sentence time is ignored, and the time taken to write the alternative sentence is used.

3) Record on the 'score sheet' time taken to complete the copied sentence.

Figure 6: Example of copied 24-letter sentence test by healthy older adult



Interpretation of Performance:

1. Compare the time taken by the client with data from healthy adults to determine if they may benefit from speed training.

Table 4: Time taken (in seconds) to copy the 24-letter sentence

Age Group (Tick)	Time taken by healthy older adults to copy a 24-letter sentence	
☐ 20-59	**Men** Pencil: 12.2 ± 3.5	**Women** Pencil: 11.7 ± 2.1
☐ 60-69	Pen: 11.24 ± 3.48 Pencil: 11.97 ± 2.62	Pen: 11.92 ± 2.65 Pencil: 12.05 ± 2.41
☐ 70-79	Pen: 12.24 ± 2.11 Pencil: 13.48 ± 2.65	Pen: 12.27 ± 2.18 Pencil: 12.81 ± 1.97
☐ 80-89	Pen: 14.63 ± 4.18 Pencil: 15.20 ± 3.38	Pen: 14.25 ± 2.21 Pencil: 16.35 ± 3.24
☐ 90-99	Pen: 20.69 ± 6.61 Pencil: 22.35 ± 7.73	Pen: 22.13 ± 7.64 Pencil: 23.60 ± 8.80

Reference: Burger and McCluskey, 2011; Jebsen et al, 1969 (20-59 age group)

Additional descriptive data for the 24-letter copied sentence (Jebsen) which can be used for comparison of performance.

Table 5: *Mean handwriting speed (± SD) recorded as time in seconds for Australian males and females (n=120) when copying a 24-letter sentence* (Burger & McCluskey, 2011)

Age Groups	Gender	Pen	95% CI †		Pencil	95% CI ‡	
			Lower	Upper		Lower	Upper
60 to 69	Male	11.24 (3.48)	8.97	13.51	11.97 (2.62)	9.73	14.20
	Female	11.92 (2.65)	9.64	14.19	12.05 (2.41)	9.82	14.28
70 to 79	Male	12.24 (2.11)	9.96	14.51	13.48 (2.65)	11.25	15.71
	Female	12.27 (2.18)	10.00	14.55	12.81 (1.97)	10.58	15.04
80 to 89	Male	14.63 (4.18)	12.36	16.90	15.20 (3.38)	12.97	17.43
	Female	14.25 (2.21)	11.98	16.52	16.35 (3.24)	14.11	18.58
90 to 99	Male	20.69 (6.61)	17.90	23.47	22.35 (7.73)	19.62	25.09
	Female	22.13 (7.64)	20.16	24.10	23.60 (8.80)	21.67	25.53

No significant difference between male and female times

†CI, 95% Confidence Intervals for pen, ‡ CI, 95% Confidence Intervals for pencil

Table 6: Mean handwriting speed times (± standard deviations, SD) recorded as time in seconds for American males and females when copying a 24-letter sentence in pencil

	Male		Female	
Age	**Mean**	**SD**	**Mean**	**SD**
20 – 59	12.2	± 3.5	11.7	± 2.1
60 - 94	19.5	± 7.5	16.7	± 4.7

Reference: Jebsen et al, 1969

Example 1

In clinical practice, we have seen people who have taken many minutes to write a 24-letter copied sentence. One stroke survivor took over four minutes to copy the 24-letter sentence subtest, and his handwriting was readable and neat.

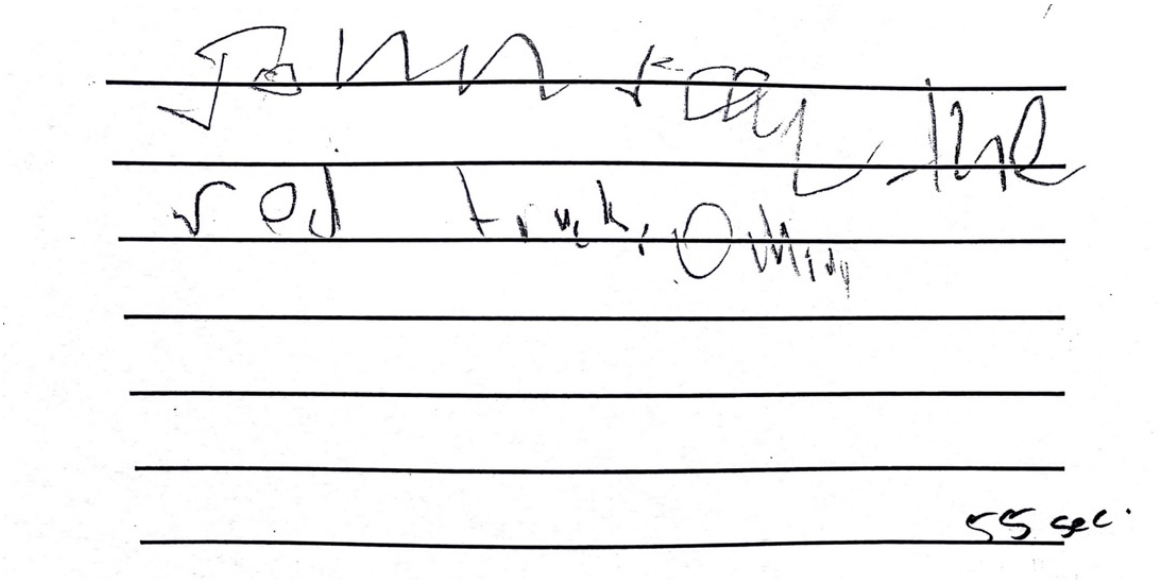
Healthy older men aged 60-69 years take an average of 12 seconds, and men aged 90-99 years take an average of 23 seconds to copy a 24-letter sentence. Therefore, this man was very slow and benefited from handwriting speed practice. Motivated by information about normative data, and an opportunity to improve his performance, he then took approximately two minutes (half the time of his first attempt) to write another, different 24-letter copied sentence.

Example 2 (Below, figure 7)

A 78-year-old woman who takes 55 seconds to copy the 24-letter sentence in pencil (see below) may benefit from retraining to increase her speed, because other women of that age (70-79 years) take up to 15 seconds (12.81 ± 1.97). However, legibility may be a more important goal, rather than speed.

For information, goals and practical task-specific handwriting retraining, see the article by Simpson and colleagues (2016).

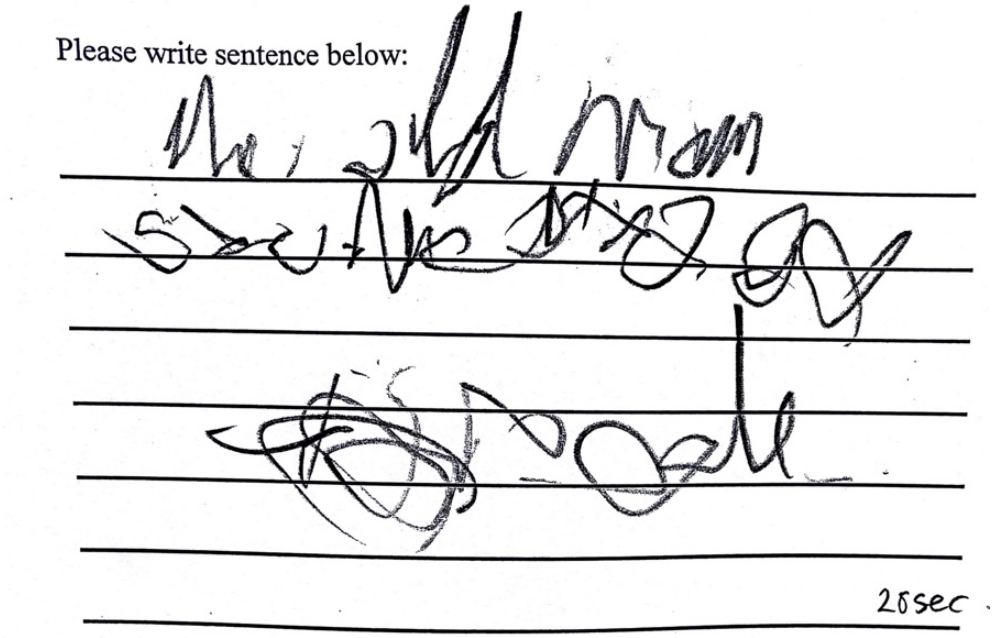
Figure 7: Example of a copied 24-letter sentence test by a 78-year-old female



Example 3 (Below, Figure 8)

A 62-yr old man took 20 seconds to copy a sentence in pen. The average speed for his age is 11.24 (± 3.48 secs), and the maximum time is 14.72 secs. He may be able to improve his speed with training and practice if that is a priority, although legibility is likely to be a more important goal.

Figure 8: Example of a copied 24-letter sentence test by a 62-year-old male stroke survivor



SELF-GENERATED SHOPPING LIST TASK – SPEED TEST

Scoring Procedure:

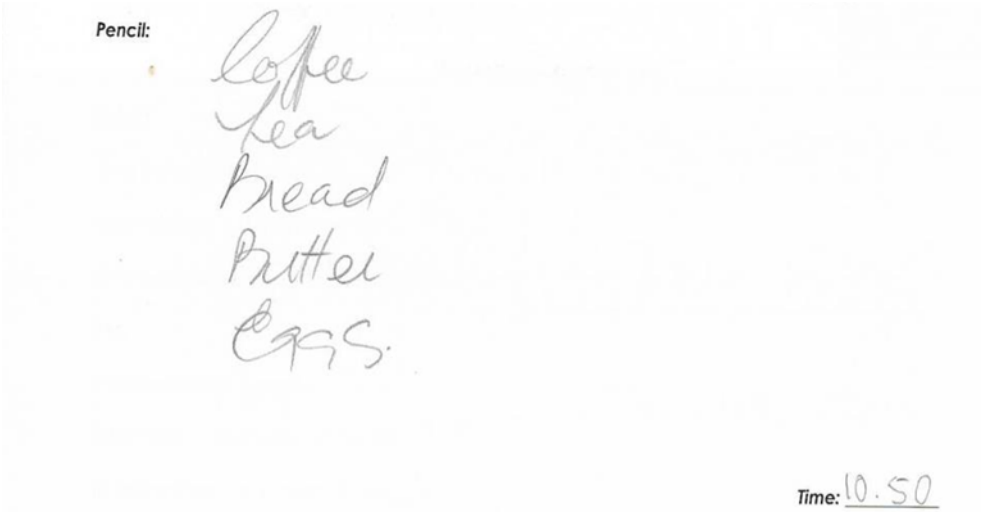
Convert the time taken to write the shopping list test into letters/minute using the following equation:

1. Record the number of letters written for the 5-word shopping list test. In the example below (see Figure 9), written by a healthy older adult, the person wrote 24 letters in total.
2. Record the time taken. In the example below (Figure 9), the time taken was 10.5 seconds.
3. Divide the number of letters by the time taken in seconds (eg. 24/10.5 = 2.285)
4. To convert to a letter rate per minute, multiple by 60 (eg 2.285 x 60 = 137.1)

The equation to calculate the shopping list written below in 10.5 seconds is:

(24 /10.5) x 60 = **137.14 letters/minute**

Figure 9: Example of a shopping list written by a healthy older adult



10.5 secs

Note: Although people may write words descending vertically down the page, some people may write the five words across the (blank) page. Both formats are acceptable.

Interpretation of Performance.

1. Compare the rate of letters/minute written for the shopping list test with data from 120 healthy adults to determine if the client may require speed training.

Table 7: Handwriting speed for the shopping list task; mean letters/minute ± SD

Age Group (Tick)	Time taken by healthy older adults to write a 5-word shopping list	
□ 60-69	**Men** Pen: 106.7 ± 30.83 Pencil: 126.6 ± 26.86	**Women** Pen: 98.1 ± 30.00 Pencil: 111.3 ± 22.32
□ 70-79	Pen: 92.2 ± 26.28 Pencil: 97.7 ± 17.89	Pen: 99.3 ± 29.15 Pencil: 105.5 ± 23.19
□ 80-89	Pen: 84.0 ± 22,36 Pencil: 83.8 ± 14.49	Pen: 88.9 ± 31.46 Pencil: 90.6 ± 22.82
□ 90-99	Pen: 58.8 ± 22.45 Pencil: 56.5 ± 23.22	Pen: 58.5 ± 18.38 Pencil: 57.0 ± 19.69

Reference: Burger & McCluskey (2011)

Example 1

An 82-year old female stroke survivor writes a shopping list containing 22 letters. The time taken to write the shopping list is 1 minute 20 seconds (80 secs). That person would be scored as writing 22/80 x 60 = **16.5 letters/minute.**

When writing a 5-word shopping list, healthy older women aged 80-89 years on average wrote 83.8 letters/minute. This lady wrote her shopping list very slowly, at a rate of 16.5 letters/minute and may benefit from speed training, if one of her goals is to improve writing speed.

For information, goals and practical task-specific handwriting retraining, see the article by Simpson and colleagues (2016).

SECTION 3: WRITING LEGIBILITY

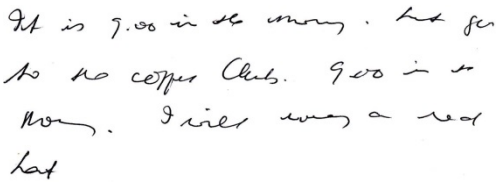
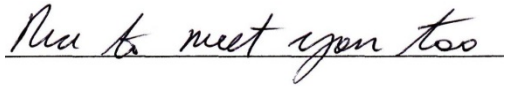
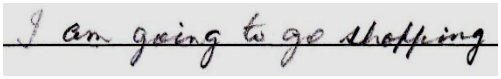
SELF-GENERATED SENTENCE COMPOSITION TASK

Adapted from **The Evaluation Tool Of Children's Handwriting** (Amundson, 1995)

Global legibility. Global legibility of the 5-word self-composed sentence is scored using a revised version of the Modified Four Point Scale **(mFPS**) (Au et al., 2012). The mFPS-v2 is a ranked ordinal scale (categories 1 to 4, from illegible to legible). A score between 1 and 4 is awarded for written text, returning one data point or score per writing sample (see Figure).

Scoring: Using the mFPS-v2 as shown in Figure 10, the self-composed sentence should be read in its entirety, then a global legibility rating assigned (1, 2, 3 or 4).

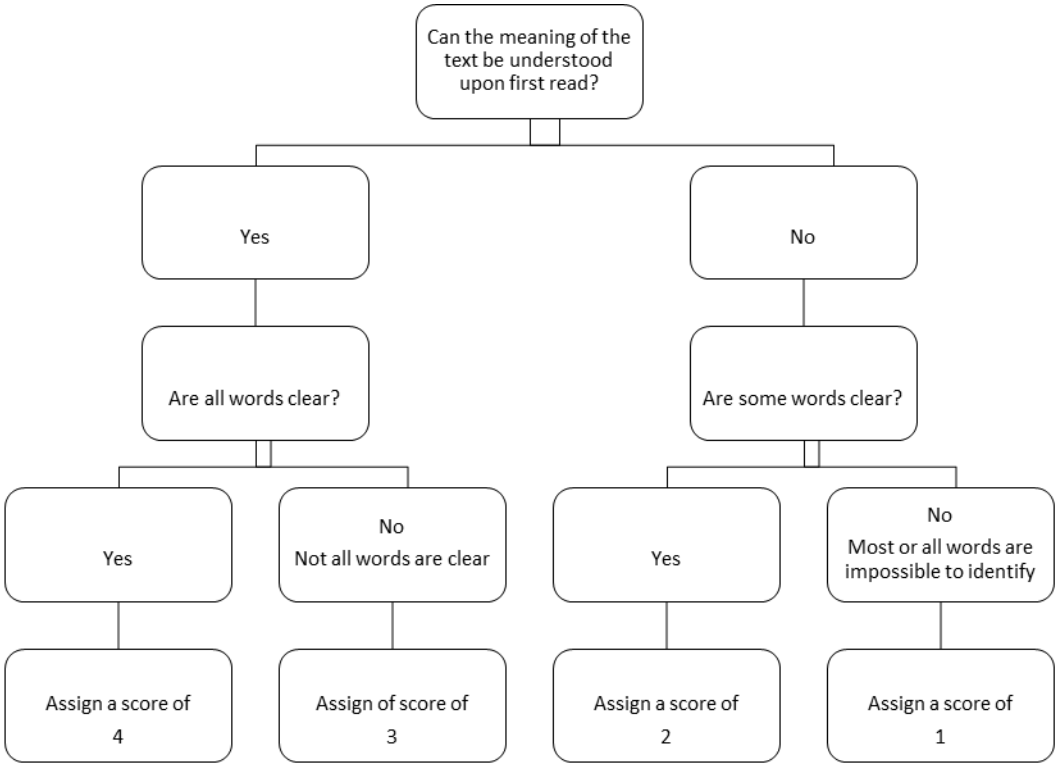
Figure 10. Modified Four Point Scale – version 2 (mFPS-v2-W) global sentence legibility categories and rating descriptors

Category	Global legibility rating descriptors	Handwriting examples
1	None or few words legible; the meaning of the text is unclear upon first read	
2	Some words legible; the meaning of the text is unclear upon first read	
3	Many words legible; the meaning of the text can be understood upon first read	
4	Most or all words legible; the meaning of the text can be understood upon first read	

Reference: Dettrick-Janes et al 2015

The decision tree below was developed to further assist global legibility scoring using the **mFPS-v2** (Dettrick-Janes et al 2018)

Figure 11. Modified Four Point Scale – version 2 (mFPS-v2) legibility decision tree to help assessors rate global sentence legibility



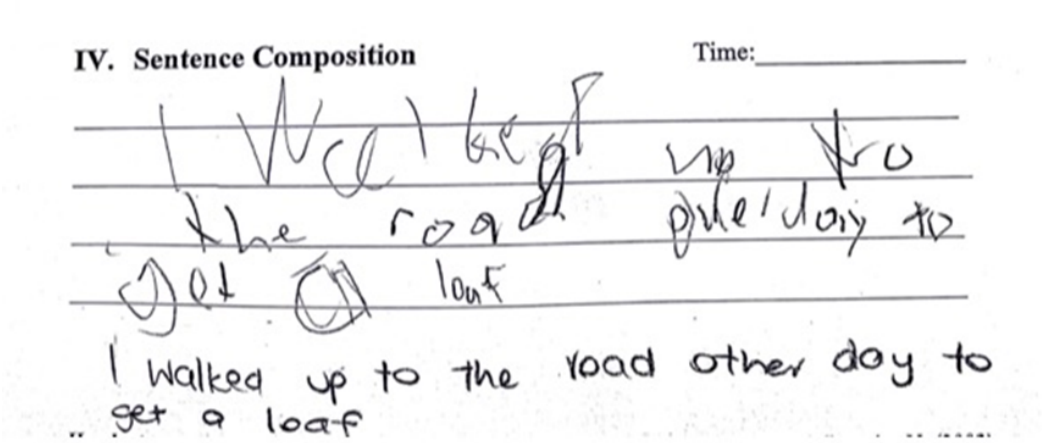
Reference: Dettrick-Janes, 2018

Scoring and Interpretation of Performance.

Example 1 (Below, Figure 12)

Using the mFPS-v2, the sentence is unable to be understood upon first read, with most or all words being illegible. Therefore, this sentence is **rated 1** for global legibility.

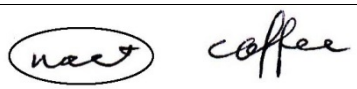
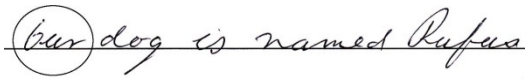
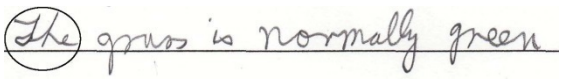
Figure 12



Word legibility. Legibility of individual words in the same sentence is also rated using the Modified Four Point Scale version 2 for Words (mFPS-v2-W, see Figure 12 (Dettirick-Janes et al, 2015). The mFPS-v2-W uses descriptive categories to allocate a numerical score for each word (1 to 4), returning one data point per word. Five words should be scored, and the self-composed sentence should contain five words. If the sentence contains more than five words, rate the first five words only.

Unlike *HAB-v5* and the **mETCH**, no attempt should be made to conceal adjacent words during scoring. Words should be viewed within the context of the entire handwritten sample.

Figure 13. Modified Four Point Scale – version 2-Words (mFPS-v2) word legibility categories and rating descriptors

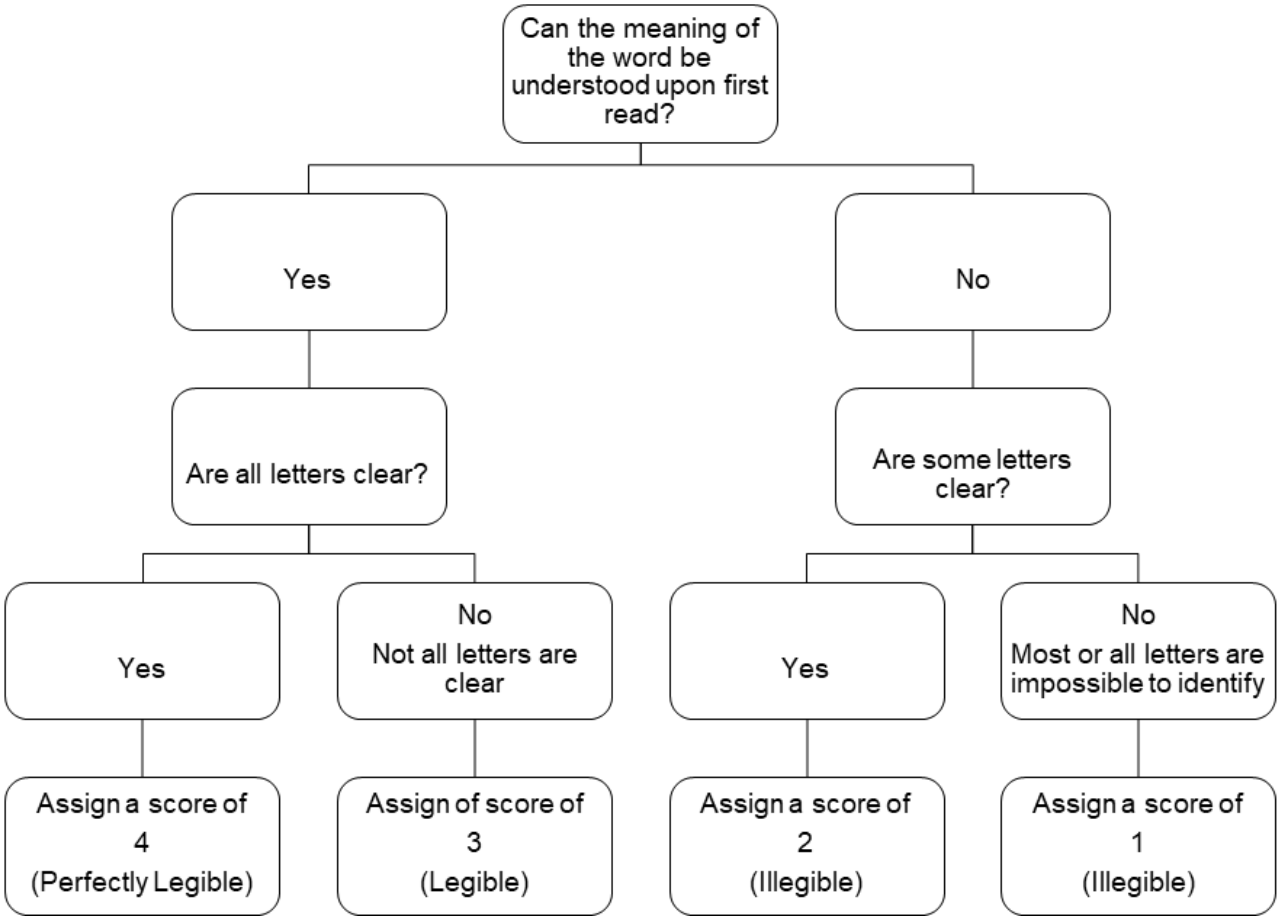
Category	Word legibility rating descriptors	Handwriting examples
1	None or few letters legible; the meaning of the word is unclear upon first read	
2	Some letters legible; the meaning of the word is unclear upon first read	
3	Many letters legible; the meaning of the word can be understood upon first read	
4	All letters legible; the meaning of the word can be understood upon first read	

Note. Circled words were selected consistently in all samples for rating

Reference: Dettrick-Janes et al 2015

A decision tree was also developed to further assist rating word level legibility scoring using the **mFPS-v2-W** (Dettrick-Janes et al 2018).

Figure 14. Modified Four Point Scale – version 2 – Words (mFPS-v2-W) legibility decision tree to help assessors rate word legibility



Reference: Dettrick-Janes, 2018

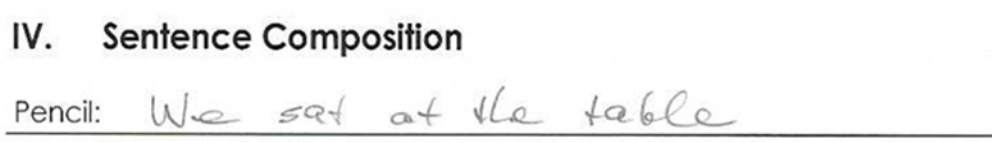
Determine the Percentage of legible words (% word legibility). The percentage of legible words produced during each subtest is then calculated. Percentages are calculated by dividing the number of words awarded a rating of 3 or 4 ('legible' and 'perfectly legible' words) by the total number of words rated (e.g. 4/5 legible words = 80% word legibility).

Interpretation of Performance.

Example 1 (Below, Figure 15)

In Figure 15, the words "We sat at the table" written in pencil are all legible upon first read, but the letters 't' and 'h' in the word "the' are less clearly formed. Score 4 (perfectly legible) for 4 of the words, and 3 for the word 'the' (legible). All words scored a 4 or 3 for word legibility, therefore 5/5 words are legible = 100%-word legibility.

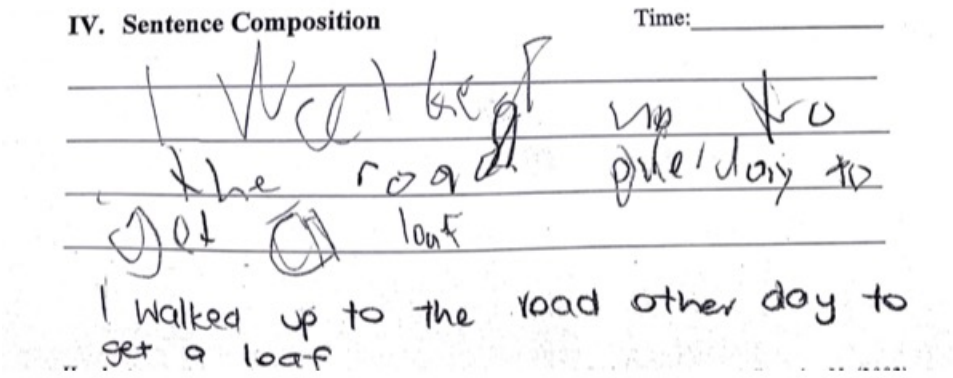
Figure 15: Example of 5-word sentence scored using the mFPS-v2



Example 2 (Below, See Figure 16)

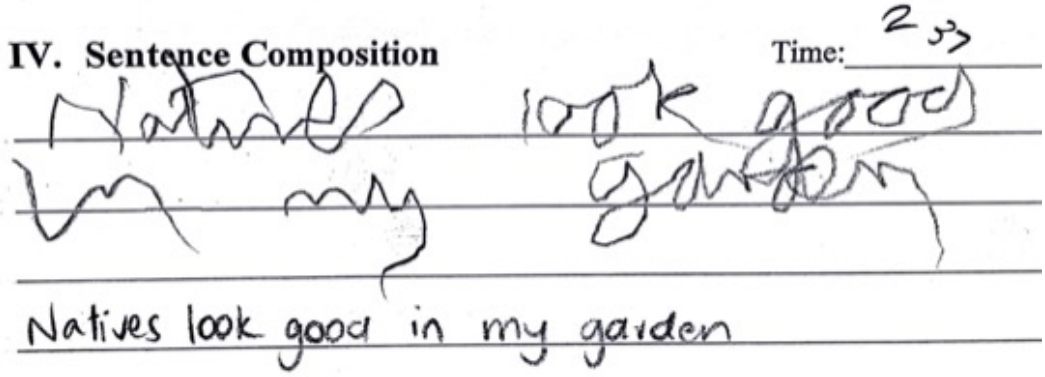
More than 5 words have been written so only score the words "I walked up to the…". The word "I" is clearly legible (score 4 = perfectly legible). The word 'the' is clearly legible upon first read, but the letters 't' and 'h' in the word 'the' are not well formed (score 3 = legible). The words "walked' 'up' and 'to' are all illegible upon first read (score 1). In summary one word is legible (3), and one word is perfectly legible (4). Only 2/5 words are legible = 40%-word legibility

Figure 16: Example of 5-word sentence scored using the mFPS-v2-W



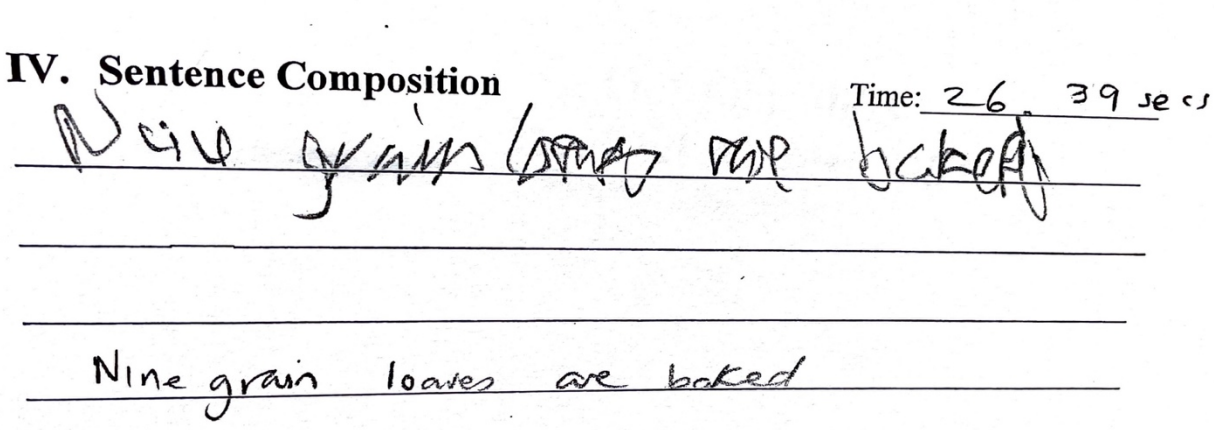
Example 3 (Below, Figure 17)

Figure 17: Example of 5-word sentence scored using the mFPS-v2-W



Interpretation: More than five words have been written so only score the words "natives look good in my…". None of the words are legible upon first read, so score 2 for four of the five words ('natives' 'look' 'good' and 'my'). The word "look" may be legible to some raters. The word 'in' is illegible, with no letters being easily recognisable (score 1). In summary, none of the words are assessed as being legible (score 3) or perfectly legible (score 4), so the word legibility score is 0/5 = 0% legibility.

Figure 18: Example of 5-word sentence scored using the mFPS-v2



Interpretation: The words are all illegible upon first read, although some letters can be recognised (eg "g" "l" and "n" in 'grain", and "b" and "e' in 'baked"). Score 2 for words 'grain' and 'baked" and score 1 for the words 'Nine' and 'loaves' and 'are'. In summary, none of the words are legible (score 3) or perfectly legible (score 4) so the word legibility score is 0/5 = 0% legibility.

SECTION 4: NEATNESS OF HANDWRITING

HASI - Handwriting Appearance Descriptors – *circle Y if assistance is requested from a therapist*			
1 Overall appearance of handwriting	Y / N	10 Use of the writing space	Y / N
2 Size of letters	Y / N	11 Spelling	Y / N
3 Spacing between letters	Y / N	12 Writing speed	Y / N
4 Spacing between words	Y / N	13 Pen grip	Y / N
5 Alignment of writing	Y / N	14 Others – List:	Y / N
6 Slant or Angle of writing	Y / N		
7 Quality/appearance of lines and curves	Y / N		
8 Extra marks around writing	Y / N		
9 Formation of letters	Y / N		

At the time of writing, no research had been conducted on the HASI. No scores are recorded for individual test questions or a total score. Therapists may use the HASI following administration of the HAB, using examples of writing produced during the test. Discuss handwriting appearance descriptors with your client. This discussion can assist goal setting and feedback about handwriting performance.

Document any of the handwriting descriptors that the person wishes to focus on. Re-administer the HASI at the end of intervention.

For information, goals and practical task-specific handwriting retraining, see the article by Simpson and colleagues (2016).

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