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# LETTER FORM ASSESSMENT

*User Instructions and  
Training Module*

## LETTER FORM ASSESSMENT VERSION 2 (LFA)



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## SECTION 1

# Introduction and Background to LFA

### **HANDWRITING FLUENCY ASSESSMENT USING THE LFA**

The Letter Form Assessment Version 2 (LFA) is an individual, standardised, performance based assessment that has been developed to measure handwriting fluency acquisition for children who are learning to write, or have difficulties with handwriting acquisition. The LFA evaluates handwriting fluency acquisition for beginning writers, and is validated for children who have had an introduction to letter names, sounds and forms and who are at least in the first year of formal schooling (in Australia, this foundation year is known as kindergarten, preparatory, reception, or transition). Administration of the LFA follows a standard procedure, which can be learnt by completing the training module in this manual (Section 5). Administration of the assessment takes between five and ten minutes. The LFA was devised and developed in Australia and can be used for any alphabetic font both in Australia and internationally.

The LFA is a pencil and paper assessment, where letter formation ability for each letter of the alphabet is evaluated in non-alphabetic sequence. The distinct feature of the LFA is that alphabet letters are assessed individually, and a cascading series of prompts, which gradually reduce cognitive load, are provided by the assessor to evaluate the acquisition of automatic and fluent letter formation.

The cascading prompts are:

- Verbal – write the letter from memory when told the name and sound by the assessor.
- Visual – copy the letter from an example shown by the assessor.
- Modelled – imitate the letter after a demonstration by the assessor.

**The LFA can be applied to any alphabetic font style in Australia or internationally, by observing the letter formation patterns for the specific font used in the classroom setting.**

Scoring is possible for two elements:

1. Handwriting fluency – Fluency (LFA-F) refers to the ability to accurately form alphabet letters from memory, and indicates a consolidation of both cognitive (orthographic) and motor processes implicit in handwriting (Palmis et al., 2017). The score for LFA-F is based on the number of prompts (verbal, visual and demonstration) needed to enable accurate letter formation for each letter. The total score is out of 104. Higher scores indicate greater handwriting fluency, with less prompts required to facilitate letter formation. Higher scores also indicate that letter formation has become more automatic and accurate, with a stronger connection between letter name, sound and form.
2. Letter sound correspondence – Letter sound correspondence (LFA-LSC) refers to the ability to write recognisable, legible letters (upper or lower case) in response to a verbal prompt, irrespective of the case (upper or lower) or formation pattern used. This ability indicates that some relationship between letter name, sound and form has been established, and provides additional useful information for the assessor. The score for LFA-LSC is based on observation of the first attempt at forming a letter after a verbal prompt only, and is scored out of 26.

## **LFA PRINCIPLES**

Letter formation ability is the earliest handwriting skill taught and involves instruction in and reproduction of the correct sequence of the series of lines and strokes needed to form a letter. Writing the letters that match a sound (phoneme grapheme relationships or letter sound correspondences) is recognised as a basis to writing ability (Coker & Ritchey, 2010; Ritchey, 2008). Key to the LFA is the association of learning a distinct letter formation pattern with acquisition of handwriting fluency. This principle is supported by research evidence that shows that targeting development of a strong association between a letter name, sound and form through specific handwriting instruction leads to gains in handwriting fluency (Dolin, 2016; Jones & Christensen, 1999; Ray, Dally, & Lane, 2021). Errors in case or formation pattern may point to less strongly developed mental representations of letters (orthographic codes) and their associated motor patterns, impacting handwriting abilities (Ray, Daly & Lane, 2021; Graham, Struck, Santoro & Berninger, 2006). A readily retrievable and reproducible motor pattern for a dictated letter may support a strong phoneme grapheme relationship.

An additional key principle of the assessment is the method of gradually reducing cognitive load (McCutchen, 1996) by providing verbal, visual and

demonstration prompts in sequence as required. This allows emerging handwriting fluency abilities to be observed at the letter level, and an overall score for fluency obtained. The prompts included in the LFA scaffold the skill of letter formation, and changes in number of prompts needed are reflected in the score for fluency (LFA-F). Psychometric evaluation of the LFA-F has found the scale to be unidimensional, and therefore a measure of change in handwriting fluency. For further details on psychometric properties of the LFA, see Section 4.

**The LFA is an assessment for beginning writers that provides evaluation of emerging handwriting fluency at the letter (sub-word) level. The LFA prompts for each letter gradually reduce cognitive load and allow for emerging fluency to be demonstrated.**

## RELEVANCE OF HANDWRITING FLUENCY

Handwriting is a core skill in early childhood education, with important links to literacy (Ray, Dally, Rowlandson, et al., 2021). Handwriting makes an important contribution to literacy as a foundation skill for documenting knowledge and, in addition, has surprising and important impacts on writing quality and reading (Kim & Park, 2019; Ray et al., 2021). There is a well-established link between fluent handwriting and literacy, with seminal studies demonstrating that improvements in handwriting lead to improvements in writing composition (Berninger et al., 1997; Graham et al., 1997; Jones & Christensen, 1999).

Further, handwriting automaticity, the ability to write fluently from memory, is a significant predictor of both reading and writing in children in the early grades of education (Malpique et al., 2020). Handwriting continues to be a significant skill for present day students, with effects across a wide range of typical classroom tasks. However, measurement of handwriting fluency in the early years is hampered by emerging letter knowledge, with many assessments targeted at children six years and above, or relying on accurate alphabetic sequence knowledge (Feder & Majnemer, 2003; Puranik et al., 2017).

The LFA provides an assessment that can be used by children who are learning to write, and enables early identification of fluency difficulties, as well as an option for measuring outcomes of early handwriting instruction. The LFA has been designed to provide an assessment of handwriting fluency acquisition at one time point, as well as an outcome measure of the effects of intervention for handwriting fluency.

### Potential uses of the LFA include:

- Evaluation of the effectiveness of whole class instruction and need for tier two (small group) or three (individual) intervention.
- A screener to determine children requiring more targeted intervention and/or instruction.
- Evaluation of effectiveness of intervention for handwriting fluency as a pre- post-measure.

### The LFA is recommended for use by:

- Occupational therapists – as an evaluation of handwriting fluency acquisition and as an outcome measure of therapy for handwriting fluency acquisition. The LFA can also be used to guide intervention strategies.
- Teachers – as a screening tool to identify students who may require targeted intervention and/or referral and as an evaluation of the impact of whole class handwriting instruction.
- Learning support teachers – as an evaluation of potential foundational difficulties in associating letter names, sounds and forms and early identification of the need for additional supports.
- Speech pathologists - as an evaluation tool for letter sound correspondence and an intervention guide.

**The LFA has been validated for children who have had an introduction to letter names, sounds and formation patterns, according to a specific font style. The LFA is not validated for children prior to introduction of letter instruction. Please contact the test developers at [lfa@newcastle.edu.au](mailto:lfa@newcastle.edu.au) for any enquiries regarding using the test in unvalidated situations.**

### HANDWRITING MEASUREMENT CONSIDERATIONS

Handwriting is commonly assessed based on appearance or legibility (Hammerschmidt & Sudsawad, 2004). However, for handwriting to be functional it must be both legible and fluent. Handwriting fluency refers to the ability to transcribe legible written forms from memory, implying coordination of cognitive, perceptual and motor processes, and is also known as “automaticity” (Kim et al., 2011). Generally, fluency is assessed by timing alphabet writing from

memory, however this relies on requisite knowledge of alphabetic sequence, and timing of alphabet task completion has not been found to be a valid measure for beginning writers (Puranik et al., 2017).

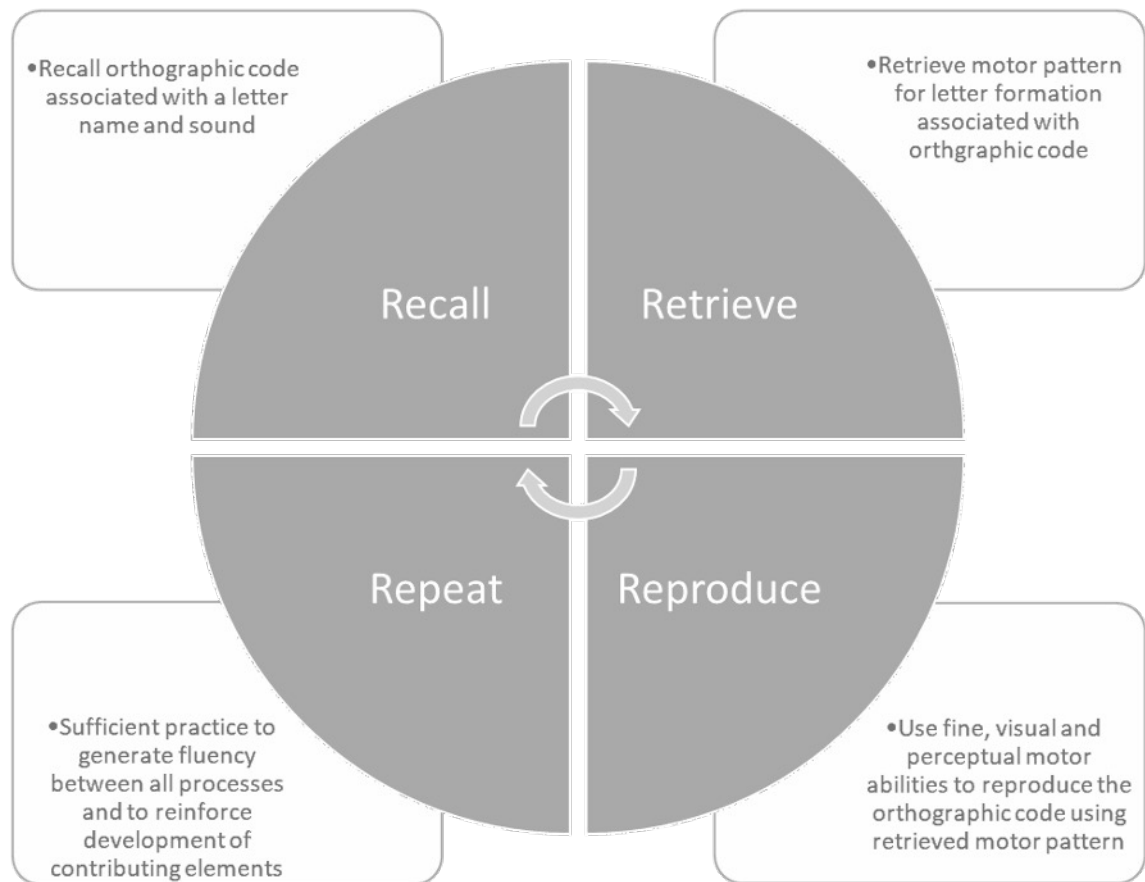
**The LFA provides a measure of handwriting fluency that does not require alphabetic sequence knowledge, making it an accessible tool for use in early education and for children with learning difficulties. Prompts included in the LFA also enable opportunities for children to demonstrate fluency for each letter, by determining capacity to write from memory, copy an example, or imitate a demonstration.**

### **THE 4Rs MODEL OF HANDWRITING FLUENCY ACQUISITION**

The LFA was devised as a tool to assess fluency for beginning writers, as skills at this time draw on developing cognitive and perceptual motor processes (Ray et al., 2021). The LFA draws on the 4Rs model of handwriting fluency acquisition, Figure 1, below (Ray et al., 2021). The 4Rs model emphasises the interaction of four processes that are integrated to acquire handwriting fluency and integrates evidence from prior models and research from a variety of fields, detailed in Table 1, below. In the 4Rs model, Recall refers to the generation of mental representations (orthographic codes) for letters and words. Retrieve refers to the motor pattern for formation associated with a letter. Reproduce refers to the perceptual motor abilities that contribute to handwriting legibility, and that may impact successful letter writing. Repeat refers to the need for sufficient opportunities to recall, retrieve and reproduce individual letters to generate a fluent, automatic system. For further discussion of this model, see Ray et al., 2021.



**FIGURE 1 - THE 4Rs MODEL OF HANDWRITING FLUENCY ACQUISITION**



The 4Rs model draws on literature findings for the impacts of cognitive and perceptual motor processes on emerging handwriting. Literature sources and related assumptions of this model are presented in Table 1.

**TABLE 1 - EVIDENCE AND ASSUMPTIONS FOR THE 4Rs MODEL OF HANDWRITING FLUENCY ACQUISITION**

Quadrant	Definition	Assumptions
Recall	Recollection of the orthographic code for a letter or word (Abbott & Berninger, 1993; Berninger et al., 1997; Puranik & Apel, 2012; Rodriguez & Villarroel, 2017).	<ul style="list-style-type: none"> <li>• Mapping phonemes to graphemes through letter formation practice creates strong, retrievable orthographic letter representations.</li> <li>• Fluent handwriting of letters facilitates early writing through increasingly retrievable letter representations that support ability to encode words phonetically.</li> </ul>
Retrieve	Retrieval or the system of movements, or motor plan, associated with the recalled letter form (Grace et al., 2018; Graham et al., 2006; van Galen, 1991).	<ul style="list-style-type: none"> <li>• Letter formation ability, the ability to learn and generate a specific series of lines and strokes to form a letter, activates cognitive processes essential for handwriting fluency.</li> <li>• When a motor pattern for a letter is quickly retrievable, phonetic spelling becomes more accessible.</li> </ul>
Reproduce	Transcribing the letter into print as planned, influenced by fine motor, visuomotor, visual perceptual and kinesthetic abilities (Cornhill & Case-Smith, 1996; Fears & Lockman, 2018; Graham et al., 2006; Kaiser et al., 2009; Kushki, Schwellnus, et al., 2011; Volman et al., 2006).	<ul style="list-style-type: none"> <li>• Component skills that predict handwriting abilities are in development for beginning writers and will influence the writing system.</li> <li>• A combination approach is required to ensure that component skill development does not impede the emergence of handwriting fluency through cognitive and motor processes.</li> </ul>
Repeat	Sufficient repetition or practice that specifically involves handwriting, rather than contributing component skills in isolation (Hoy et al., 2011; Santangelo & Graham, 2016).	<ul style="list-style-type: none"> <li>• Letter formation practice is most effective when memory recall is activated.</li> <li>• Graphemes are mapped to phonemes through sufficient handwriting repetition.</li> </ul>

## **USE OF THE LFA AND THE 4Rs MODEL TO EVALUATE HANDWRITING ACQUISITION**

The LFA can be used in conjunction with the 4Rs handwriting fluency acquisition model to identify areas of concern and appropriate intervention. LFA scoring patterns and the relationship of these patterns to the 4Rs model are discussed in Section 6, with examples provided.

## **STUDIES TO DEVELOP THE LFA**

A preliminary version of the LFA was developed as a new method of measuring handwriting fluency to address floor effects observed in standard measures of fluency assessment for beginning writers, including timed and untimed alphabet writing (Ray, Dally, & Lane, 2021). Adaptations were made to the LFA after this study, including the extension of testing to include all alphabet letters (LFA-F), and inclusion of a measure of letter sound correspondence (LFA-LSC). The LFA Version 2 was used as a primary outcome measure in a study examining the effectiveness of a handwriting intervention for children in their first year of formal instruction and the impacts of this intervention on reading (Ray et al., 2021).

## **FEEDBACK**

The LFA is a newly developed tool, and enquiries and feedback are welcome. Please feel free to contact via [lfa@newcastle.edu.au](mailto:lfa@newcastle.edu.au) if you would like more information on the LFA or would like to provide feedback.

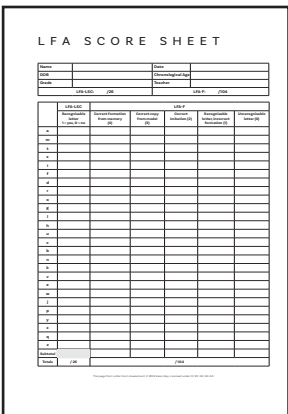
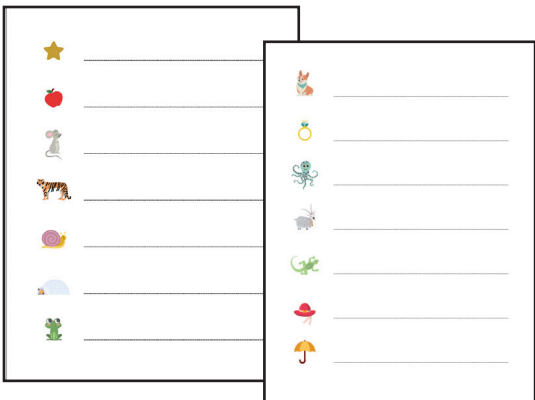
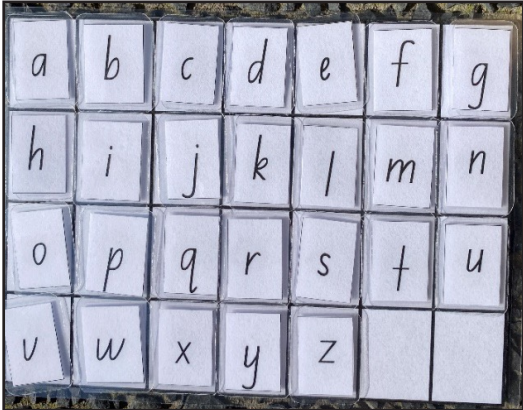
## SECTION 2

# Assessment Form and Equipment

The LFA is an individually administered pencil and paper test, designed to assess the level of handwriting fluency in beginning writers. The LFA aims to detect the levels of emerging fluency through assessment of both letter formation ability (LFA-F) and letter sound correspondence (LFA-LSC).

### PREPARING FOR THE ASSESSMENT

#### Materials Required:

<p>LFA score sheet</p> 	<p>LFA response form</p> 
<p>Set of alphabet letter tiles</p> <p><i>Use font that is being taught in classroom</i></p> 	<p>Pencil and Pen</p> <p>Ensure the child uses the same pencil as that used in class, including a pencil grip if required. Examiner requires pen for marking on the response form during administration.</p>

## **INSTRUCTIONS FOR PREPARING ALPHABET LETTER TILES**

Letter tiles:

- Using the same font that is taught within the classroom (e.g. NSW/ACT foundation font), print individual letter tiles (16mm x 23mm each tile).
- Use a font type that does not include any directional arrows or prompts for starting cues.
- Secure the individual letter tiles onto a sheet so they can be removed and displayed individually. Laminate the tiles and use blutak/removable adhesive for easy access.

**Fonts used in Australian schools can be purchased for download from Australian School Fonts**

**<https://www.australianschoolfonts.com.au/>**

## SECTION 3

# Administration and Scoring

The LFA is a paper and pencil assessment, with a series of small pictures representing each letter of the alphabet and a line next to each picture. The letters are ordered non-alphabetically down the page and follow common sequencing for the introduction of letter sounds used in beginning writing, based on simplicity, as some letters are known to be more difficult to write (Ritchey, 2008).

The procedure for administration is as follows:

- The assessor points to the first picture prompt, says the name of the picture and the letter name and sound the picture begins with, and asks the participant to write the letter from memory in lower case, for example, “This is an apple, apple starts with ‘a’, the sound is /a/. Can you please write a lower case ‘a’ next to the apple?”
- The assessor carefully observes letter formation. If a formation error is made, or the student is unable to recall the letter, they are shown a model of the letter and asked to write it.
- If a further error is noted, the examiner demonstrates the formation of the letter on the line on the assessment sheet and asks the participant to write the letter “just like me”.

**A flow chart showing administration procedure is detailed in Figure 2.**

Scoring is based on the level of prompting needed for the participant to form the letter correctly. Two scores are recorded in the LFA: LFA-Formation (LFA-F) and LFA-Letter Sound Correspondence (LFA-LSC).

LFA-F is a score of letter formation accuracy. Scoring is calculated based on the number of prompts needed to correctly form the letter, with four points given for correct formation from memory, three points for correct formation when shown a model, two points for correct formation after a demonstration of

the letter form and one point for a recognisable attempt after demonstration regardless of the formation pattern used. For unrecognisable attempts after demonstration, no points are awarded. A score is obtained for each letter and tallied to obtain a score out of 104.

LFA-LSC is a score of letter sound correspondence. A score (one for correct, zero for incorrect) is recorded for the first attempt at each letter. This is a measure of ability to write a matching letter after a verbal prompt, irrespective of the use of upper or lowercase or incorrect letter formation pattern. LFA-LSC is scored out of 26. Please refer to Section 4 for appropriate use of this score.

### **TIPS FOR ADMINISTRATION**

- Position yourself on the participant's non-dominant side to ensure you can view their formation and model individual letters at the imitation prompt as required.
- Ensure letter tiles are positioned out of participant's sight, however easy to access for when the second step, showing a sample letter, is required.
- Have a pen for mark making on the response form.
- The method of administration ensures that the score sheet can be completed after administration of the assessment, as marks made on the response form indicate scores for each letter for both LFA-LSC and LFA-F.
- Ensure all examiner marks made on the assessment form are made in pen, to distinguish clearly from the participant's writing.

### **EXAMINER SCRIPT**

A standardised method to introduce the assessment and each letter prompt is used in the LFA. Instructions are printed on the response form as follows:

1. Could you please write your name next to the star?
2. I am going to ask you to write some letters. I want you to write them the way you have been learning in class. I will show you a picture and tell you what letter the picture starts with and the sound it makes. Then I want you to write the letter in lower case. Sometimes I might ask you to write the letter again.
3. The first picture is an apple. Apple starts with the letter 'a'. The sound is /a/. Write a lower case letter 'a' on the line next to the picture (point).

### If formation error noted after verbal prompt:

1. I am going to show you the letter for you to copy.
2. (Show the prompt letter) – This is the letter ‘a’. Can you copy the letter ‘a’ just like this one?

NB – If student first attempt is recognisable but formed incorrectly (e.g. wrong start point, use of extra strokes to form letter), say, ‘That looks just the same – now I’m going to show it to you – can you write it again?’ (Often, when shown the sample letter, participant’s are then able to retrieve and reproduce the correct formation pattern. This can be explained by a reduction in cognitive load).

### If formation error noted in copying:

1. Now I am going to write the letter ‘a’. Watch me write the letter (write in pen on response form adjacent to the participant’s attempts). Can you write the letter just the way I did?

### If formation error imitating move onto next letter:

- Indicate on the response form that the letter was formed incorrectly by placing a dot above the letter

## SCORING

Scoring can be completed after the assessment, as the letters and marks on the response form indicate the score.

4 – Correct formation from memory – one attempt on response form.

3 – Correct formation from copying – two attempts on response form (indicates that the model letter was shown).

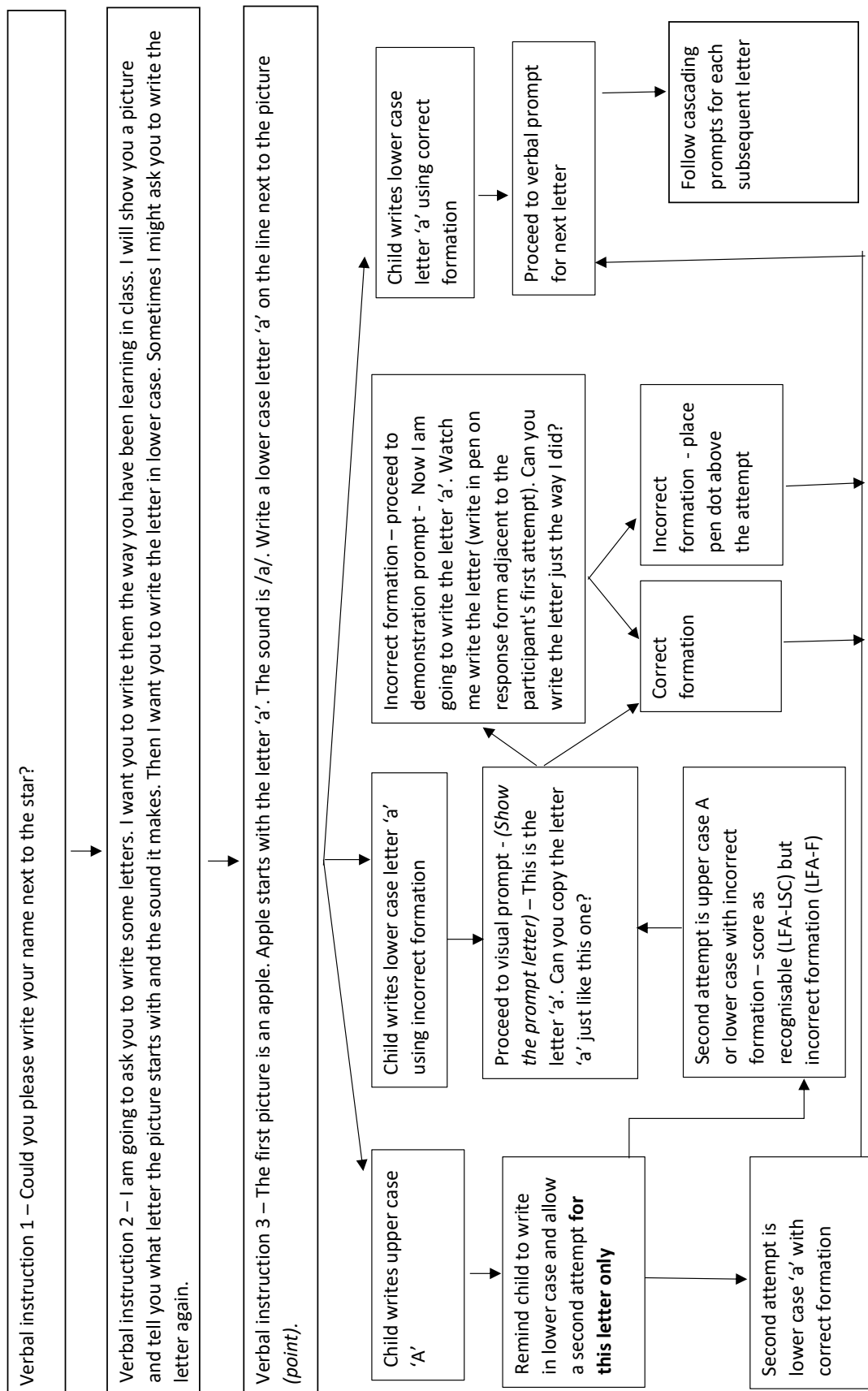
2 – Correct formation from imitation – two attempts, followed by pen sample to imitate, followed by another participant attempt.

1 – Incorrect formation but recognisable letter – a dot above the last attempt (after imitation) indicates that the letter was recognisable but formation pattern was not imitated correctly.

0 – Non recognisable letter – the imitated letter is not recognisable.



**FIGURE 2: LFA ADMINISTRATION PROCEDURE**



## SCORING RULES

### LFA administration and scoring rules:

1. Follow the script to introduce the test, noting the instruction to write in lower case, using the way being taught in class.
2. Use the foundation font used in class as the basis for evaluating accuracy of letter formation and recognisability. Letters that could be mistaken for another letter are scored as unrecognisable and incorrect formation.
3. If the first letter (a) is written in upper case, remind the participant to write in lower case and allow a second attempt. Do not score the upper case letter A as incorrect, base scoring on the second attempt and follow procedures as per usual. If the participant writes the letter in upper case on the second attempt, score as incorrect formation (but recognisable) and proceed with prompts as usual.
4. For all subsequent letters, if the first attempt is upper case, score this as incorrect formation.
5. Only the first attempt at a letter is used to make a decision about recognisability of the letter (LFA-LSC).
6. Upper case letters are scored as recognisable but incorrect formation.
7. Reversed letters are scored as unrecognisable and incorrect formation.
8. Follow the formation rules of the font taught in class to determine whether correct formation has been made. Exceptions are made for small cross strokes and second stroke of /x/.
9. Use the 'more than half' rule to determine recognisability for tall letters that include a 'ball' or bump' i.e. if the beginning of the 'ball' or the 'bump' comes up more than half the length of the stick, mark as unrecognisable and incorrect formation.
10. Use the 'less than half' rule to determine recognisability for letters where an upward line retraces a downward stroke in full i.e. if the upward stroke deviates from the downward line below the half way point, mark as unrecognisable and incorrect formation.

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# Psychometric Properties of the LFA

This section provides an overview of the factor structure, reliability and validity that support the use of the LFA-F. Please note that only the LFA-F has been subjected to psychometric evaluation at this stage, and as such is the only score that can be used as a measure of handwriting difficulties. LFA-LSC scores provide additional clinical information and possible contributors to LFA-F scores, however cannot be used as a measure of handwriting difficulties. Further research is required into this scale prior to its use in reporting of handwriting difficulties.

Factor structure refers to the dimensions of the scale, and whether scores can be treated as unidimensional or are a number of sub-scores. Reliability refers to the reproducibility of the measure, and validity refers to the relationship of the measure to other tools that evaluate similar constructs. A number of studies have been conducted to evaluate these dimensions of the LFA-F.

The investigation of the psychometric properties of the LFA-F is based on data obtained from a two group study of a handwriting intervention for Kindergarten children, which used the LFA-F as a primary outcome measure (Ray et al., 2021). Data were obtained from 78 participants who completed the LFA at three time points in the study: pre-intervention (baseline), post-intervention (8 weeks) and follow up (20 weeks). Studies undertaken using this data have included factor analysis, inter-rater reliability and concurrent validity, with additional data from a range of assessments included in concurrent validity studies.

## **FACTOR ANALYSIS AND SCALE RELIABILITY**

A preliminary study of the factor structure of the LFA-F has been conducted. The factor structure of the assessment was examined using exploratory factor analysis to determine the associations between the 26 letters (variables). Confirmatory factor analysis was then used to explore the goodness of fit of alternatives to the correlated factors structure. This investigation has focussed on the LFA-F score of the LFA, which measures handwriting fluency.

Investigation revealed that a bifactor model was the best interpretation of the relationships between assessment variables for the LFA-F, being a better fit than unidimensional ( $p < .001$ ) and correlated factor ( $p = .003$ ) alternatives. The bifactor model indicates that total scores can be used confidently as the general factor is predominant. These preliminary results indicate that the LFA-F can be applied as a unidimensional scale in practice, meaning that therapists should use the total score of the LFA-F assessment to make interpretations regarding handwriting fluency for children with emergent literacy or handwriting difficulties.

## **RELIABILITY**

Inter-rater reliability, or agreement between independent raters, was investigated for the LFA-F using video footage of a convenience sample of 16 participants completing the LFA (Evans et al., 2019). An expert assessor administered the LFA for each convenience sample participant, and one expert rater scored all 16 video samples. Subsequently, a video editing protocol was applied, and then additional scorers were recruited and trained to score the edited video samples. The completed videoed assessments were edited by segmenting and inserting pause screens, providing a five second time frame where a blank screen was displayed after each LFA prompt to enable the additional trained scorers to make a decision regarding their observation. The edited video was then used by the five recruited scorers to independently rate each of the 16 participants' performance on the LFA-F while viewing the video footage, and without reference to the ratings of the expert LFA assessor. The five additional LFA scorers were a registered occupational therapist from the University of Newcastle's Occupational Therapy Clinic, and four fourth year occupational therapy students from the University of Newcastle. Prior to viewing the edited videos, scorers attended a 1-hour training program delivered by the expert LFA assessor. Training included a demonstration of letter formation processes used during the assessment (the NSW/ACT Foundation Letter Font), orientation to the LFA and scoresheet, with instructions on how these were to be completed, orientation to the video footage including the pause screen, and a practice rating exercise to ensure accuracy. When independently viewing the edited videos, scorers placed a tick into the appropriate box on the LFA scoresheet for each letter, depending on their rating of participant performance. Scorers were instructed not to change previous scores.

Inter-rater agreement (IRA) was assessed by comparing the level of agreement between the ratings of all raters as a group, the expert rater and the other five raters. Each rater provided five ratings per letter (based on scoring categories

0–4). If on the first attempt the participant formed the letter correctly, a ‘yes’ rating for correct formation was recorded (correct formation from memory) and a ‘no’ rating was made for the other four columns (correct copy from model, correct imitation, recognisable letter but incorrect formation, and unrecognisable letter).

Inter-rater reliability between the raters (total score) was assessed using the Interclass Correlation Coefficient (2,1), and for letter score, proportion of agreement, unweighted and weighted kappa, and Gwet’s AC1. Total score inter-rater reliability was excellent (Interclass Correlation Coefficient 0.96, 95% CI [0.90, 0.98]) and individual letter inter-rater reliability was good to excellent (kappa 0.71 to 1.00; Gwet’s AC1 0.79 to 1.00). These results indicate that the LFA-F is a reliable measure of handwriting proficiency, and assessors with basic training score very similarly for both total score and at the individual letter level.

## **CONCURRENT VALIDITY**

An additional study of concurrent validity was undertaken, to examine the correlations of the LFA with other measures of handwriting fluency and motor skills that contribute to handwriting proficiency (Daly et al., 2020). Data from baseline assessments of LFA-F, timed and untimed alphabet writing, Beery-Buktenica Developmental Test of Visual Motor Integration (Beery VMI, 6th Edition; Beery et al., 2010), fine motor precision and manual dexterity subtests of the Bruininks-Oseretsky Test of Motor Proficiency (Bruininks & Bruininks, 2005) conducted prior to the two group study intervention were used in this study. Spearman’s Product-Moment correlation was used to determine the association of the LFA-F with handwriting fluency measures (timed and untimed alphabet writing) and component skills indicated in handwriting (visual motor integration, fine motor precision and manual dexterity). Spearman’s rank correlation were used for all correlation analyses.

A positive moderate correlation was found between the LFA-F and timed and untimed alphabet writing scores ( $r = .32$  and  $r = .36$  respectively,  $p < 0.01$ ). This indicates that children who are more adept on the LFA-F produced more letters correctly in the alphabet tests, and provides preliminary evidence that the LFA-F and alphabet tests are both measuring skills related to handwriting fluency. The LFA-F extends the alphabet writing test by providing more detail on the level of fluency in letter formation for each letter, and also does not limit students who have incomplete knowledge of alphabetic sequence.

Results also showed a positive strong correlation between the LFA-F and visual motor integration ( $r = .55$ ,  $p < 0.01$ ) and low to moderate positive correlations with manual dexterity and the fine motor precision scores ( $r = .34$  and  $r = .35$  respectively,  $p < 0.01$ ). Overall, these results indicate that students with better visual motor integration, fine motor precision and manual dexterity skills will show more proficient skills in letter writing fluency as measured on the LFA-F.

Future validity studies over time are required to support these preliminary results, and investigate the predictive and discriminatory validity of the LFA-F. Further study on the LFA-LSC is also anticipated.

## SECTION 5

# Training Module

The following training module will equip a new user with the skills to administer and score the LFA. The module refers to materials available for download, including audio, video and the LFA response form at:

<https://hdl.handle.net/1959.13/1468664>

**Prior to introducing the LFA to your work setting, the following steps should be taken:**

1. Read sections 1–4 of the user instructions, to be familiar with the background and psychometric properties of the LFA.
2. Download and print the LFA response form, which includes the examiner script and score sheet.
3. Complete the training exercises included in this module.
4. Score two sample videos available for download. Compare your results with the answers in this module.
5. Review administration procedures and rules for clarification of any points of difference in the practice examples.

The training module consists of 5 steps:

1. Orientation to New South Wales (NSW/ACT) Foundation Font.
2. Review of letter names and sounds.
3. Scoring practice.
4. Answer review.
5. Interpretation and uses of the LFA.

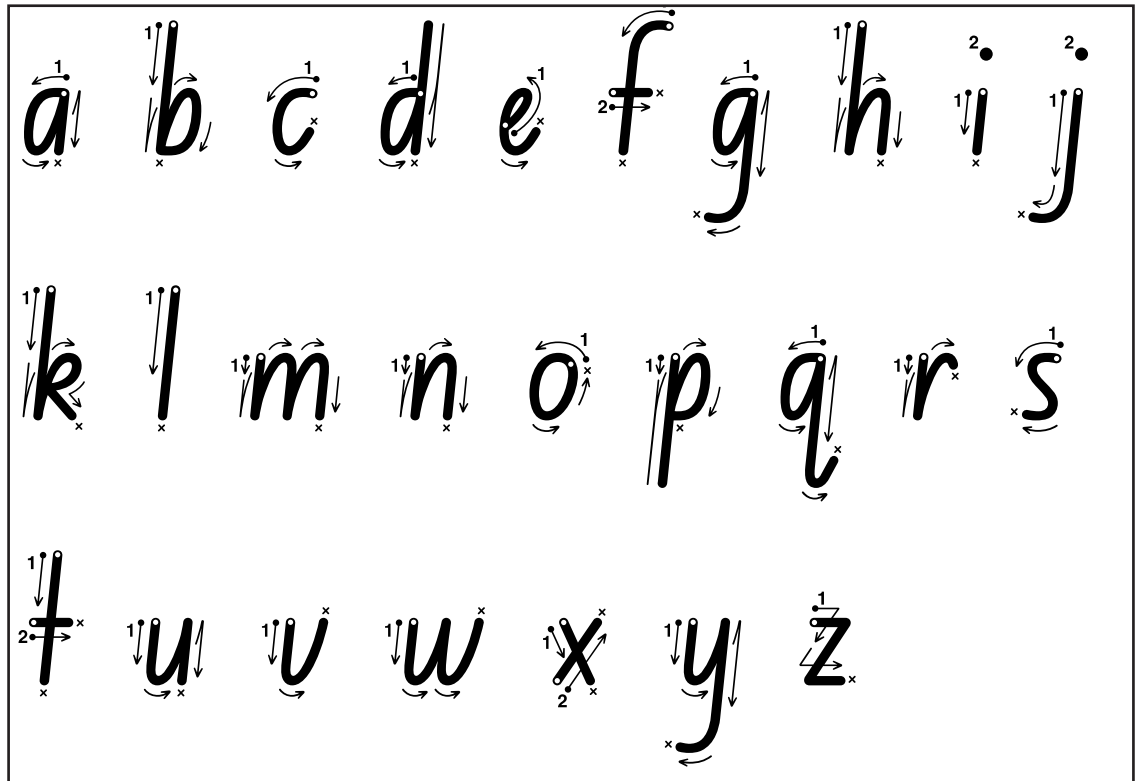
### **1. ORIENTATION TO NSW/ACT FOUNDATION FONT**

NSW/ACT Foundation Font is used throughout this training module, however please note, that once training is complete, other font styles can be applied to and used in the LFA. For the purposes of training however, the user must be familiar with the formation patterns used in NSW/ACT Foundation Font.



## Activity 1 – Review the following letter formation patterns for NSW/ACT foundation font

YOU WILL BE REQUIRED TO BE FAMILIAR WITH THIS FONT TO SCORE THE PRACTICE VIDEOS



NSW/ACT Foundation font © 2001-2022 Graphity! All rights reserved. Used with permission. Available from [australianschoolfonts.com.au](http://australianschoolfonts.com.au)

## 2. REVIEW OF LETTER NAMES AND SOUNDS

It is essential that users of the LFA accurately state the names and sounds of each alphabet letter used in the LFA. The letter names and sounds are stated to LFA participants for each letter, in association with the picture prompt. Letter names and sounds and the picture prompt are the only cues used in the first step of the assessment for each letter, so it is essential that these are stated accurately.

### Activity 2 – Listen to voice recording: Letter names and sounds

The LFA is standardised in administration and users should refer to Section 3, administration and scoring for administration instructions. Of particular note:

1. Use the standardised script to introduce the assessment.
2. Follow scoring rules within the LFA user instructions.
3. Print letter tiles using font that is being taught in the classroom .

### **3. SCORING PRACTICE**

Two videos are available for scoring practice and training purposes. The videos are of Kindergarten children completing the LFA and an assessor providing the prompts as required. These videos do not include sound, and have been edited to include a pause screen between each attempt on each letter, to enable a scoring decision to be made.

#### **Activity 3 - Scoring practice**

1. Download and print two copies of the LFA response form.
2. View and score Training video 1 and Training video 2 (score as you watch).
3. Review administration procedures and rules for clarification (answers are provided below).

For each attempt at letter formation for each letter, decide if the attempt adheres to NSW/ACT foundation font letter formation. Review the administration instructions in Section 3. If you think the first attempt is correct, place a mark in the appropriate column for that letter. If you think the attempt is incorrect, leave the appropriate column empty. The videos show the decisions made by the expert assessor, as to whether they have decided additional (visual or demonstration) prompts are required. You will be able to review your answers by comparing with the correct answers, below.

### **4. ANSWER REVIEW**

#### **Activity 4 - Answer review**

Compare your answers to the two answer sheets provided on the following page. Note areas of difference and refer to administration instructions for clarification of scoring procedures.

#### **The following answers are provided for Training video's 1 and 2**

N.B. Response forms used in Training videos are LFA Version 1.

## Training video 1 - Answers

# L F A S C O R E S H E E T

Name	Training Video 1	Date	
DOB		Chronological Age	
Grade	Kindergarten	Teacher	
LFA-LSC: 22/26		LFA-F: 89/104	

	LFA-LSC	LFA-F				
	Recognisable letter 1 = yes, 0 = no	Correct formation from memory (4)	Correct copy from model (3)	Correct imitation (2)	Recognisable letter, incorrect formation (1)	Unrecognisable letter (0)
a	1	✓				
m	1		✓			
t	1		✓			
s	1	✓				
i	1		✓			
f	1		✓			
d	1			✓		
r	0			✓		
o	1				✓	
g	1	✓				
l	1	✓				
h	1	✓				
u	1	✓				
c	1	✓				
b	1	✓				
n	0		✓			
k	1	✓				
v	1		✓			
e	1	✓				
w	1	✓				
j	0		✓			
p	1	✓				
y	1	✓				
x	1	✓				
q	0		✓			
z	1	✓				
Subtotal		60	24	4	1	
Totals	22/26	89/104				

# L F A S C O R E S H E E T

Name	Training Video 2	Date	
DOB		Chronological Age	
Grade	Kindergarten	Teacher	
LFA-LSC: 22 /26		LFA-F: 88 /104	

	LFA-LSC	LFA-F				
	Recognisable letter 1 = yes, 0 = no	Correct formation from memory (4)	Correct copy from model (3)	Correct imitation (2)	Recognisable letter, incorrect formation (1)	Unrecognisable letter (0)
a	1	✓				
m	1		✓			
t	1	✓				
s	1	✓				
i	1	✓				
f	1		✓			
d	1			✓		
r	1			✓		
o	1	✓				
g	1		✓			
l	1	✓				
h	1	✓				
u	1	✓				
c	1	✓				
b	1	✓				
n	0		✓			
k	0				✓	
v	0		✓			
e	1	✓				
w	1	✓				
j	0		✓			
p	1			✓		
y	1	✓				
x	1	✓				
q	1	✓				
z	1		✓			
Subtotal		60	21	6	1	
Totals	22 / 26	88 / 104				

## 5. INTERPRETATION AND USES OF THE LFA

### Uses of the LFA-F score

As per the psychometric evidence, the LFA-F score can be used as a measure of handwriting fluency and is validated for use with children who have been introduced to alphabet letters. The LFA-F can be used to measure:

- Outcomes of a handwriting intervention as a pre- post-test score.
- Early identification of handwriting fluency difficulties.
- Response to intervention for whole class approaches to handwriting instruction.

### Uses Of The LFA-LSC Score

The LFA-LSC is a clinical indicator and can be used to identify factors contributing to LFA-F scores. This score is not yet validated for use as a measure of handwriting fluency, however provides useful clinical information to understand and interpret LFA-F scores.

Research into the use of the LFA is ongoing and clinicians are invited to contact [lfa@newcastle.edu.au](mailto:lfa@newcastle.edu.au) for enquiries into alternate uses and for further information on interpretation.

# Possible Scoring Patterns

A range of scoring patterns are possible within the LFA domains. Interpretation and suggestions for intervention approaches are discussed below. Please refer to Section 1 to review the 4Rs model of handwriting fluency acquisition (Recall, Retrieve, Reproduce, Repeat) in relation to the following scoring patterns.

### **HIGH LFA-LSC, LOW TO MODERATE LFA-F**

High LFA-LSC and low LFA-F scores suggest relationships between letter names, sounds and forms have been established, however this result can occur if the student writes in upper case letters or uses an incorrect formation pattern for lower case letters on their first attempt (after verbal prompt only). Letter formation patterns and habits may be well established and resistant to change. An example of this is forming letters from the 'bottom up'. Careful assessment is required to determine the merits and importance of generating new (correct) motor patterns to attach to the letter sounds. For some, movement patterns can be inefficient, and may not serve well in later years. For students who write on first attempt in capital letters, the focus should be on developing lower case letter forms, which are important for reading and writing. It is important to consider how the formation patterns in existence are impacting school tasks and how the trajectory of the writing style will impact in coming years. If intervention is indicated, based on LFA results and examination of the context and impact on school tasks, the following strategies may be beneficial:

- Introduce the letter formation pattern with explicit instruction.
- Group letters with similar formation patterns together into 'families'.
- Assist stable orthographic representations of letters using cognitive strategies - memory retrieval routines and activities that allow for recall and retrieval of the letter formation pattern are most effective.
- Repeat the correct formation pattern by slowing down, using activities that promote high levels of engagement, focussing in on key letters that are showing errors, and encourage letter forming accuracy when writing words.
- Attach a mnemonic to each letter and use as the letter is written. For

some children it may be advantageous to say only the name of the letter as they are writing it, as too much auditory information could be overwhelming.

- Promote attention to the details of the task and slowing down, by providing engaging and multi-sensory approaches to reproducing the letter forms.
- Focus on retrieving and repeating the sequence of lines and strokes for each letter alongside the development of orthographic knowledge.

Scoring pattern	Indicative scores	Scoring pattern indications
High LFA-LSC	Scores up to 26/26 but may be capital letters and/or incorrect formation	<ul style="list-style-type: none"> <li>- Attempt after first (verbal) prompt may be upper case or incorrect formation.</li> <li>- Incorrect letter formation patterns may be resistant to change.</li> <li>- Determine merits of correcting formation pattern based on current and future impact on reading and writing tasks.</li> <li>- If intervention warranted, focus is on establishing correct letter formation, using memory retrieval routines through Repetition to consolidate Recall, Retrieve and Reproduce.</li> <li>- Multi-sensory practice opportunities may enhance attention to task and engagement with learning the new patterns.</li> </ul>
Low LFA-F	Some 4's  Mostly 3's and 2's	

### Example:

Jay is in year 1 (second year of formal schooling) and was referred to school based occupational therapy services for self-regulation and handwriting difficulties. Jay scored 24/26 for LFA-LSC, however he scored 61/104 for LFA-F, indicating many individual letters scores of 2's and 1's. Jay consistently demonstrated difficulty correctly forming letters after verbal, visual and demonstration prompts, often using bottom-up strokes. He was able to form some letters correctly imitating the therapist's demonstration of correct formation for approximately half of the letters incorrectly formed. Jay's letter formation motor patterns were entrenched after practising incorrect formation for a significant period for the first year and a half of schooling and his handwriting was inefficient and required a lot of effort. Intervention included Jay working with the school based occupational therapist to increase his ability to attend to school work. Jay's strong interest in a favourite cartoon was used as

a motivating hook to engage him in focussing on key letters that were showing consistent errors and then applying this when writing words. For example, letters that Jay consistently reversed, capitalised or formed incorrectly were recalled (or imagined) being painted in his favourite cartoon character's colour, using the correct formation pattern, and this pattern was then retrieved and repeated in writing. A priority was to encourage Jay to slow down when writing letters by providing cognitive strategies to promote a "just right" speed for handwriting, using a slow/just right speed cartoon character to remind Jay of the importance of thinking before writing his letters. These approaches had benefits over time, with Jay able to acquire a fluent and less effortful handwriting pattern, and apply this in written tasks. Jay's teacher reported significant improvements in Jay's handwriting and attention to tasks in class by the end of the school year.

### **LOW LFA-LSC, LOW LFA-F**

A low LFA-LSC and low LFA-F score suggest both difficulties with orthographic representations (recall) of letters and difficulties retrieving and reproducing motor patterns after verbal, visual and demonstration prompts. Low LFA-LSC combined with low LFA-F suggests a significant problem across domains. Scoring for LFA-F would be mostly 2's and 1's or 0's. A low LFA-LSC indicates a poor relationship between letter name, sound and form, reflecting limited recall of mental representation of letters and/or retrieval of motor pattern when provided with a verbal letter prompt. As previously described in this manual, the purpose of the LFA-LSC is to assess the emergence of relationships between names, sounds and forms regardless of formation pattern or use of capitals. This scoring pattern indicates possible significant difficulty with recall, retrieval and reproduction of the letter forms as per the 4Rs model (see Section 1). A multi-disciplinary approach may be indicated, in order to gain more understanding of the factors that could be impacting. It is also very important if this scoring pattern is observed to ensure that initial instruction in handwriting has occurred, and that the assessment has occurred at an appropriate time within the school year based on the scope and sequence of the curriculum. It may be possible for this pattern to be observed if the assessment is conducted prior to adequate initial instruction.



Scoring pattern	Indicative scores	Scoring pattern indications
Low LFA-LSC	Very few correct attempts after verbal letter prompt	<ul style="list-style-type: none"> <li>- Check initial instruction in letter formation has occurred.</li> <li>- Consult with multi-disciplinary team regarding speech, language and learning factors that may be contributing.</li> <li>- Establish realistic and achievable goals to support handwriting fluency acquisition.</li> <li>- If indicated, focus on all 4R's quadrants, as scores indicate issues with all areas.</li> </ul>
Low LFA-F	Mostly 2's, 1's or 0's	

### Example:

Sonny is in the first year of schooling, and has been introduced to the names, sounds and forms of all alphabet letters by the third term of the school year. Many children in the class are now reading decodable books and writing short sentences, however, Sonny's teacher is concerned about literacy development, noticing issues for handwriting, reading and writing. Sonny was seen by an occupational therapist for handwriting difficulties, and scored 10/26 for LFA-LSC and 68 for LFA-F. Scores on LFA-F individual items were a combination of 2's, 1's and 0's. The occupational therapist noted that these scores were low across the two LFA domains, and consulted with the multi-disciplinary team and the school regarding identification of other difficulties such as speech, language and learning difficulties. The therapist worked in collaboration with the school and the multi disciplinary team to establish goals for Sonny and it was agreed that it was appropriate to aim for Sonny to be able to write individual letters fluently by the end of the school year. Intervention approaches focussed on cognitive strategies that supported the development of mental representations of letters (recall), and the establishment of motor patterns attached to these mental representations (retrieve). It was also noted by the therapist that Sonny had significant difficulties with a range of perceptual motor skills (reproduce), and therefore activities for handwriting practice incorporated promotion of these skills. Intervention included strategies to promote fluency using cognitive recall incorporated into activities that promoted perceptual motor skills supportive of handwriting. Sonny was excited by the end of the year to be able to write her name, the alphabet and some consonant-vowel-consonant words.

### LOW TO MODERATE LFA-LSC, MODERATE LFA-F

This scoring pattern suggests the child has difficulty with the recall quadrant of the 4Rs model. On initial verbal prompt, it may be observed that letters are not written at all, are illegible or substituted with other letters, leading to a low to moderate LFA-LSC score. However, when shown the visual letter prompt

in the next stage of the assessment, the child is able to retrieve the letter formation pattern and reproduce this using correct letter formation. Scoring for LFA-F would be mostly 3's. This score suggests that a mental representation of the letter (recall) may not be available for some letters. In this situation, it becomes clear that when provided with a visual letter prompt, cognitive load or mental effort is reduced, and the child is able to retrieve the correct letter formation pattern and reproduce this. An approach to intervention is to provide consolidating practice opportunities, as this may be a factor in the establishment of a clear recall and retrieve relationship.

Scoring pattern	Indicative scores	Scoring pattern indications
Low - moderate LFA-LSC	Half or less alphabet letters recalled in upper or lower case with any formation pattern on verbal prompt	<ul style="list-style-type: none"> <li>- Reducing cognitive load by providing a visual model of the letter enables retrieval and correct reproduction of the letter.</li> <li>- The 4R's quadrant that may require focus is Repeat.</li> <li>- Repetition that includes memory retrieval is most effective, rather than copying or tracing. This may need to be graded to support student abilities.</li> <li>- A range of writing materials and tools may promote higher levels of engagement and self monitoring of letter writing, contributing to fluency acquisition.</li> </ul>
Moderate LFA-F	Mostly 3's	

### Example:

Lin is in the first year of schooling and has had a systematic introduction to letter names, sounds and forms by the middle of the school year. The teacher has used a method of instruction for handwriting that emphasised a specific letter formation pattern, and has provided opportunities for practice from memory. However, the teacher has noted that Lin is having difficulty with writing short words that other children in the class are able to write independently. The teacher decides to assess the need for early intervention for Lin, and conducts the LFA assessment. Lin scores 17/26 for LFA-LSC and 83/104 for LFA-F. The teacher notes that on first attempt at the letter there were a number of occasions when Lin was not able to write the letter either in lower case or upper case, or wrote a different letter entirely. The teacher also observed that Lin scored quite a few 3's on LFA-F, and noted that the letter forming pattern used by Lin was retrieved and reproduced as soon as she was shown the letter prompt in stage two of the assessment. This pattern suggested a need for more

practice and more opportunities to consolidate the relationship between the letter name, sound and form in order to assist with recall. The teacher referred Lin to a small group program focussing on handwriting fluency and was pleased to see that this early identification enabled Lin to achieve a high LFA-LSC and LFA-F score by the end of the year. This also translated to story writing, with Lin being able to use letter writing fluency to write short sentences with some correct spelling, and other words spelled phonetically. The teacher was pleased to see Lin grow in confidence with her writing skills.

### **HIGH LFA-LSC, HIGH LFA-F**

These scores indicate strong relationships between letter name, sound and form and strong, retrievable and accurate letter formation patterns for most or all letters. No intervention is required, however whole class programs to support handwriting fluency development would allow these students to consolidate and apply skills to spelling in written tasks. Extension may be required in regular writing tasks, such as writing words and sentences rather than practicing individual letters. Scores for LFA-F would be mostly 4's with some 3's for less common letters or for minor formation errors. Score for LFA-LSC would be high, and likely to be 26/26.

Scoring pattern	Indicative scores	Scoring pattern indications
High LFA-LSC	26/26	<ul style="list-style-type: none"> <li>- No or very minor errors for letter formation for all letters.</li> <li>- Initial instruction for handwriting fluency has been effective for this student OR intervention program has been effective.</li> <li>- Extension work for writing tasks may be indicated.</li> </ul>
High LFA-F	Over 100/104	

### **Example:**

At the completion of a handwriting instruction program Kit's teacher checks student handwriting fluency acquisition using the LFA. Kit scores 26/26 for LFA-LSC and 102/104 for LFA-F. The teacher concludes that the handwriting instruction program has been effective for Kit and that no further intervention is required, however also uses this information to assist in planning extension activities for writing for Kit. The teacher encourages Kit to add additional writing to his work during guided sentence writing activities conducted with the whole class and also during independent work.

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# The Letter Form Assessment Version 2 (LFA)

## *User Instructions and Training Module*

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