GL Assessment®

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USER MANUAL

CoPS

Cognitive profiling system for 4 to 7 years

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About CoPS

CoPS (Cognitive Profiling System) is a fully digitised psychometric assessment system that has been standardised for use with students from 4 years 0 months to 7 years 11 months. It is designed to enable teachers, psychologists and other appropriately trained and qualified persons working in education or related professions to identify students' cognitive strengths and weaknesses. This information can assist in the:

- diagnosis of dyslexia (or specific learning difficulty)
- assessment of many other special educational needs
- identification of various developmental difficulties
- recognition of students' cognitive strengths and weaknesses
- differentiation of educational provision for children with learning difficulties
- creation of individualised teaching and learning activities for all students in the age range.

Although administration of CoPS is relatively straightforward, interpretation of the results produced by CoPS and implementation of appropriate educational provision, requires educational expertise and experience. Consequently, CoPS is not suitable for use by persons without qualifications in education or psychology.

CoPS should ideally be used for screening all students on school entry, or as soon as possible thereafter, i.e. at the age of four or five years. When used in this way, it can reveal many students who are likely to encounter significant difficulties in learning basic skills but who might otherwise have passed undetected at that stage. The problems experienced by such students may then be addressed swiftly and before these students have been discouraged by failure. However, CoPS can also be used for screening students aged six to seven years, or for assessment of any student within the age range who has encountered difficulties in learning. In such cases, CoPS can reveal underlying cognitive causes of learning difficulties.

The subtests in CoPS are delivered in the form of games, which are stimulating, enjoyable and non-threatening for students. The game format helps to keep the student on task while maintaining their interest and motivation. It also contributes to greater accuracy and reliability of results.

CoPS provides direct assessment of the following areas of cognitive ability:

- visual spatial sequential memory
- visual-verbal sequential memory
- visual associative memory
- visual sequential memory
- visual-verbal associative memory
- auditory sequential memory

- phonological awareness
- auditory discrimination
- colour discrimination

The advantages of CoPS for early screening and assessment

The advantages are as follows:

- Greater precision in presenting assessment tasks.
- Greater accuracy in measuring responses.
- Greater objectivity of assessment.
- It can be used much earlier than most conventional methods of assessment.
- It does not require a psychologist to do the assessment.
- It requires only minimal training of teachers or other personnel.
- Students enjoy it more than conventional assessment methods and so are motivated, which helps to ensure reliable results.
- It gives a detailed picture of a student's cognitive strengths and weaknesses, which can provide pointers for differentiation within the classroom.
- The program can be used as many times as required without the recurrent expense of test booklets.

Dr Joanna Horne is a Chartered Psychologist and Chartered Scientist, and has worked on the development of computerised educational assessments for 25 years. For much of this time she was employed as a Lecturer in Psychology at the University of Hull, teaching research methods and statistics, educational psychology and educational testing, and carrying out research, primarily within the educational psychology field. Joanna has published widely in peer-reviewed journals and presented research findings at national and international conferences. She is also a Test Reviewer for the British Psychological Society's Psychological Testing Centre and is the Educational Editor of 'Assessment and Development Matters'. Joanna is now a freelance consultant psychologist working in test development and psychometrics, and educational and psychological research.

Getting Started

Accessing CoPS via GL Ready

CoPS runs on the GL Ready platform at www.glready.com. After being set up with a GL Ready account and a subscription for CoPS, an email will be sent from glready@gl-assessment.co.uk with information on how to access the platform.

Before logging in, set a new password via the 'Set or reset your password' link – www.glready.com/password/reset. Once this is done, log in to your GL Ready account to start setting up students and assigning CoPS.

To check the status of the school's subscription to CoPS, go to the 'Manage school' tab at the top of the GL Ready page.

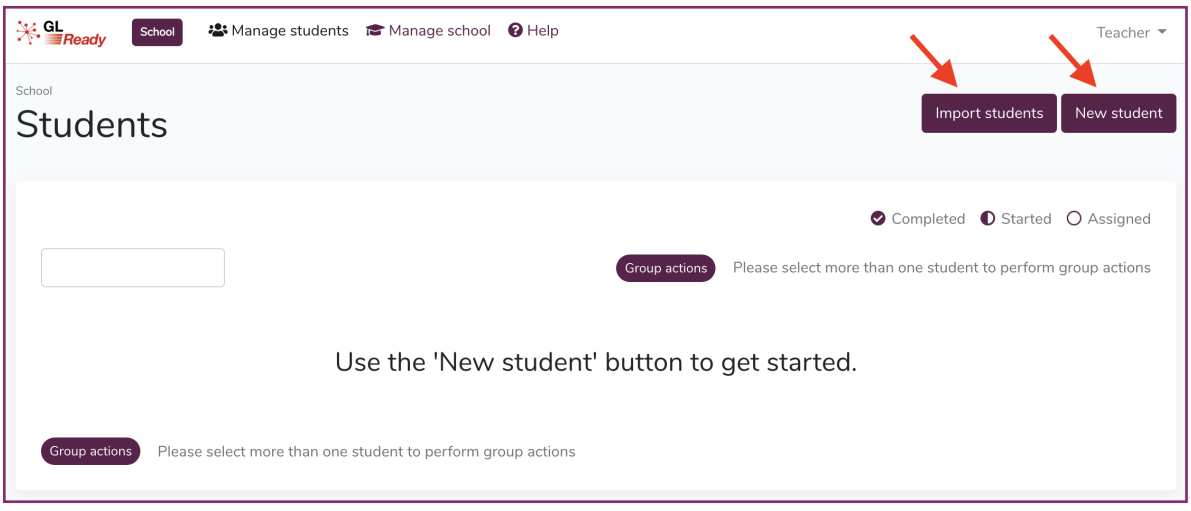
For further information about accessing and using CoPS on the GL Ready platform, please visit www.glreadysupport.com.

Adding students to GL Ready and assigning CoPS

To administer CoPS, first add students to the GL Ready platform.

Students can be added from the 'Manage students' page (www.glready.com/students) either individually, by using the 'New student' button and completing the form, or in batches via CSV import by using the 'Import students' button and following the instructions on the page.

Figure 1. Adding students

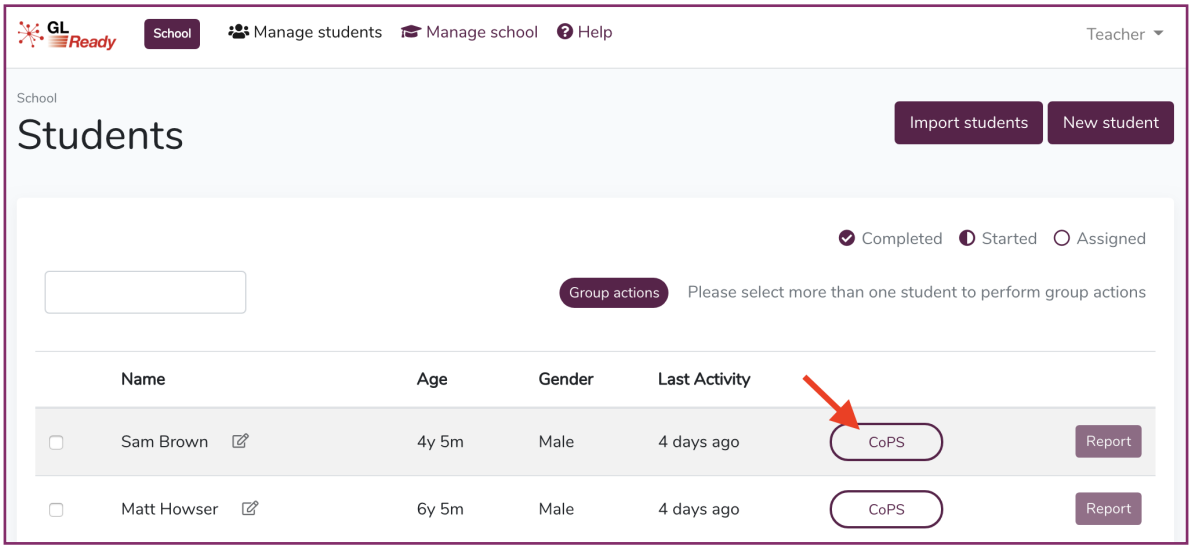


It is very important that the date of birth of each student is entered correctly as the subtests that are given to each student and the norms that are applied in their report is determined by their age.

Once students have been added to the GL Ready platform, assign CoPS to them.

To assign CoPS to an individual student, click on the 'CoPS' button next to their name.

Figure 2. Assigning CoPS to an individual student

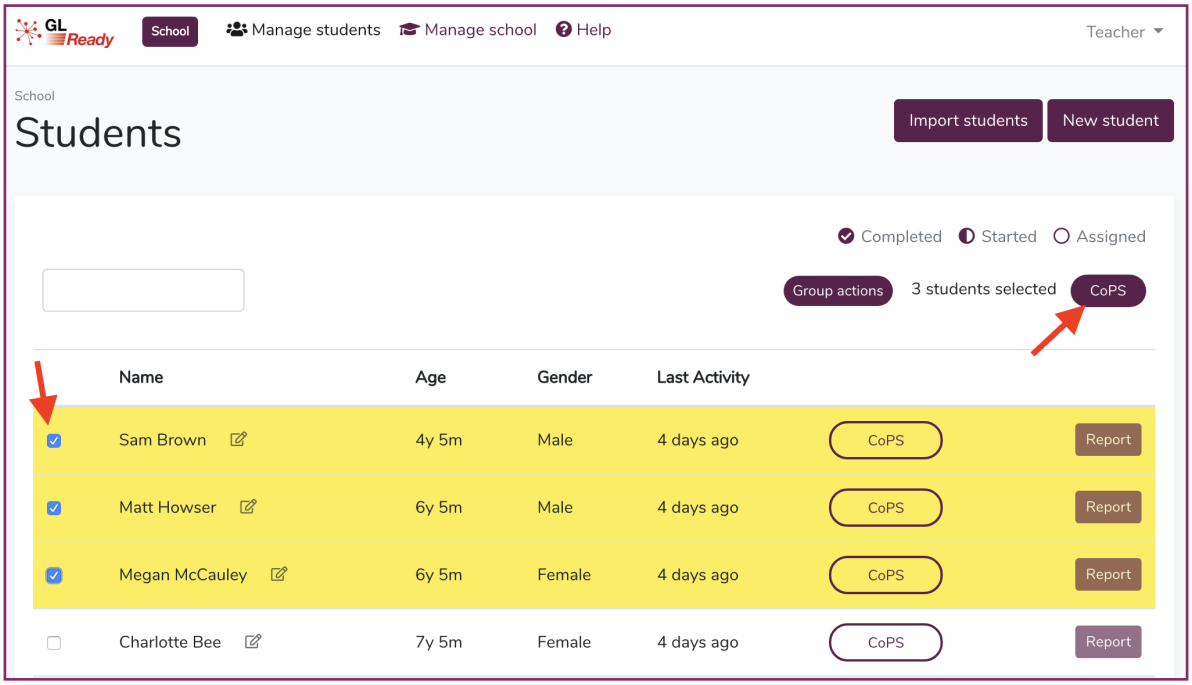


Two options are given:

- Start testing the student immediately on the machine you are using (this will take you straight to the student's session and will log you out of your teacher account) **OR**
- Confirm and return to the 'Manage students' page. This allows the student to start testing at another time or on a different machine.

To assign CoPS to multiple students, select the students by ticking the boxes next to their names, then in the group actions above the list of students click on the 'CoPS' button.

Figure 3. Assigning CoPS to multiple students



When a student has successfully been assigned CoPS, an empty circle will appear in the CoPS button against their name.

Figure 4. Assigned student

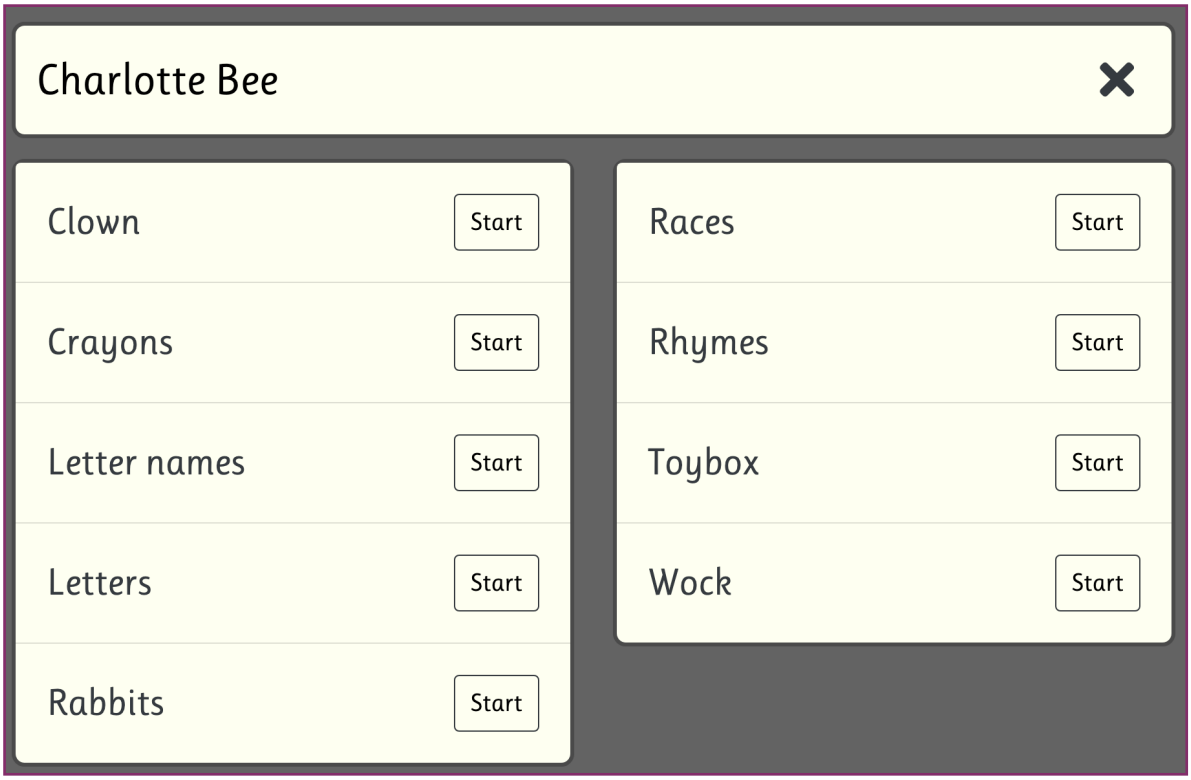
For further information about adding students and assigning CoPS, please visit www.glreadysupport.com.

Starting a student session

To start testing on a machine, go to www.glready.com/student and enter the school password (found on the 'Manage school' page at www.glready.com/school). This gives access to a student login page that lists the names of each student that has subtests available to complete.

To start a student session, select the name of a student, enter their date of birth and press start. A list of the subtests available to that student will show on screen. To start a subtest, click on the 'Start' button next to a subtest name.

Figure 5. Student session



Monitoring the progress of your students

To easily track the progress of each student, go to 'Manage students' on the school's GL Ready account and look at the 'CoPS' buttons against each of the students' names.

	Figure 6. Student has not been assigned CoPS
	Figure 7. Student has been assigned CoPS but has not started testing
	Figure 8. Student has started testing on CoPS
	Figure 9. Student has completed all subtests in CoPS

Using this manual

Please be aware that in this manual 'teachers' is used to refer to anyone who will be administering CoPS.

Ensuring you are set up for testing

Before carrying out any screening with your students, you should ensure that your machines are appropriately set up to run the subtests.

To do this, you must run the 'Diagnostic tool' - available from www.glready.com/student - on all the machines that will be used for testing. We recommend you do this while logged in to each machine as a student rather than a teacher (student sessions will tend to have more access restrictions).

Please note that each subtest contains audio instructions. If you intend to administer the product to multiple students in one room, every student will need access to a pair of headphones.

For further information about the technical requirements for running CoPS on your machines, please visit www.glreadysupport.com.

Using the subtests in CoPS

Before administering any subtest in CoPS, teachers should first read *Getting Started, Before you begin* and *Administering CoPS*. Together, these provide detailed guidance on how to select CoPS subtests and administer them. Assessing students with CoPS is straightforward but before attempting to test any students, first run through the complete suite of CoPS subtests to familiarise yourself with it thoroughly. To do this, add yourself as a 'student' and assign the product to yourself.

Interpreting CoPS results

Before attempting to interpret CoPS results, and especially when drawing up an Education, Health and Care (EHC) plan or considering educational provision for any student in detail, teachers are strongly advised to consult the chapters in this manual dealing with interpretation of CoPS profiles. Teachers who have already read these chapters and who are seeking speedy hints on interpretation of CoPS profiles may consult *Brief pointers for interpretation of results*.

Before you begin

Is the teacher familiar with the subtest being administered?

Teachers should be thoroughly familiar with each subtest before they attempt to administer it. The CoPS subtests are extremely easy for any competent adult to deliver, but before administering the subtests to a student, it is essential for teachers to become thoroughly familiar with them. The best way to do this is for teachers to add themselves as a 'student', assign the product to themselves and run through all the subtests personally. When doing this, teachers should carefully consult the details of each subtest given in *About the subtests*. This is especially important, for this chapter explains:

- the structure of each subtest
- how the student should be prepared for that subtest
- hints about administering that subtest.

Is the testing environment satisfactory?

The ideal testing environment is one that is reasonably quiet, with minimal distractions. However, CoPS was designed to use in the ordinary classroom, where distractions are often unavoidable. Visual and auditory distraction (both to the student being tested and to other students in the class) should be minimised. It is recommended that the computer or tablet and the student are positioned in such a way that the student is not looking directly at the rest of the class, nor should the rest of the class easily be able to see the screen. The best position for this is usually in the corner of the room. To minimise auditory distraction, headphones should be used (these are strongly recommended for ***Wock***, unless the testing environment is very quiet). Two pairs of headphones will be required – one for the student and one for the teacher – with a splitter. Inexpensive lightweight headphones will be adequate (but not the type that are inserted into the ear).

The student should be sitting comfortably at a suitable level in front of the screen (not too high or low in order to see the screen satisfactorily). It is not recommended that students attempt the tests standing up, as they are more likely to move about and alter the angle at which the screen is viewed – this can lead to failure to see everything that is happening on the screen, and can also disrupt the student's response accuracy and time. The teacher should check for reflections on the screen from windows and lights that could impair the student's perception. To do this the teacher should check by viewing the screen from the same position that the student will adopt.

It is not recommended that students attempt the tests when other students are standing or sitting in a position in which they can become involved in the task or act as a distraction. It will be hard for other students to inhibit their responses and their behaviour may influence the decisions of the student being tested.

Is the equipment functioning correctly?

Run the diagnostic tool – available from www.glready.com/student – on the computers before administering the product to students.

The teacher should check that (a) the screen is clear and its colours correct, (b) the sound (using speakers or headphones) is audible (not too loud or too soft, and without interference), and (c) if using a mouse, that it is functioning correctly and is positioned in front of the student on a suitable surface so that its movements are unimpeded. Note that in the four 'auditory' subtests (***Letter names, Races, Rhymes*** and ***Wock***) sound quality will be rather more important than in the other subtests.

Is the student prepared for the task?

It is important that the student understands the nature of the task, how to indicate responses, and when to respond (essentially when the subtests will allow them to respond). Students should not be allowed to take the subtests if they are unwell. In particular, colds are likely to affect the student's performance on ***Wock*** (although if the student regularly suffers from colds or glue ear it may be appropriate to assess the extent to which such problems are impairing auditory discrimination).

A story or scenario can be created for each subtest in order to make the task more interesting and enjoyable for the students. All verbal instructions delivered by the teacher should be appropriate to the level of understanding of the student. If the student does not understand any instructions the teacher may express them again in a more suitable manner. For example, in ***Races***, many young students may not fully understand what 'order' means. Here the teacher may give examples of what is a correct order (and what is an incorrect order) to aid comprehension. Explaining and re-expressing the task requirements to the student may continue into the demonstration and practice stages of each subtest. This is particularly useful for any student who is experiencing problems in understanding the true nature of the task. It is often easier for the student to comprehend the task requirements by experience of the practice stages, than by more abstract oral explanation. Once the test items commence, there should be no further aid given to the student.

Administering CoPS

Order in which subtests are administered

The order in which CoPS subtests are attempted is not particularly important. As teachers become more experienced with CoPS, they will find that they develop their own views about what subtests are most useful to begin with. However, it is generally not recommended that ***Rabbits*** be given as the first subtest (especially with younger students) because of the high demands which that subtest places on visual scanning, concentration and attention.

Some teachers like to use ***Clown*** or ***Crayons*** as the first subtest, because they are quite simple for students to understand and easy for them to do.

Number of subtests to be administered per session

A satisfactory test result cannot be obtained if students are not attending to the tasks and attempting to do their best. However, the CoPS subtests are mentally demanding and young students, especially, can easily become mentally fatigued after a few subtests. Their level of effort can diminish significantly, although they may still enjoy the activity. Consequently, it is recommended that not more than two subtests are given to a student in a continuous session. This may vary according to the concentration level of the student and other factors. The teacher should use his or her discretion in these matters.

It is also preferable to spread administration of the whole suite of subtests over several days. This avoids the situation where results may be grossly distorted because a student has an 'off day' through illness or some other idiosyncratic reason. Where any individual subtest result appears anomalous or unrepresentative the subtest may be re-administered after a suitable time period has elapsed.

Is the assessment being conducted fairly?

In order for the assessment to be fair (i.e. to give a reasonably accurate representation of the student's abilities) it is essential for the teacher to ensure that during the test:

- the student is paying attention, is on task and is not distracted
- the student does not become unduly fatigued
- there is no teaching or helping with the task during the test items (whether from the teacher or other students)
- there is no cheating – this may take the form of the student placing his or her hands on the computer screen to circumvent memory element of the test (e.g. in ***Rabbits***)
- feedback from the teacher is minimised and encouragement consistent.

Giving encouragement, prompts and feedback

As much as possible, the teacher should avoid giving specific feedback to students during the test, because this may influence their behaviour in an undesirable fashion. There is a risk of feedback differentially affecting students, so that some are encouraged and others discouraged. CoPS itself provides appropriate and limited feedback (i.e. 'well done', 'good'). Nevertheless, some students will try to elicit additional feedback from the teacher about their performance. This may take the form of verbal and non-verbal behaviours. For example, the student may ask directly if they were correct. Many students will look for the teacher's facial and bodily reactions to their responses. Some students may even try to evaluate the teacher's reaction by observing the teacher's reflection in the monitor screen. For these reasons it is usually preferable that the teacher sits to the side and slightly behind the student to minimise any feedback to the students which may bias the results.

Rather than specific feedback, general encouragement should be given to the student. This encouragement should be referenced to task completion rather than task accuracy and ideally should be delivered equitably to all students. However, it is inevitable that some students will require more encouragement than others, and where this is the case the teacher should be mindful of the possibility of influencing results unduly. Differential encouragement between students is likely to have an influence on the results obtained and therefore should be avoided where possible. Some key phrases and general incentive prompts which may be used to aid the administration of the subtests include: 'well done'; 'you were good at that game, now try the next one'; 'you will like this game'; 'now concentrate on this'; 'try hard'; 'listen very carefully'; 'have go at this one'; 'have a try'; 'just do your best'. Unless it is felt absolutely necessary, prompting during the actual test items should be kept to a minimum. For the most part any necessary prompting should occur between the subtests.

However, there are occasions when prompting during the actual testing may be necessary in order to direct the student's attention and to ensure the student is on task. These prompts may take the form of cues to attend to the stimuli which is about to be presented. One subtest which is more likely to require cueing for some students is ***Races***.

Keeping a comments record

It is recommended that the teacher makes a written record of the student's behaviour at each time of CoPS testing, particularly noting such factors as health, tiredness, attention, concentration, distractions, and general motivation. A template **CoPS Comments Sheet** is provided on the following page. This may be printed out or photocopied freely and used for recording any observations during testing. This record can then be referred to when interpreting the student's CoPS results. The teacher should particularly be on the lookout for colds and coughs, which not only disturb concentration, but which can also affect auditory discrimination and would show up as low scores on ***Wock*** and possibly other auditory/verbal tests as well. Sometimes a student may cough at a critical moment during a test and miss either the image that appears on the screen and/or the word that is spoken. Obviously in these circumstances testing should be discontinued until the student has recovered from the cold or cough. Cases of possible 'glue ear', in which auditory discrimination difficulties can be chronic or persistent, should be noted (for further information on auditory discrimination difficulties, see *Auditory discrimination problems*).

The following are examples of suggestions regarding completion of the **CoPS Comments Sheet**:

Testing Room: e.g. 'quiet room', 'classroom – noisy' (also mention any uncomfortable conditions)

Health: e.g. 'good', 'had bad cold', 'coughing' (also mention any other health factors)

Attention: e.g. 'good', 'fair', 'distracted', 'tired'

Other comments: e.g. 'over-confident', 'responded very quickly', 'nervous at first', 'did not understand instructions', 'could not hear computer properly', 'unconfident – kept asking "Is that right?"'

CoPS Comments Sheet

Name of student ..... Date of Birth .....

Class ..... Tester .....

School or Centre .....

Test	Date	Testing room	Health	Attention	Other comments	Initials of tester
Crayons						
Rabbits						
Toybox						
Letters						
Letter names						
Races						
Rhymes						
Wock						
Clown						

General comments

.....

.....

.....

.....

This sheet may be freely photocopied for use in conjunction with CoPS testing.

Retesting with CoPS

Teachers often ask 'How soon can a student be retested with CoPS?' The answer depends on why retesting is being considered. If the teacher has good reason to believe that a given result is not truly indicative of a student's ability because of some hindrance factor, then retesting can be as soon as is convenient. For example, this would be the case if a student had a cold and could not hear the words, was unwell and not able to concentrate, was excessively nervous, or because there were unexpected distractions in the room. Obviously, efforts should be made to ensure that those hindrance factors have been resolved before retesting.

Retesting will overwrite the student's previous results.

If, on the other hand, the teacher wants to see if the student has improved as a result of some intervention – e.g. insertion of grommets as treatment for glue ear, or training in phonological awareness – then a sensible interval should be allowed before retesting. In general, three months would be recommended as the minimum interval, but this could be less if the teacher had good reason for doing so. Repeated retesting on CoPS is not advisable, because under those circumstances any test is likely to show spurious improvements in performance by virtue of a practice effect.

For guidance on how to re-administer a subtest, go to www.glreadysupport.com.

Strategies for solving time-shortage problems

In cases where teachers wish to administer all the subtests in the CoPS suite but are prevented from doing so due to lack of time, they could try some of the useful strategies listed below for solving time-shortage problems.

- Ensure that administration of CoPS is part of school policy and that appropriate staff time is allocated for it on the timetable, rather than expecting teachers somehow to create the time on top of their other responsibilities. Giving CoPS to students does take time, but the information gained is valuable in students' education.
- Encourage staff to recognise that CoPS is a useful educational activity in its own right. The CoPS subtests are mentally stimulating and involve use of concepts and skills which are vitally important in early learning (e.g. discrimination of colour, shape and sound, memorisation, understanding of ordinal position, visual and aural attention, awareness of rhyme and alliteration). Hence time spent by teachers and students on the CoPS subtests has a wider educational value.
- Train non-teaching personnel to administer CoPS. Although it is essential that the interpretation of CoPS results is carried out by an experienced teacher, administration of the subtests can be done by any suitable adult who understands the essentials of what the task involves. In particular, students need to know that they are tests, so they have to understand what is required, but the tester is not permitted to coach the student or give hints to the answers. In many schools CoPS subtests are being successfully and efficiently delivered by various non-teaching personnel, such as classroom assistants, parents, volunteers or school governors. However, it is not advisable to use older students to supervise testing.

- Register all students in a block to be more time-efficient, rather than registering students singly at the time of testing. To add multiple students at once use the 'Import student' button on the GL Ready platform. Instructions on how to upload students via a CSV file are provided on the upload page (for more guidance, please visit www.glreadysupport.com).
- Give all students in the class the same CoPS subtest, before moving on to another subtest. That way, the teacher can get into a rhythm and does not have to re-adjust to delivery of each different subtest.
- Organise activities in order to use available time most effectively. Using playtime or lunchtime can work in some cases. Amalgamating classes for some activities (e.g. story time) can free up one teacher who can use that time to administer CoPS.
- Operate an efficient queuing system, so that the teacher does not have to waste time locating the next student and bringing that student to the computer for assessment.

Quick CoPS

When teachers feel that there is insufficient time available to administer *all* of the CoPS subtests and the solutions for overcoming this problem suggested in the last section are not appropriate, a shorter testing procedure, known as *Quick CoPS* may be adopted. In this procedure only four of the nine CoPS subtests are used, and the assessment will usually be completed in less than 30 minutes overall. Obviously, a more complete picture of the student's abilities will be achieved by using all of the CoPS subtests, but *Quick CoPS* is a satisfactory solution when circumstances prevent this.

Use of *Quick CoPS* requires the teacher to make decisions about which four CoPS subtests to use. This will differ according to:

- the age of the student (to the nearest month)
- the nature of the student's difficulties (if known) and any other information about the student which the teacher possesses.

In order to decide which subtests to employ, the teacher should refer to the **Quick CoPS Grid** (see below). This indicates which four CoPS subtests should be used, based solely on the age of the student (shown by the four ticks ✓ in each column). However, when a teacher has relevant information about a student (e.g. information from medical records, from the student's pre-school, from parents, or from the student's performance in school) the *Quick CoPS* procedure can be made much more efficient by adding in that information on the grid. This is achieved by consulting the Relevant Factors Chart (see Table 1). The Relevant Factors Chart shows which CoPS subtests should be given additional ticks on the grid, according to appropriate criteria listed (e.g. if there is a history of difficulties in language and/or literacy in the student's family, then additional ticks should be given to ***Races***, ***Rabbits*** and ***Rhymes***). Note that of the three subtests indicated in each row of the Relevant Factors Chart, the one which is printed in **bold** is the most important.

Quick CoPS testing procedure

- If the assessor has no relevant information about the student, then deliver *Quick CoPS* according to the student's age (to the nearest month), administering the four subtests which are ticked in the **Quick CoPS Grid**.
- If the assessor has relevant information about the student in any of the areas detailed below, then refer to the Relevant Factors Chart (Table 1) and where appropriate place additional ticks in the specified cells of the **Quick CoPS Grid**. A photocopy of the grid, given below, should be used for this purpose. Then select the four subtests which have the most ticks. In the case of ties making it difficult to decide which four to choose, the subtest printed in bold type in the Relevant Factors Chart should be given greater weight.

	Age of student			
Subtest	**4:0 – 4:11**	**5:0 – 5:11**	**6:0 – 6:11**	**7:0 – 7:11**
Crayons	✓	✓	✓	
Rabbits			✓	✓
Toybox				
Letters	✓			✓
Letter names				✓
Races		✓	✓	✓
Rhymes	✓	✓	✓	
Wock	✓	✓		
Clown				

Note: *Do not write on the above grid; a copy of the* **Quick CoPS Grid** *is provided below; this may be freely photocopied and used for the purposes of deciding which CoPS subtests to administer. When completed, the* **Quick CoPS Grid** *should be filed together with the child's results from CoPS testing and the* **CoPS Comments Sheet**.

The rationale behind Quick CoPS

The subtests which have been pre-selected in *Quick CoPS* (i.e. those which are ticked for the various age groups on the **Quick CoPS Grid**) have been chosen on the basis of their predictive validity, using data from the original CoPS research project. The criteria which appear in the first column of the Relevant Factors Chart have been selected on the basis of evidence from research on the correlations of learning difficulties in general, and literacy difficulties/dyslexia in particular. The philosophy is that where the teacher is aware of factors which could affect the student's learning, it will be most useful to concentrate on those CoPS subtests which can confirm or disconfirm the teacher's suspicions. For example, if the teacher believes the student to have poor listening skills [item g) on the Relevant Factors Chart] then the CoPS subtests which are selected should be ones which can give the teacher the most useful information on the significance of those apparently poor listening skills. These will be ***Letter names***, ***Wock*** and ***Races***, because these are the subtests which make the highest demands on the student's listening ability. If the student performs poorly on these subtests, this suggests that the problems are pervasive, confirming the teacher's suspicions and supporting a case for intervention on this basis. If, on the other hand, the student performs at an average level, or even well, on these subtests, this suggests that the student's suspected poor listening skills are not pervasive and may even be transitory. The latter finding may also indicate that the student's listening skills are good in some situations (e.g. 1 to 1 with the teacher) but poor in others (e.g. in a group situation). Either way, the results help the teacher to clarify the nature and extent of the student's difficulties.

Table 1. Quick CoPS Relevant Factors Chart

If the student satisfies the following criteria:	Add an additional tick on the Quick CoPS Grid in the following cells:
a Family history of dyslexia and/or literacy difficulties	**Races**, Rabbits, Rhymes
b Early speech and/or language problems	**Rhymes**, Wock, Races
c Glue ear and/or hearing difficulties	**Wock**, Rhymes, Letter names
d Poor reading skills (oral and/or silent reading)	**Rhymes**, Races, Rabbits
e Poor writing and/or spelling skills	**Letters**, Letter names
f Poor maths and/or number skills	**Toybox**, Rabbits, Letters
g Poor listening skills	**Letter names**, Wock, Races
h Poor attention and/or concentration	**Rabbits**, Toybox, Races
i Known or suspected co-ordination difficulties	**Rabbits**, Clown, Letters
j Known or suspected visual difficulties	**Clown**, Rabbits, Letters

Quick CoPS – an example in practice

Emily is 6 years 5 months. She is making little progress in reading (particularly picking up phonics) and her teacher believes she also has poor attention and concentration. The teacher filled in the **Quick CoPS Grid** as shown in Figure 10.

It can be seen that on this basis, *Quick CoPS* indicates that Emily should be assessed with ***Races*** and ***Rabbits*** (both received 3 ticks), ***Rhymes*** (2 ticks) and *either* ***Crayons*** or ***Toybox*** (both 1 tick). Both of the latter subtests would be suitable under these circumstances. Both measure fluency of verbal labelling, while ***Toybox*** is sensitive to lapses in attention and concentration and ***Crayons*** is more sensitive to weaknesses in sequential memory. If the teacher is unable to decide then it is perfectly acceptable to administer both these subtests (although then the administration time will take a little longer).

In Emily's case, the teacher decided to administer ***Races, Rabbits, Rhymes*** and ***Crayons***. The results are shown in Table 2. In order to understand these results, users who have not yet read the chapters on test interpretation may need to consult the relevant portions of those chapters before proceeding.

Table 2. Results for Emily Pearson (age 6:5) using Quick CoPS (Standard Age Scores)

Test	Races	Rabbits	Rhymes	Crayons
Accuracy score	**78**	**95**	**83**	**105**
Speed score	**93**	**107**	**98**	**118**

It is clear that Emily is having problems with ***Races*** (SAS 78) and ***Rhymes*** (SAS 83), whereas her performances on ***Rabbits*** and ***Crayons*** are both satisfactory (SAS 95 and 105, respectively). All the speed scores are satisfactory. This suggests that Emily's suspected problems of attention and concentration do not give cause for great concern. She has managed to cope quite well with ***Rabbits***, a test that demands close attention and maintenance of good concentration. Her result on ***Crayons*** suggests she does not have problems of verbal labelling and visual sequencing. However, the ***Races*** and ***Rhymes*** results suggest underlying difficulties of phonological processing and auditory memory, which are 'classic' symptoms of dyslexia. In fact, after the assessment, Emily's teacher talked to her parents and they revealed that one of Emily's cousins had been diagnosed as dyslexic the previous year, a finding which further supports the conclusion that Emily seems to be experiencing difficulties of a dyslexic nature.

Figure 10. Quick CoPS Grid for Emily Pearson (age 6:5)

Quick CoPS Grid

Student's name: **Emily Pearson** Date of Birth: **17.4.91**

Age at time of testing: **6** years **5** months

Class: **Miss Evans**

Relevant factors used: a) b) c) (d) e) f) g) h) (i) j)
(please circle)

Other information:

	Age of student			
Subtest	**4:0 – 4:11**	**5:0 – 5:11**	**6:0 – 6:11**	**7:0 – 7:11**
(Crayons)	✓	✓	✓	
(Rabbits)			✓ ✓ ✓	✓
Toybox			✓	
Letters	✓			✓
Letter names				✓
(Races)		✓	✓ ✓ ✓	✓
(Rhymes)	✓	✓	✓ ✓	
Wock	✓	✓		
Clown				

This form may be freely copied. The four subtests selected for administration should be ringed in the first column.

Notes:

Quick CoPS Grid

Student's name: Date of Birth:

Age at time of testing: years months

Class:

Relevant factors used: a) b) c) d) e) f) g) h) i) j)
(please circle)

Other information:

	Age of student			
Test	**4:0 – 4:11**	**5:0 – 5:11**	**6:0 – 6:11**	**7:0 – 7:11**
Crayons	✓	✓	✓	
Rabbits			✓	✓
Toybox				
Letters	✓			✓
Letter names				✓
Races		✓	✓	✓
Rhymes	✓	✓	✓	
Wock	✓	✓		
Clown				

This form may be freely copied. The four subtests selected for administration should be ringed in the first column.

Notes:

Assessing students who have English as an additional language

Assessment of any student who has limited proficiency in spoken English is always difficult (Cline and Shamsi, 2000). However, CoPS is less problematic than conventional methods of assessment, due to its strongly visual format and minimal reliance on spoken instructions. The demonstration and practice items enable most students, even those with very little English, to understand the tasks, and where there is uncertainty a teacher or assistant who speaks the student's first language can help with instructions. Administering the visual tests in CoPS (***Crayons, Toybox, Rabbits*** and ***Letters***), as well as ***Clown*** and ***Letter names***, to students who have little or no English is quite straightforward, provided a teacher or classroom assistant can explain to the student in their own language what they have to do. The tasks will be essentially the same as for English-speaking students: only the instructions will be translated. Under most assessment circumstances, CoPS is perfectly adequate for testing students with limited English.

Many students from other language backgrounds who have only limited English can still do ***Rhymes*** and ***Wock*** perfectly satisfactorily. In fact, those with the least experience of English do not inevitably perform less well on ***Rhymes*** and ***Wock*** than those with more experience of English (they may be somewhat better because of their bilingual or multilingual experience). What is most important is that the students understand the tasks confronting them and listen carefully to the items. ***Races***, however, creates a special problem for students with limited experience of English (especially young children), and that is knowing the names of the animals. Details of all the animals that appear in ***Races*** is given in *About the subtests*. If the teacher is unsure whether students know the names of all these animals, the most obvious solution is to familiarise all students with the animals, perhaps playing recognition games (e.g. bingo) using the pictures of the animals. Translation of the animal names into the student's first language is not necessarily a solution, because the names of some animals might not exist (or be familiar) in their first language. Even if straight translation of the names of the animals were to be possible, this would inevitably introduce an uncontrolled factor into the subtest, because in different languages the numbers of syllables in the animal names is likely to differ. (In ***Races*** syllable length has been controlled and the subtest has been standardised in this format.)

Case studies of four bilingual (EAL) students, together with their CoPS results are discussed in *Interpreting profiles of students who have English as an additional language*. These show that it is possible to obtain extremely valuable information from CoPS assessment of such children.

For further information on assessment of learning difficulties in literacy (including dyslexia) in EAL pupils and other multilingual children, see Cline (2000), Cline and Frederickson (1999), Cline and Shamsi (2000), Durkin (2000), Mortimore et al. (2012), Peer and Reid (2016) and Tsagari and Spanoudis (2013).

Assessing students with coordination difficulties

Teachers often ask whether slowness or difficulty in using the mouse or a touchscreen device makes a significant difference to a student's performance on CoPS. In general, the answer is no, because it is the accuracy scores derived from CoPS which are of paramount importance. Other than in ***Toybox***, the speed scores only provide a check that the student has attempted the task in a reasonable time – e.g. not too fast – see *Speed scores* for a discussion of how to interpret speed scores. Even if a student is totally inexperienced with using a mouse or touchscreen and is consequently very slow, the accuracy scores would still be a valid measure of their performance. Of course, a student may be slow on a CoPS subtest because they are finding it difficult – i.e. the cognitive load is high. Sometimes, if the test is far too difficult the student may appear very quick – in such cases they cannot remember the items at all and so their responses are random. In exceptional circumstances where a student's extreme inefficiency with the mouse or touchscreen is affecting their confidence (e.g. in cases of students with a physical disability), it is acceptable for the teacher to allow the student to point at the target on the screen and the teacher uses the mouse to click on that target. Alternatively, using a tablet or touchscreen device may be preferable.

However, the distinction between students who are slow in using the mouse or touchscreen (perhaps because of inexperience) and those with more serious motor co-ordination difficulties may be tricky for the teacher. Children with motor co-ordination problems are described as having 'Developmental Co-ordination Disorder' (DCD) (American Psychiatric Association, 2013). They are students with significantly poor motor performance which may manifest as co-ordination problems, poor balance, clumsiness, dropping or bumping into things, delays in achieving developmental motor milestones or the acquisition of basic motor skills. These symptoms interfere with daily life, onset in the early developmental period and are not explained by intellectual disability, visual impairment or a neurological condition. In adults who have acquired such problems (typically due to stroke or head injury) the term 'apraxia' is normally used, 'praxis' being defined as the ability to manipulate and deal intelligently with objects in the environment (Ayres, 1985). Thus, in students who have similar problems, the related term dyspraxia (or Developmental Dyspraxia) is also often used.

Developmental dyspraxia covers a range of childhood disorders affecting the initiation, organisation and performance of action (Ayres, 1988; Fisher et al., 1991). However, there is no universal agreement amongst neuropsychologists and neurologists about the categorisation of such problems because dyspraxic students do not form a homogeneous group. Some seem to have problems more at the planning stage of skilled action, others more with the execution of actions. Furthermore, successful actions must usually be underpinned by a number of visual processes as well as motor ones and it may be the case that these visual processes are faulty as well as (or instead of) the motor ones (Lord and Hulme, 1987). Indeed, there appears to be some degree of overlap between students diagnosed with dyslexia and those with dyspraxic difficulties, although many dyslexic students exhibit excellent motor skills and coordination (see Thomson, 2001).

Assessment of dyspraxia can cover a very wide range of tasks, including manipulation of small objects, shape copying by drawing, imitating and repetition of actions and postures, ability to co-ordinate arms and legs together, throwing, catching, jumping and skipping. Both large and small muscles may be involved, as well as fast and slow actions. Tests of motor co-ordination include the Movement ABC-2 (Barnett, Henderson and Sugden, 2007) and the Developmental Test of Visual-Motor Integration-6 (Beery, Beery and Buktenica, 2010). Scores are sometimes averaged to give a 'motor age' but this is not usually very useful, because it is possible for a student to have a co-ordination difficulty in one area and not another. Thus, a limited range of tasks may fail to identify a real difficulty and an overall measure may be misleading (Anderson and Fairgrieve, 1996; Beardsworth and Harding, 1996).

For the above reasons, the incidence of DCD is difficult to establish with any certainty. Figures vary according to the procedures used to assess the students. Reviewing this, Hoare and Larkin (1991) conclude that it is safe to assume that about one student in 10 has co-ordination difficulties, although these will vary in severity. Studies generally report a higher incidence in boys than in girls (Piek and Edwards, 1997). Evidence provided by Knuckey and Gubbay (1983) suggests that some young students with observed DCD have a delay in maturation and will eventually grow out of it. Labelling such students 'clumsy' at an early age may consequently be harmful. On the other hand, several studies indicate that long-term effects of DCD are common, including continuing motor difficulties as well as a variety of social, educational and emotional problems (Losse et al., 1991; Piek and Edwards, 1997). Gueze (2007) concludes that, although the incidence of DCD decreases with age, particularly during adolescence, 50% of cases continue to have motor difficulties. Because of this, many educationalists now believe that it is desirable to identify students with DCD as early as possible in their school lives, because it may affect their educational progress, and as such come within the heading 'Special Educational Needs'. The *Special Educational Needs and Disability Code of Practice: 0-25 years (2015)* states that schools should take all reasonable steps to identify and address such needs as early as possible in the student's school career.

For an overview of the current state of knowledge on developmental coordination disorder, see Zwicker et al. (2012). Guidance on assessing dyspraxia/DCD is given by SASC (SASC Working Group on Dyscalculia: New Guidance on Dyscalculia, 2019). General advice for teachers and parents is provided by Ripley, Daines and Barrett (1997), Boon (2010) and the Movement Matters organisation (www.movementmattersuk.org).

Assessing students with Attention Deficit Hyperactivity Disorder (ADHD)

The *Diagnostic and Statistical Manual of Mental Disorders* – DSM–V (American Psychiatric Association, 2013) distinguishes three presentations of ADHD:

- Inattentive type: the student with ADHD who is predominantly inattentive
- Hyperactive/impulsive: the student with ADHD who is predominantly hyperactive and impulsive
- Combined: the student with ADHD who is *both* inattentive *and* hyperactive/impulsive

In the World Health Organisation's *International Classification of Diseases* – ICD–10 (WHO, 2016), the term 'Hyperkinetic Disorder' corresponds to DSM-V combined type. It can be seen that the symptoms of ADHD do not just concern hyperactivity (i.e. restlessness, difficulty with sitting still, excessive movement or fidgeting). Rather, such students are equally, or even more, likely to have problems in sustaining attention on the task in hand, inhibiting impulsive responding, and generally in regulating and controlling behaviour. There are strong indications of genetic factors causing ADHD, although perinatal complications have also been associated with it (Amor et al., 2005). Current estimates suggest that the incidence of ADHD in school-aged children is between 5.9% and 7.1% (Willcutt, 2012). Between 18% and 45% of individuals with diagnosed ADHD also have dyslexia (Germano, Gagliano and Curatolo, 2010). Obviously, these reading difficulties could be the result of poor attention and concentration in the learning situation (i.e. an *indirect* effect of ADHD). In addition, it has been suggested that students with ADHD have problems with working memory (Holmes et al., 2014), which affects learning *directly*, because information is not stored properly nor is it retrieved fluently and reliably. Treatment for ADHD usually involves a combination of psychological methods (e.g. behaviour modification) and pharmacological methods (e.g. use of the drug Ritalin), but good educational management and committed parent involvement is crucial (Goldstein and Goldstein, 1993, 1998).

Students with ADHD are liable to experience difficulty with many types of assessment (not just computerised assessment) because of inattention and impulsiveness in responding. In cases of students with ADHD, teachers should therefore be prepared to take such factors into consideration when interpreting the results of CoPS tests. On the other hand, CoPS tests are typically found to be more stimulating than conventional tests, so students with ADHD will generally remain engaged and attentive for longer than might be expected. To maintain engagement and interest, however, and ensure that results are as reliable as possible, it is recommended that only one test per session should be administered to students with ADHD. Particular care should be taken when administering the ***Rabbits*** subtest as the student needs to watch the screen carefully to notice whereabouts the rabbits appear. Lapses in concentration and attention would be particularly expected to affect this test.

For practical guidance on identifying and teaching students with ADHD, the book by Cooper and Bilton (2002) is recommended.

Assessing students with colour blindness or colour discrimination problems

Two of the CoPS subtests – ***Crayons*** and ***Toybox*** (under 7 years version only) – specifically rely on colour perception for the student's response. Obviously if the student scores poorly on these subtests it could be because of colour blindness or some other colour discrimination difficulty. Indeed, if the student performs poorly on either of these two subtests, it is recommended that the student should be given the supplementary subtest ***Clown*** in order to check for problems of colour discrimination. In the remaining subtests in CoPS, although colour is employed, it is not central to the task, and colour blindness or colour discrimination difficulties should not affect performance.

Teachers sometimes ask whether knowing the names of the colours helps students to complete ***Crayons*** and ***Toybox***. However, whether they do or do not know colour names, these subtests are still valid because they were found to be predictive of later literacy difficulties without reference to knowledge of colour names. Teaching the students colour names specifically for the purposes of attempting these subtests is not recommended, because students who have only just acquired the names of the colours and not begun to use them fluently might be more liable to confusion. Some students clearly use the labels for the colours as a verbal strategy in these subtests, but this does not seem to be the case with all students – it appears to be possible to do these subtests using only visual strategies.

Accessing reports

Reports are calculated in real time, i.e. at the time of access or viewing, so that if any information has changed it will be incorporated in the current displays. Results are calculated using raw data stored in the central database. This data is loaded, scored and cross-referenced with national norms tables before being displayed.

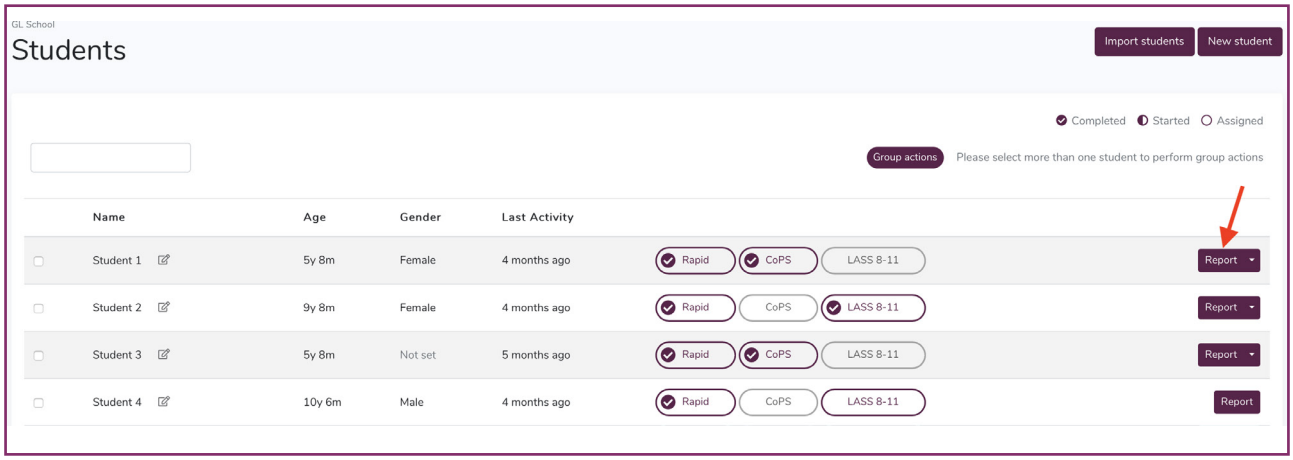
All scores are saved automatically on completion of each subtest. The data saved also includes the date the subtest was completed. **If a subtest has been abandoned before completion, then no results will be saved for that subtest.**

There are two types of report: graphical and CSV.

Graphical reports

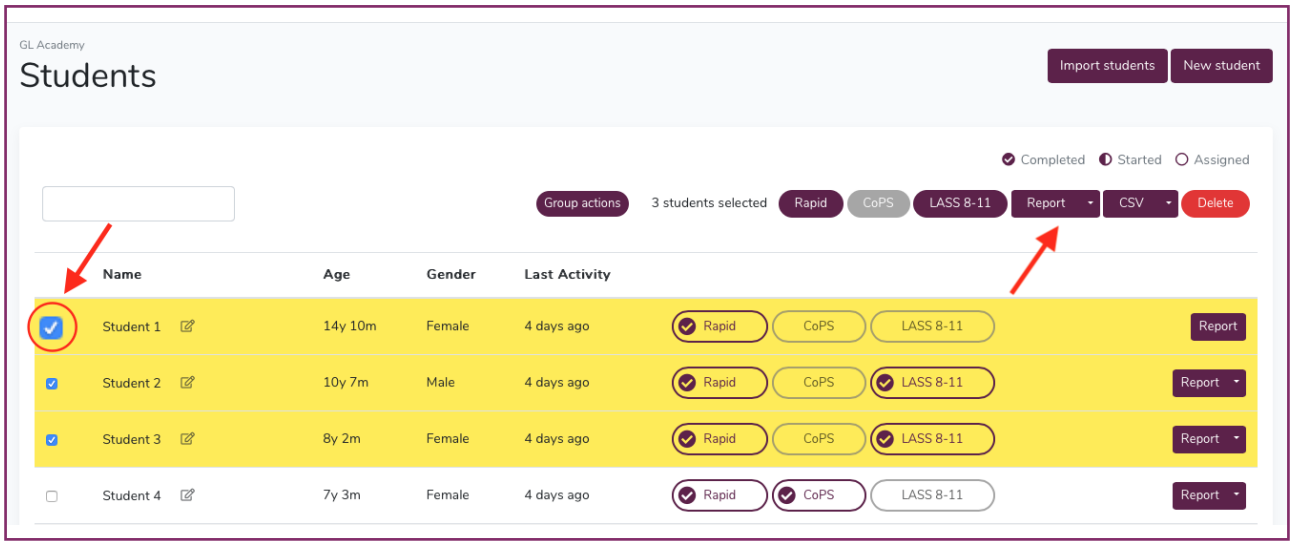
To access a student's graphical report, go to the 'Manage student' page on GL Ready and click on the 'Report' button against that student's name.

Figure 11. Accessing the graphical report of an individual student



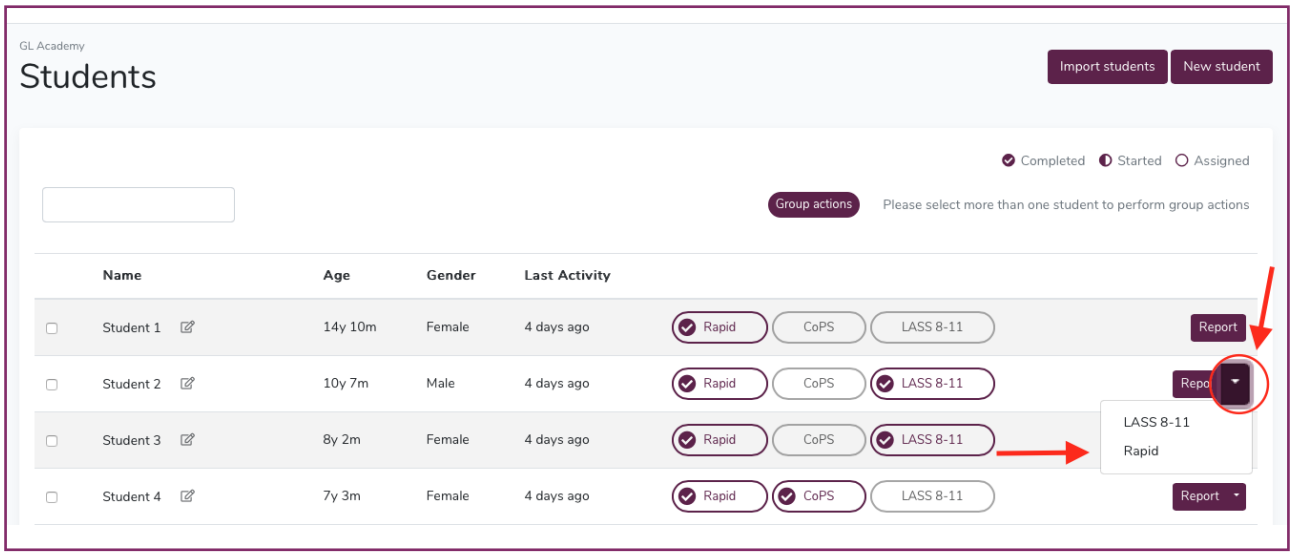
To pull up the reports of multiple students, select those students by ticking the boxes next to their names and then click on the 'Report' button in the group actions above the list of students.

Figure 12. Accessing graphical reports for multiple students



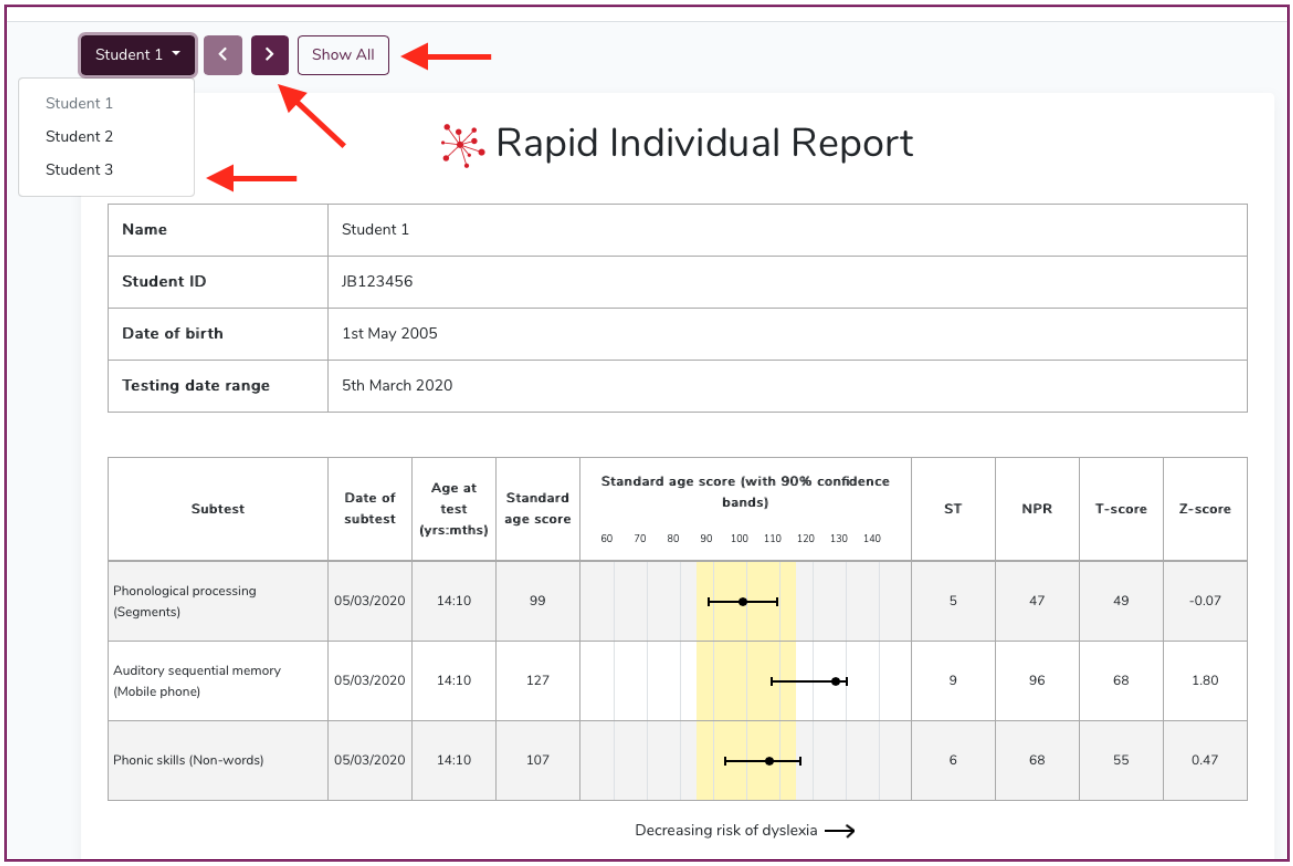
If the school is subscribed to multiple products on GL Ready and a student has more than one report available, use the dropdown arrow to select the correct report.

Figure 13. Selecting the correct graphical report for a student



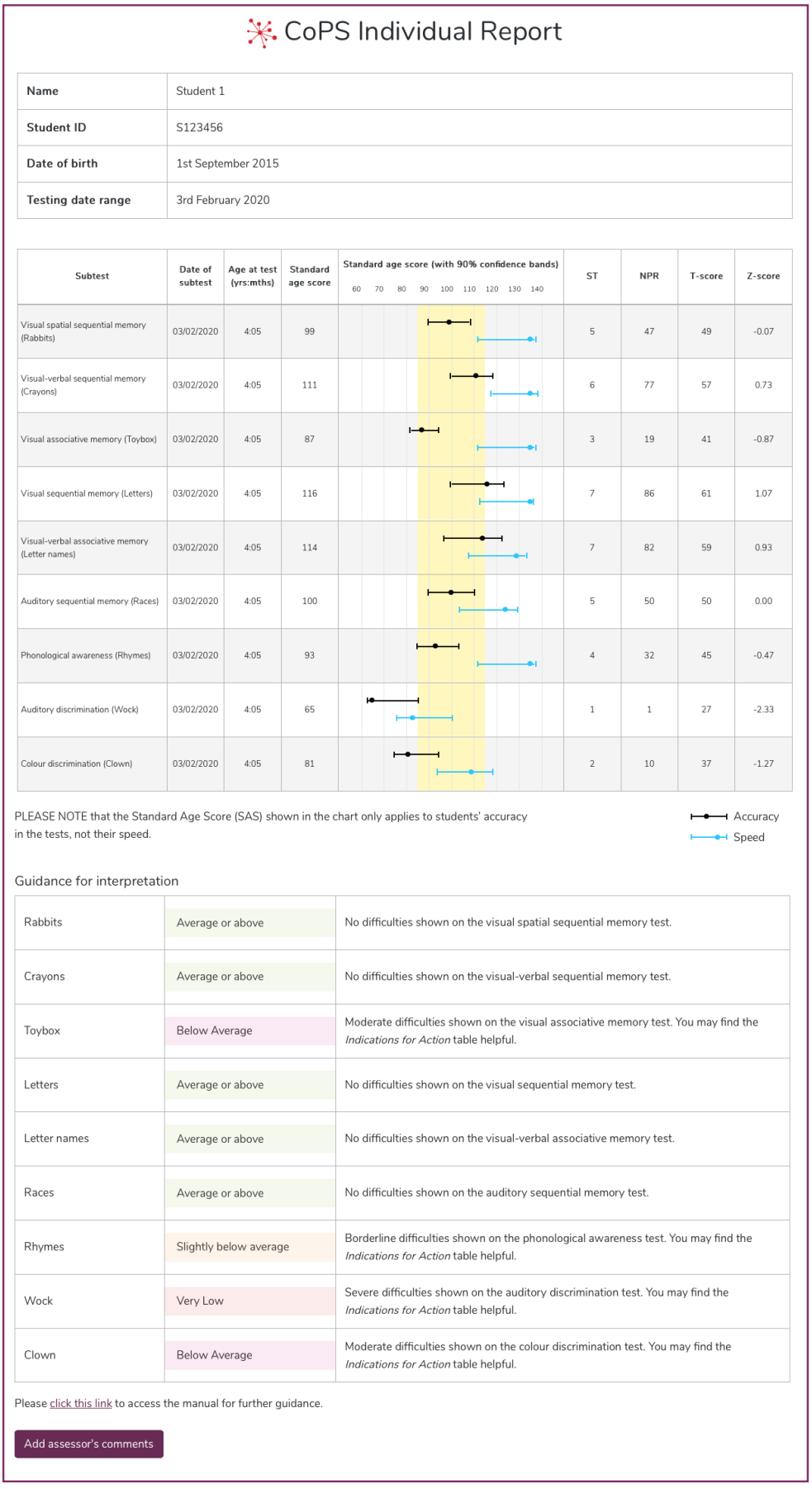
To navigate between reports, use the dropdown list of names, the arrows at the top of the screen, or select 'Show All' to view all reports consecutively.

Figure 14. Navigating between graphical reports



To add comments to a report, click on 'Add assessor's comments', type the comments in the box and click 'Save'. To print out a report, use your internet browser's printing options.

Figure 15. Example graphical student report



CoPS Individual Report

Name	Student 1
Student ID	S123456
Date of birth	1st September 2015
Testing date range	3rd February 2020

Subtest	Date of subtest	Age at test (yrs:mths)	Standard age score	Standard age score (with 90% confidence bands) 60 70 80 90 100 110 120 130 140	ST	NPR	T-score	Z-score
Visual spatial sequential memory (Rabbits)	03/02/2020	4:05	99		5	47	49	-0.07
Visual-verbal sequential memory (Crayons)	03/02/2020	4:05	111		6	77	57	0.73
Visual associative memory (Toybox)	03/02/2020	4:05	87		3	19	41	-0.87
Visual sequential memory (Letters)	03/02/2020	4:05	116		7	86	61	1.07
Visual-verbal associative memory (Letter names)	03/02/2020	4:05	114		7	82	59	0.93
Auditory sequential memory (Races)	03/02/2020	4:05	100		5	50	50	0.00
Phonological awareness (Rhymes)	03/02/2020	4:05	93		4	32	45	-0.47
Auditory discrimination (Wock)	03/02/2020	4:05	65		1	1	27	-2.33
Colour discrimination (Clown)	03/02/2020	4:05	81		2	10	37	-1.27

PLEASE NOTE that the Standard Age Score (SAS) shown in the chart only applies to students' accuracy in the tests, not their speed.

Accuracy
Speed

Guidance for interpretation

Rabbits	Average or above	No difficulties shown on the visual spatial sequential memory test.
Crayons	Average or above	No difficulties shown on the visual-verbal sequential memory test.
Toybox	Below Average	Moderate difficulties shown on the visual associative memory test. You may find the *Indications for Action* table helpful.
Letters	Average or above	No difficulties shown on the visual sequential memory test.
Letter names	Average or above	No difficulties shown on the visual-verbal associative memory test.
Races	Average or above	No difficulties shown on the auditory sequential memory test.
Rhymes	Slightly below average	Borderline difficulties shown on the phonological awareness test. You may find the *Indications for Action* table helpful.
Wock	Very Low	Severe difficulties shown on the auditory discrimination test. You may find the *Indications for Action* table helpful.
Clown	Below Average	Moderate difficulties shown on the colour discrimination test. You may find the *Indications for Action* table helpful.

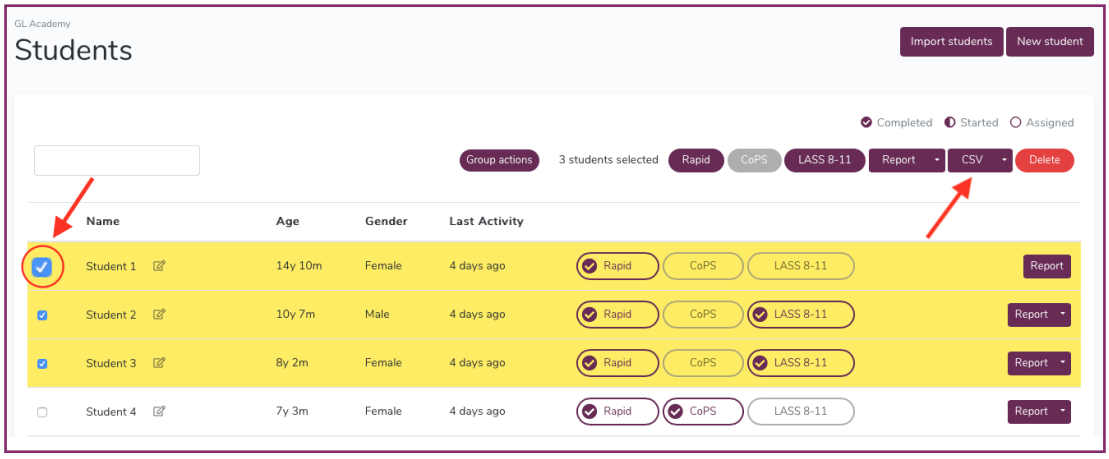
Please click this link to access the manual for further guidance.

Add assessor's comments

CSV reports

To download the CSV reports of individual or multiple students, select those students by ticking the boxes next to their names and then click on the 'CSV' button in the group actions above the list of students.

Figure 16. Accessing CSV reports for multiple students



To download the CSV reports of individual or multiple students, select those students by ticking the boxes next to their names and then click on the 'CSV' button in the group actions above the list of students.

Figure 17. Example CSV report.

	A	B	C	D	E	F	G
1	Name	StudentID	DateOfBirth	TestDate	SubTestName	SAS	Interpretation_IndividualSubtest
2	Student 3	CharlotteBee	01/01/2012	05/03/2020	Word chopping	129	Average or above
3	Student 3	CharlotteBee	01/01/2012	05/03/2020	Mobile phone	111	Average or above
4	Student 3	CharlotteBee	01/01/2012	05/03/2020	Funny words	132	Average or above
5	Student 2	JS123456	08/08/2009	05/03/2020	Word chopping	85	Below Average
6	Student 2	JS123456	08/08/2009	05/03/2020	Mobile phone	122	Average or above
7	Student 2	JS123456	08/08/2009	05/03/2020	Funny words	116	Average or above
8	Student 1	JB123456	01/05/2005	05/03/2020	Segments	99	Average or above
9	Student 1	JB123456	01/05/2005	05/03/2020	Mobile phone	127	Average or above
10	Student 1	JB123456	01/05/2005	05/03/2020	Non-words	107	Average or above

For further information about accessing reports on the GL Ready platform, please visit www.glreadysupport.com.

About the subtests

The nine subtests in the CoPS suite are listed in Table 3. ***Rabbits, Crayons, Toybox*** and ***Letters*** are predominantly visual in their task requirements. However, students can (and many do) use verbal strategies for some of these visual tests, e.g. saying the names of the colours to themselves in ***Crayons*** or ***Toybox***, or inventing 'names' such as 'bird' or 'table' for the symbols in ***Letters***. ***Letter names*** involves visual and verbal elements equally, whereas ***Races, Rhymes*** and ***Wock*** are fundamentally verbal in their task requirements, even though they are presented in a visual manner.

Each subtest is preceded by verbal instructions delivered by the computer, followed by a practice phase in which the student is told by the computer how to play the game. Although these procedures are usually sufficient to enable the student to understand the test requirements thoroughly, it is nevertheless worthwhile for the teacher to prepare the student for the task by explaining the scenario of the game, which is described in the following sections.

Table 3. The nine subtests in CoPS

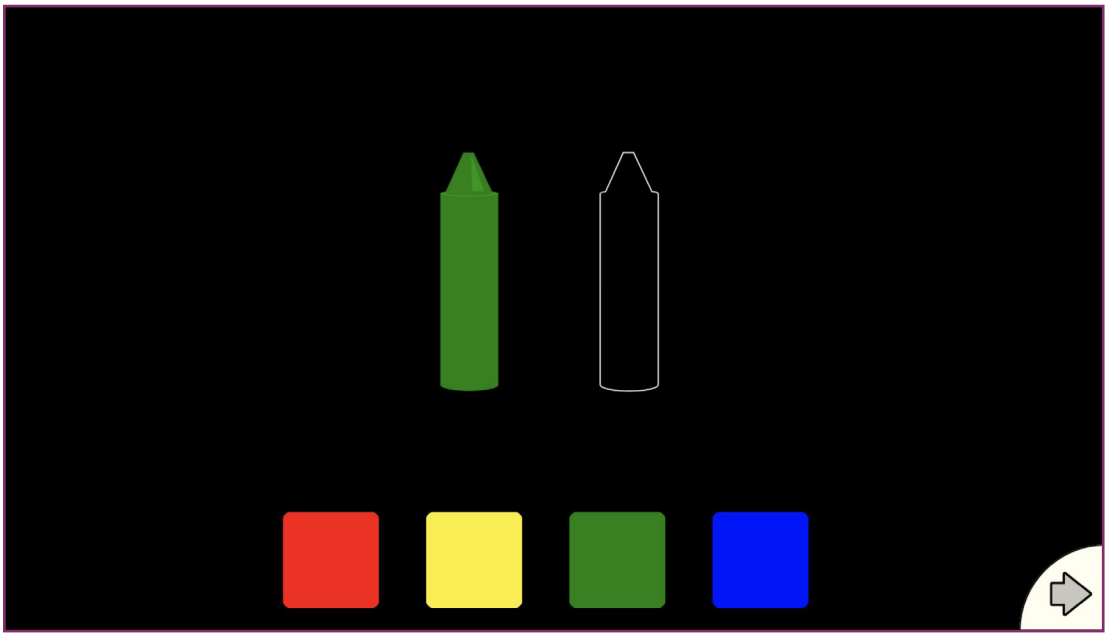
Subtest name	Cognitive skills being assessed
Rabbits	Visual spatial sequential memory (spatial/temporal position)
Crayons	Visual-verbal sequential memory (colours)
Toybox	Visual associative memory (shape and colour/pattern)
Letters	Visual sequential memory (symbols)
Letter names	Visual-verbal associative memory (names and symbols)
Races	Auditory sequential memory (animal names)
Rhymes	Phonological awareness (rhyming and alliteration)
Wock	Auditory discrimination (phonemes)
Clown	Colour discrimination

All subtests are preceded by a practice phase, and some provide a demonstration also. The practice item(s) will be repeated if the student gets them wrong. The teacher should help the student to understand the requirements of the subtest by explaining the scenarios of each subtest to the student. These scenarios are described in the following sections. Most of the subtests contain a number of levels, with the levels administered being dependent on the student's age and performance on the subtest.

Crayons

This is a test of visual-verbal sequential memory using temporal position and colour. During the test items the child is presented with a coloured crayon which disappears, and another coloured crayon appears in its place. The task is to remember the colours of each crayon as they appear and then replicate the presented colours in the same order by selecting the colours from a set of four presented at the end of the test item (see Figure 18). The student may change their mind by simply selecting the colour filled crayon they wish to change. Once the student is happy with their selection they must press the green arrow to continue. The teacher must ensure, as far as possible, that the student understands the full task requirements. Special attention must be given to ensuring that the student tries to replicate the *order* of colour presentation and not simply the colours shown in any order. The test begins with a practice.

Figure 18. Screen from Crayons

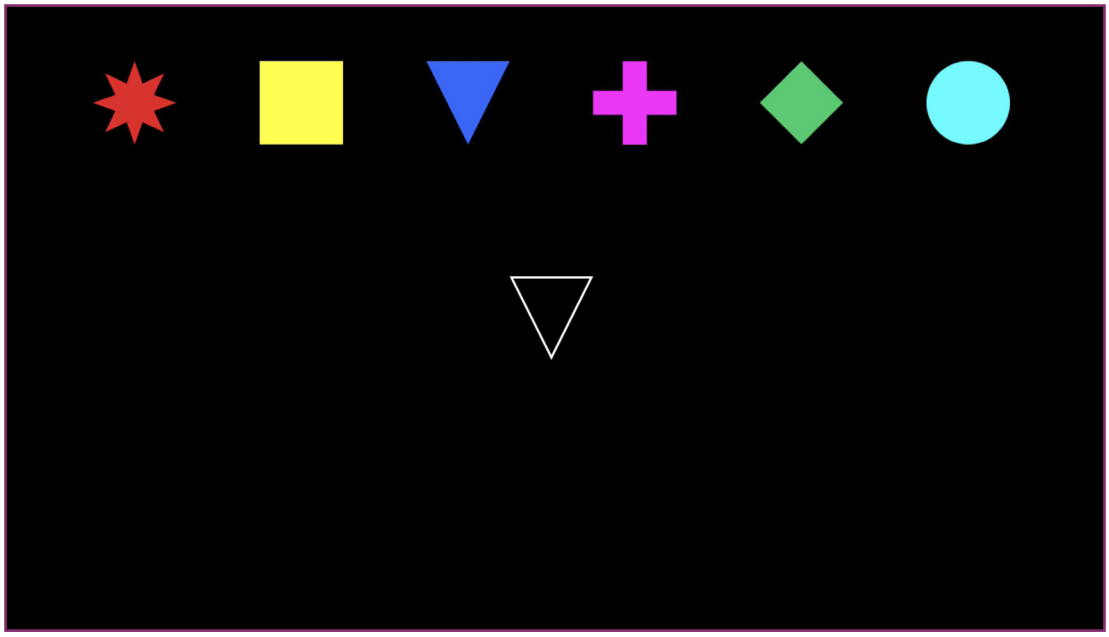


Toybox

This is a test of visual associative memory, based on either a shape-colour association (children aged 4-6) or a shape-pattern association (children aged 7). An array of shapes either coloured or patterned appears at the top of the screen. The shape-colour or shape-pattern relationship is consistent within a test but is not consistent across different students, i.e. it varies from student to student, so that the outcome of the subtest cannot be affected by students communicating (e.g. one student saying to another 'the star is red'). An empty shape appears in the middle of the screen and then as the array at the top disappears, a new array of colours or patterns undifferentiated by shape appears at the bottom. The student is required to click on the colour or pattern that is associated with the shape in the middle of the screen. The order of colours or patterns at the bottom of the screen is randomised for each item of the test, so that a student cannot associate a colour or pattern with a particular spatial position.

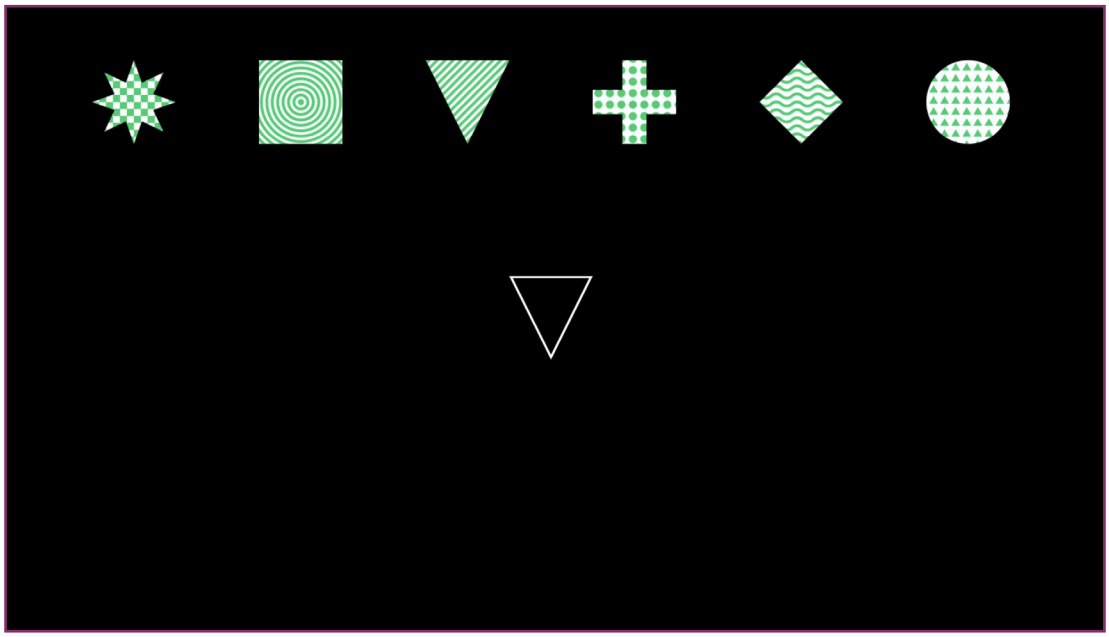
The scenario for students younger than 7 years old is that the computer has some toys, which are shapes (see Figure 19). Sometimes the computer 'forgets' which colour each shape should be. It wants the student to remember which colour goes with each shape and when the computer 'forgets' the colour the student has to 'tell' the computer which one it is by choosing the correct colour from the array of different colours that appears at the bottom of the screen. For children aged 7 the scenario is that the computer shows various shapes, which have different patterns inside (see Figure 20). The student has to remember the patterns inside each shape and demonstrate this by selecting the correct pattern from the array of different patterns that appear at the bottom of the screen.

Figure 19. Toybox – 'Remember the colour of the shapes'



In all cases the student has a practice phase in which the requirement is to correctly match 5 shapes with their correct colours (or patterns). In the test phase the student is given 90 seconds to match as many shapes as possible with their correct colours (or patterns), which provides the accuracy data for this subtest. The speed score is based on the number of items attempted within the 90-second test phase. A maximum of 15 attempts in total are permitted.

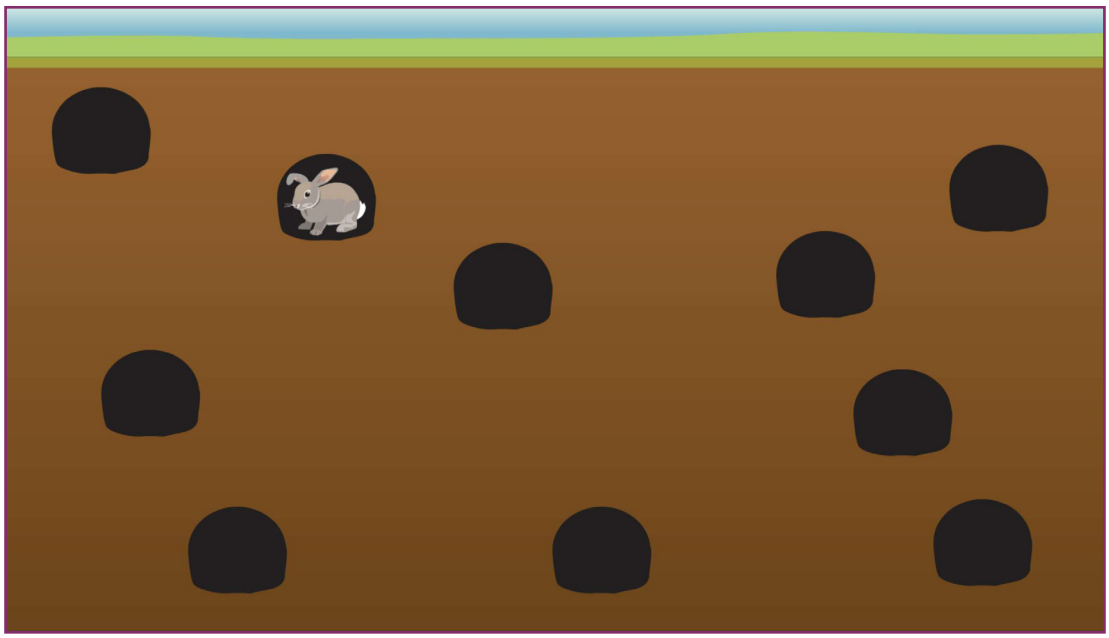
Figure 20. Toybox – 'Remember the pattern within the shapes'



Rabbits

This is a test of visual spatial sequential memory based on temporal and spatial position. The teacher should explain to the student that the picture on the screen (see Figure 21) is where some rabbits live, and the holes are the homes of the rabbits. There is one friendly rabbit who likes to visit many friends. The student has to remember where the rabbit goes, i.e. which rabbit holes the rabbit visits in the order in which it visited them. The student demonstrates their recall by selecting the holes in the correct sequence. A demonstration is given first, followed by a practice phase before the test phase.

Figure 21. 'Remember where the rabbit appears'

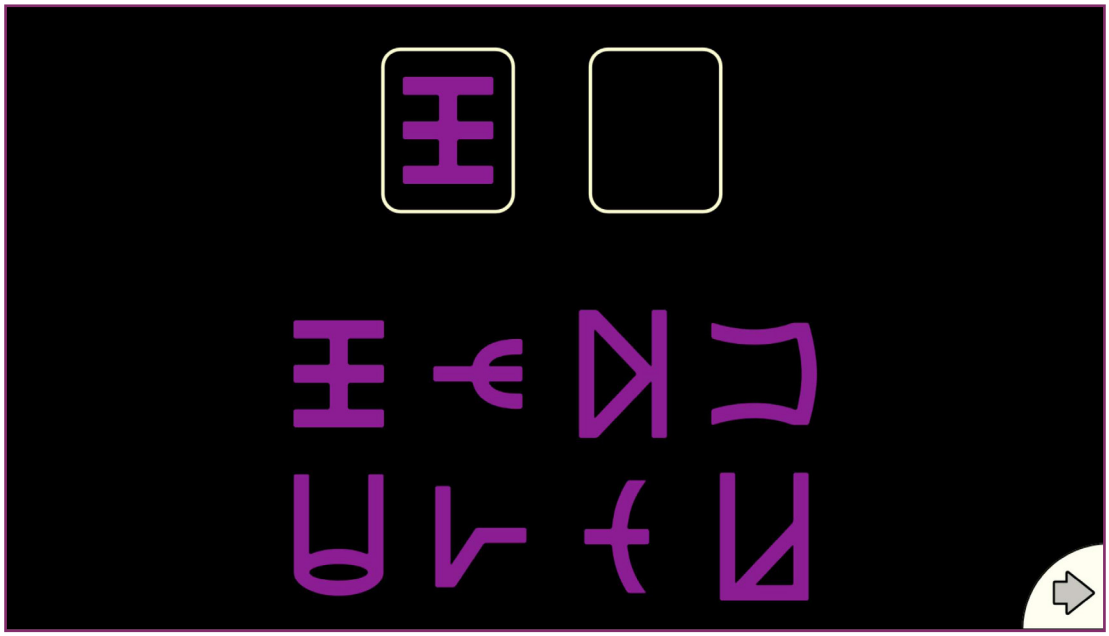


Letters

This is a test of visual sequential memory based on symbol sequence. The scenario is that a girl called Zoe has a secret language and she wants to see if the student can remember her letters. Zoe will show the student some of her letters and the student has to remember them in sequence. The student demonstrates by choosing the correct ones from the full set of letters. Once the student has chosen the symbol(s) they have to confirm their selection by pressing on the green arrow (see Figure 22). The student may change their selection by clicking on the shape which they wish to change and it will be removed. They must then re-select their new choice.

The teacher should ensure that the student knows that the correct order of symbol presentation must be replicated, not simply to remember the symbols shown and replicate them in any order. The test phase is preceded by a practice phase. Throughout the subtest, target stimuli are randomly selected from the complete array of eight symbols shown in Figure 22.

Figure 22. 'Which shape did you see?'



Letter names

This is a test of visual-verbal associative memory in which the student has to remember the name that is given to each symbol in the subtest. The scenario is that a girl called Zoe has a secret language, with 'letters' (some of which are from ***Letters***) that have names. Zoe wants to see if the student can remember the names of the letters. The computer shows two of Zoe's letters and tells the student the name of each. The computer then asks the student to show it one of Zoe's letters, by selecting the symbol that was associated with the name spoken (see Figure 23). Care must be taken to ensure that the student listens carefully and is concentrating on the task. It is not expected that the student will recognise the symbol name since it is a non-word. This is part of the subtest design and is obviously much less dependent on the familiarity with words or the vocabulary experience of the student than it would be if real names were used in the subtest. There is a practice phase followed by a test phase.

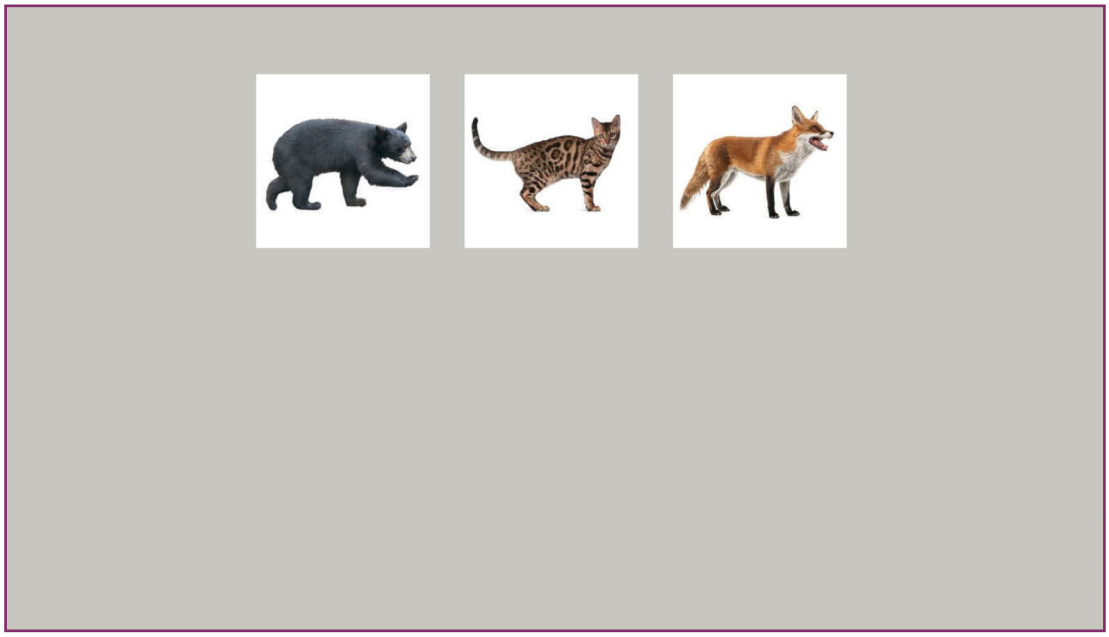
Figure 23. 'Which one is called Baf?'

Races

This is a test of auditory sequential memory using animal names. The scenario is that some animals are going to have races together. The student sees a static image and hears the sound of a group of animals running. To find out the finishing order of the animals (i.e. to find out which animal came first, which one came second, and which one came third) the student has to listen to the computer. The computer tells the student the order by saying the animal names one after the other. The student is required to remember the animal names *in the same order* that the computer says. They then demonstrate their recall by selecting the pictures of the animals in the order that they finished the race (see Figure 24). It is important to ensure that the student does not attempt to predetermine the finishing order based on the pictorial representations (the order they appear on screen), nor on the assumed superiority of one animal over another (e.g. believing that a lion will necessarily beat a tiger). It is important that the student knows the names of all the animals included in the test, although not all students will be administered

all items. The animal names for students aged 4-6 are: elephant, hippopotamus, fox, bear, cat, goat, sheep, donkey, rabbit, squirrel, mouse, panda, tiger, monkey, spider, ant, crab, frog, duck, hen, penguin, robin, horse, camel, reindeer and lion. The animal names for students aged 7 are: elephant, hippopotamus, cat, fox, goat, rabbit, squirrel, mouse, spider, ant, crab, frog, duck, hen, penguin, robin, horse, camel, reindeer, lion, rhinoceros, panda, donkey, monkey, grasshopper, beetle, scorpion, snake, lizard, seagull, pigeon, eagle, parrot, blackbird, kangaroo, buffalo, giraffe, zebra and tiger.

Figure 24. 'Choose which one came first, then second, then third'



Particular care must be taken with this subtest to ensure that the student knows that they must remember the spoken animal names and reproduce them in the correct order. Younger students may not fully understand terms such as 'order', 'first', 'second', 'third', or 'fourth', so re-expression of the task requirements may aid comprehension. In addition, providing examples for the student will aid understanding (ensure that the animals chosen are not the same as those in the subtest). Cueing the child to listen to the specific moment of the memory element will also help. This may take the form of waiting until the computer says its cueing prompt of 'the order that they finished in was'. At this point the teacher may reinforce this cue with their own, for example they may simply point to the computer screen or say a phrase such as 'remember these', 'listen carefully', 'listen now', 'listen'. Again, the practice level allows the student to make mistakes and have subsequent attempts before the test begins and the teacher may reinforce the task requirements during this process.

Rhymes

This is a test of phonological awareness, involving detection of rhyme (in the case of children aged 4–6 years) and rhyme and alliteration (in the case of children aged 7 years).

The scenario presented to students younger than 7 years old is that the computer will display some pictures which have names. Some of the names rhyme (sound the same at the end). If the student already knows what rhymes are, you can quickly progress to testing. If the student does not know what a rhyme is then the teacher may provide examples of rhymes. The teacher may emphasise the rhyming end sounds during the CoPS demonstration and practice phases. After no more than a few examples, testing should commence, whereupon the student should not be given the benefit of any repetition or emphasis from the teacher.

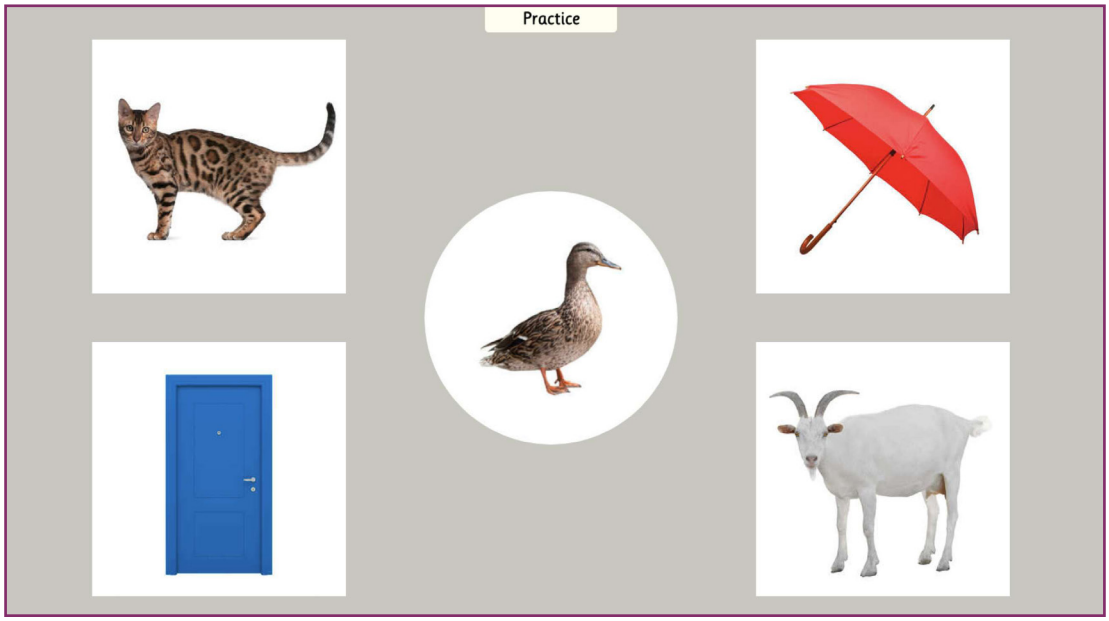
For students aged 7 years a similar scenario can be used for the first part of this subtest, after modification to ensure it is age appropriate. However, the second half of the subtest for the older students includes items which alliterate rather than rhyme. Instructions should be modified for these different subtest items. Such instructions may be in the form of: 'Instead of words sounding the same at the end, they will sound the same at the beginning. Listen very carefully' (see Figure 26).

It is possible that the teacher may feel that the student will not be very successful at this subtest even after they have explained the task personally. Do not worry about this and proceed with testing as normal. This is not a problem since the subtest has been shown to be valid and reliable adhering to these test principles. Simply try to encourage the student to complete the test in the best way they can.

Note that each of the rhyming and alliterative items include a semantic distracter (see Figure 25). This is a picture which has some meaningful link to the 'to be rhymed with' item but its name does not rhyme. So, in the example given in the figure the semantic distracter to the 'boat–coat' rhyme is 'boat-river'. If the student cannot rhyme with confidence, then they may tend to select the semantic distracter.

Figure 25. An example of a rhyming test item (boat–coat)

Figure 26. An example of an alliterative item (duck–door)

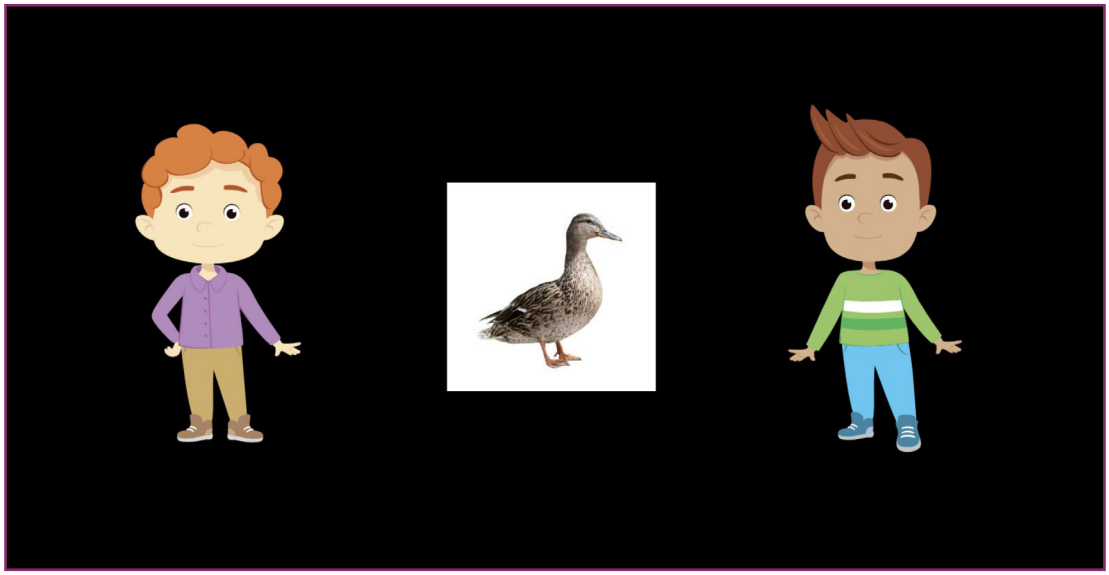


Wock

This is a test of auditory discrimination. The scenario is that two children are learning some new words. The computer shows a picture of an object and says its name. Then the two characters will try to say the word, one after the other. The student has to listen very carefully and decide which of the characters says the word properly (correctly). The student tells the computer which one said the word correctly by selecting that character (see Figure 27).

Care must be taken to ensure that the student listens very carefully to the spoken words. This process can easily be disrupted by excessive or sudden noise, so care must be taken to minimise this type of influence. The practice level provides the student the opportunity to become familiar with the task before the test begins.

Figure 27. The duck–buck discrimination item



Clown

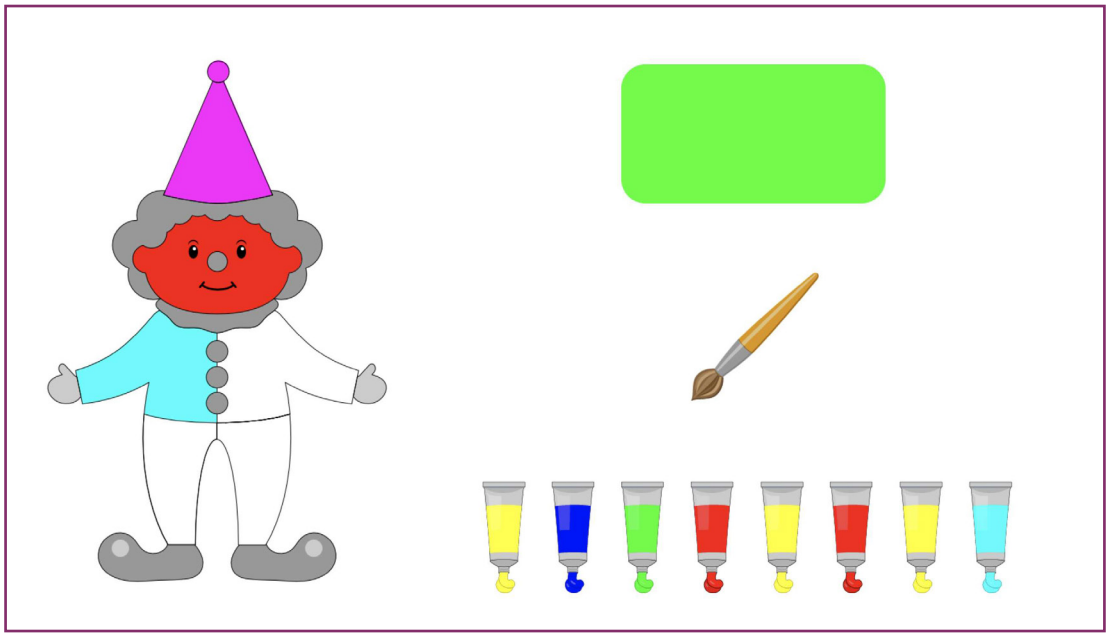
The ninth subtest (***Clown***) was added to CoPS in order to identify students with poor colour discrimination or colour 'blindness'. This is not because colour discrimination is a predictor of literacy attainment, but because performance on two CoPS tests (***Crayons*** and ***Toybox***) may be affected by poor colour discrimination. Approximately 7.5% of males and less than 1% of females are colour blind, which reflects a sex-linked recessive inheritance. The colour discriminations tested in ***Clown*** are:

- Yellow
- Red
- Purple
- Green
- Light Blue
- Dark blue

These are the colours used in ***Toybox*** and ***Crayons***. Of these colours, the most likely confusion in a student who is colour blind will be when trying to distinguish red and green.

The task is to paint sections of the clown with the colours indicated, by selecting the appropriate coloured paint tube in the row at the bottom of the screen – the range of colours in this display changes each time. ***Clown*** may be regarded as a supplementary subtest (rather than a core subtest). In cases where students have scored low on either ***Crayons*** and/or ***Toybox***, ***Clown*** should be administered; otherwise it is optional. However, because ***Clown*** is a very easy subtest for most students to do, many teachers use it as an introduction to the CoPS subtests, especially for younger students in the age range.

Figure 28. 'Paint the clown'



Interpreting CoPS profiles

Understanding CoPS scores

For each CoPS subtest, results are calculated automatically and are shown both for accuracy (black dots on the report) and speed (blue dots on the report). Of these, accuracy is usually the most important indicator. CoPS results for both accuracy and speed on each subtest are given as Standard Age Scores. Standard Age Scores, like IQ, are usually expressed with a mean of 100 and a standard deviation of 15. These scores reflect the student's performance compared to those of the norm referenced group, which is based on the student's age, in three-month age bands from 4:0 up to 7:11.

Any test score is only an estimate of the student's ability, based on their performance on a particular day. Performance on any test can be affected by several factors. The CoPS report provides confidence bands, which give an indication of the range within which a student's score lies. The dot on each subtest row within the table represents the student's SAS and the horizontal line represents the 90% confidence band. The shaded area shows the average score range. 90% confidence bands are a very high-level estimate; if the test were taken again, we would expect the score to fall within this range 90% of the time.

Accuracy scores

How low must a CoPS subtest result be before the teacher should be concerned about the student's performance? Put another way: what is the critical cut-off point or threshold that can be used when deciding whether or not a given student is 'at risk'? Unfortunately, this is not a question that can be answered in a straightforward fashion, because much depends on other factors. These include: (a) the particular CoPS subtest under consideration (some subtests are more highly predictive of later literacy difficulties than others), (b) whether the results of other CoPS subtests confirm or disconfirm the result being examined, and (c) the age of the student being tested.

The Threshold of Concern

Traditionally, a score which falls below an SAS of 85 (which is below one standard deviation below the mean) is by definition significantly below average and thus indicates an area of weakness, which requires some intervention. However, as stated at the start of this chapter, any test score is only an estimate of the student's ability, based on their performance on a particular day. As there is some error in any test score, those test scores in the borderline range (i.e. just above SAS 85) could potentially represent 'true scores' that are within the 'at risk' range.

Therefore, the CoPS report identifies SAS scores of 88–94 as being 'Slightly below average' and SAS scores of 75–87 as 'Below average'. As such, action is recommended where SAS scores are in either of these ranges and the CoPS report will refer the tester to the Indications for Action table on the GL Ready Support website (www.glreadysupport.com), where appropriate. Where there is strong confirmation (e.g. a number of related subtests below an SAS of 88) then the assessor can be convinced that concern is appropriate.

The Threshold of Risk

On the other hand, where a student is scoring below a Standard Age Score of 75 on any subtest (near or below two standard deviations below the mean), this generally indicates a serious difficulty and should always be treated as diagnostically significant. Usually this will be a strong indication that a student is at risk of later literacy and/or numeracy difficulties. Remediation by way of training will often be required as well as a differentiated approach to basic skills teaching. The CoPS report identifies SAS scores below 75 as being 'Very low' and will refer the tester to the Indications for Action table on the GL website. Again, where there is strong confirmation (e.g. a number of related subtests below SAS 75) then the assessor can be even more confident about the diagnosis.

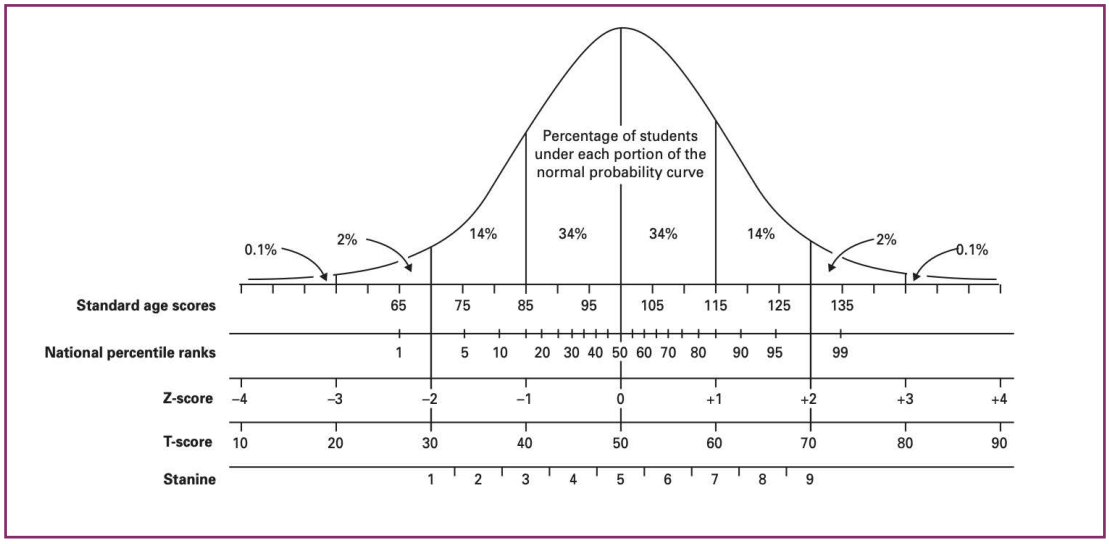
Additional scores

The CoPS reports also provide Stanine scores (ST), National Percentile Ranks (NPR), T-Scores and Z-Scores:

- The Stanine places the student's score on a scale of 1 (low) to 9 (high) and offers a broad overview of performance.
- The National Percentile Rank relates to the SAS score and shows the percentage of students obtaining a certain score or below. An NPR of 50 is average since 50% of students obtained an SAS of 50 or below. An NPR of 5 indicates that a student's score is within the lowest 5% of the nationally representative sample and an NPR of 95 means that a student's score is within the highest 5% of the national sample.
- T-scores have a mean of 50 and a Standard Deviation (SD) of 10, so a T-score of 40 is one SD below the mean and a T-score of 60 is one SD above the mean. 68% of T-scores would fall within the 40–60 range, so a T-score below 40 would be considered below average and a T-score above 60 would be considered above average.
- Finally, Z-scores show us the student's score in standard deviation units, with a mean of 0 and an SD of 1. So, a Z-score of -1.0 would indicate that the student's score is one SD below the mean and a Z-score of +1.0 would indicate that the student's score is one SD above the mean.

The relationships between these different scores are shown in Figure 29.

Figure 29. Relationship between scores



Differences between subtests

Some CoPS subtests are more highly predictive of later literacy difficulties than others. For example, ***Races*** and ***Rhymes*** (given at age 5 years) are the CoPS subtests which most consistently show the best correlation with literacy at 6 years 6 months and 8 years. After ***Races*** and ***Rhymes***, ***Wock*** shows the next highest correlation, but higher at 6 years 6 months than at 8 years, which suggests that the importance of auditory discrimination in reading development (although still significant) decreases somewhat during that period. However, although this is probably true of readers in general, auditory discrimination remains an important factor for poorer readers and most of those who are dyslexic. The next highest correlations are produced by ***Crayons*** and ***Rabbits***, with ***Letters*** having a higher correlation at 6 years 6 months than at 8 years. Again, this latter finding suggests that for most readers simple sequential memory for letter shapes as a componential factor in reading declines in importance over that period, although it will still remain significant for the poorer readers and many dyslexic students. The associative (as opposed to sequential) memory tasks (***Toybox*** and ***Letter names***) showed the lowest (although still statistically significant) correlation with later reading ability. Differential predictive efficacy is probably due to quite different factors operating. ***Toybox*** is quite easy for most children in the 4 to 7 year old range, whereas ***Letter names*** is much more difficult. In fact, many dyslexic adults cannot do ***Letter names*** very well. Of course, the results have been standardised to permit comparison between different subtests and with the population of students of that age. Nevertheless, it was important to include these two subtests in the CoPS suite because otherwise there would not have been any measures of associative memory for the teacher to rely on. Particularly in the case of a student who has difficulties with sequential memory – i.e. keeping those letters and sounds in the right order – it is important for the teacher to know whether associative memory is intact. If the student's scores on ***Toybox*** and/or ***Letter names*** are satisfactory, then at least the teacher knows that the student should be able to cope with the memorisation of basic associations (e.g. between letters and sounds). Another reason for including ***Toybox*** in CoPS is that it has a high correlation with later numeracy skills.

Speed scores

Speed scores are shown on the report by the blue dots. A high speed score is one in which the student completes the subtest more quickly than average (or attempts a higher number of items within the 90-second test phase on ***Toybox***). Note that scores are not shown on the report if the speed score exceeds 5 SDs from the median speed score for that subtest.

Speed results can be useful to the teacher in a number of ways. Broadly, the teacher should look at:

- the overall pattern of speed results
- speed scores for individual subtests

The overall pattern of speed results

The overall pattern of speed results from all the subtests for an individual student can tell the teacher whether the student is generally fast, average or slow at carrying out the CoPS subtests. However, speed results inevitably show wide variability between children and when interpreting CoPS, speed scores are not nearly as important as accuracy scores. Students with Attention Deficit Hyperactivity Disorder (ADHD) tend to be relatively fast and students with developmental co-ordination disorder (dyspraxia) tend to be rather slow. Fast speed, when associated with low accuracy, may indicate ADHD, but not necessarily. In such circumstances it is likely that the student has been rushing some of the tasks, or perhaps responding impulsively. Whenever there is a significant negative correlation between speed and accuracy (i.e. fast speed being linked with low accuracy, and slow or average speed being linked with average or high accuracy), the data should be regarded as suspicious.

Speed scores for individual subtests

Observation of speed scores for individual subtests usually enables the teacher to check whether the student has approached the task carefully enough for the accuracy score to be relied upon. Conscientious use of the CoPS Comments Sheet when testing will also help the teacher to resolve cases where it appears that the student was unwell, inattentive, distracted, or poorly motivated. Obviously, if a student has a number of low accuracy scores coupled with high speed scores for those same subtests, it strongly suggests that the student has simply been doing the subtest too quickly. If he or she slowed down to a more reasonable speed, then the accuracy score might then be within the average range. If the teacher suspects that this is what has happened, then it would be a legitimate reason for repeating the subtest(s) in question. On the other hand, if the student has a high speed score coupled with an average or above-average accuracy score for that particular subtest, then the teacher has no cause for worry.

It is important to appreciate that different students can all achieve similarly fast speeds, but for quite different reasons. Correspondingly, different students can all achieve fairly slow speeds, but for equally different reasons. Speed scores can sometimes reflect personality factors. Some students are by temperament slow, meticulous and careful, others are fast, impetuous and careless. Some students are slow and still fail to achieve high accuracy, and a few are surprisingly fast but achieve high accuracy throughout.

Case studies showing fast response speeds

Occasionally, a student who is consistently a fast responder shows some low accuracy scores. In such a case, even though there is a big discrepancy between the speed scores (high) and the accuracy scores (low), the accuracy scores may still be relied upon, especially if there is good confirmation from other CoPS subtests.

An example of this is given in Figures 30a and 30b, which shows CoPS scores for Adam, who is nearly six. He displayed consistently poor accuracy scores for the visual tests, but average or above-average scores for the auditory tests. All speed scores were high. Even though he was quite bright (WISC-V Full Scale IQ 123) and despite being in school for about eighteen months, he was making abysmal progress in reading and writing. Although he tried very hard, he could not remember letter shapes or visual word patterns very well. His father once commented, 'Adam learns with his ears'. However, he had slight hyperactive tendencies and was orally extremely fluent, so his teacher had assumed that he just needed to settle down and concentrate better and then he would begin to learn without any special or individualised teaching. In fact, CoPS indicated that he was dyslexic (a diagnosis later confirmed in full psychological assessment) and only when he received appropriate teaching using a structured phonic approach, did he begin to make significant improvement. In Adam's case, although he did obtain scores on some tests which showed a large discrepancy between accuracy and speed, high speed scores were normal for him and so did not diminish the validity of his accuracy scores.

Figure 30a. Case study – Adam

CoPS Individual Report

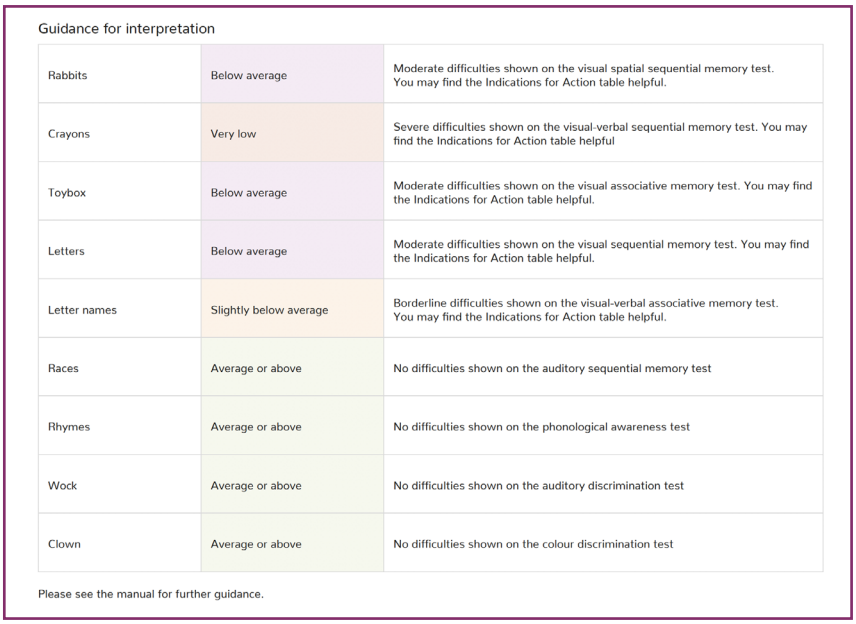
Name	Adam Jenson
Student ID	AJ12345
Date of birth	7th October 2013
Testing date range	4th September 2019 - 6th September 2019

Subtest	Date of subtest	Age at test (yrs:mths)	Standard age score	Standard age score (with 90% confidence bands) 60 70 80 90 100 110 120 130 140	ST	NPR	T-score	Z-score
Visual spatial sequential memory (Rabbits)	06/09/19	05:10	85		3	16	40	-1.00
Visual-verbal sequential memory (Crayons)	04/09/19	05:10	67		1	1	28	-2.20
Visual associative memory (Toybox)	05/09/19	05:10	83		3	13	39	-1.13
Visual sequential memory (Letters)	06/09/19	05:10	80		2	9	37	-1.33
Visual-verbal associative memory (Letter names)	06/09/19	05:10	93		4	32	45	-0.47
Auditory sequential memory (Races)	05/09/19	05:10	106		6	66	54	0.40
Phonological awareness (Rhymes)	05/09/19	05:10	108		6	70	55	0.53
Auditory discrimination (Wock)	04/09/19	05:10	114		7	82	59	0.93
Colour discrimination (Clown)	04/09/19	05:10	99		5	47	49	-0.07

PLEASE NOTE that the Standard Age Score (SAS) shown in the chart only applies to students' accuracy in the tests, not their speed.

Accuracy
Speed

Figure 30b. Case study – Adam



Guidance for interpretation

Rabbits	Below average	Moderate difficulties shown on the visual spatial sequential memory test. You may find the Indications for Action table helpful.
Crayons	Very low	Severe difficulties shown on the visual-verbal sequential memory test. You may find the Indications for Action table helpful
Toybox	Below average	Moderate difficulties shown on the visual associative memory test. You may find the Indications for Action table helpful.
Letters	Below average	Moderate difficulties shown on the visual sequential memory test. You may find the Indications for Action table helpful.
Letter names	Slightly below average	Borderline difficulties shown on the visual-verbal associative memory test. You may find the Indications for Action table helpful.
Races	Average or above	No difficulties shown on the auditory sequential memory test
Rhymes	Average or above	No difficulties shown on the phonological awareness test
Wock	Average or above	No difficulties shown on the auditory discrimination test
Clown	Average or above	No difficulties shown on the colour discrimination test

Please see the manual for further guidance.

Consider, on the other hand, CoPS scores for Peter, which are shown in Figures 31a and 31b. In Peter's report we notice that the normal process of interpretation is confounded by a high negative correlation between speed and accuracy, where tasks that have low accuracy scores have been attempted far too quickly. By contrast, those subtests which have average accuracy scores have been attempted at speeds within the average range. This inconsistency is also apparent if one attempts to interpret Peter's profile of accuracy scores. Thus, auditory discrimination (***Wock***) appears poor, but nevertheless Peter has still managed an average performance on ***Rhymes***, ***Races*** and ***Letter names***, all of which demand good auditory discrimination and listening skills, which is clearly contradictory. Similarly, ***Rabbits*** gives a very poor score, suggesting visual sequential memory problems, but ***Crayons*** is satisfactory, which appears to contradict this view (although it must be acknowledged that ***Rabbits*** and ***Crayons*** do assess somewhat different aspects of visual sequential memory, so it is not necessarily an inconsistent finding). However, some younger students, especially if they have attempted computer games of older siblings, erroneously assume that the only approach to all computer games is to 'shoot everything in sight as quickly as possible'. They tend to point and click without really thinking about what they are doing. The recommendation with Peter would therefore be to retest, explaining to him that he must think about the tasks carefully and must not rush them.

Figure 31a. Case study – Peter

CoPS Individual Report

Name	Peter Reynolds
Student ID	PR12345
Date of birth	18th March 2013
Testing date range	6th September 2019 - 10th September 2019

Subtest	Date of subtest	Age at test (yrs:mths)	Standard age score	Standard age score (with 90% confidence bands) 60 70 80 90 100 110 120 130 140	ST	NPR	T-score	Z-score
Visual spatial sequential memory (Rabbits)	10/09/19	06:05	70		1	2	30	-2.00
Visual-verbal sequential memory (Crayons)	06/09/19	06:05	99		5	47	49	-0.07
Visual associative memory (Toybox)	09/09/19	06:05	81		2	10	37	-1.27
Visual sequential memory (Letters)	10/09/19	06:05	85		3	16	40	-1.00
Visual-verbal associative memory (Letter names)	10/09/19	06:05	97		5	42	48	-0.20
Auditory sequential memory (Races)	09/09/19	06:05	96		4	39	47	-0.27
Phonological awareness (Rhymes)	09/09/19	06:05	98		5	45	49	-0.13
Auditory discrimination (Wock)	06/09/19	06:05	81		2	10	37	-1.27
Colour discrimination (Clown)	06/09/19	06:05	101		5	53	51	0.07

PLEASE NOTE that the Standard Age Score (SAS) shown in the chart only applies to students' accuracy in the tests, not their speed.

Accuracy
Speed

Figure 31b. Case study – Peter

Guidance for interpretation

Rabbits	Very low	Severe difficulties shown on the visual spatial sequential memory test. You may find the Indications for Action table helpful
Crayons	Average or above	No difficulties shown on the visual-verbal sequential memory test
Toybox	Below average	Moderate difficulties shown on the visual associative memory test. You may find the Indications for Action table helpful.
Letters	Below average	Moderate difficulties shown on the visual sequential memory test. You may find the Indications for Action table helpful.
Letter names	Average or above	No difficulties shown on the visual-verbal associative memory test
Races	Average or above	No difficulties shown on the auditory sequential memory test
Rhymes	Average or above	No difficulties shown on the phonological awareness test
Wock	Below average	Moderate difficulties shown on the auditory discrimination test. You may find the Indications for Action table helpful.
Clown	Average or above	No difficulties shown on the colour discrimination test

Please see the manual for further guidance.

General issues in interpretation

Adopting a 'problem solving' approach

Interpretation of CoPS results requires some thought. CoPS is a complex instrument and a careful, problem-solving approach is necessary. Teachers should resist the temptation to seek instant answers but instead should get used to considering a number of essential issues before reaching a conclusion. At first this approach may seem unfamiliar and a little slow, but with experience the task becomes quicker and easier. It is important not to lose sight of the fact that the interpretation (particularly in the case of the 'at risk' student) is likely to have a significant effect on the student's education, and such decisions should not be made lightly or hurriedly.

A brief guide to interpretation is given in Brief pointers for interpretation of results. This may be used as a starting point for interpretation but will not give sufficient information to enable a proper interpretation to be carried out.

In this section, unless otherwise specified, the terms 'scores' or 'results' should be taken to mean measures of the accuracy of the student's performance. In addition, however, CoPS gives the teacher information on the speed of the student's responses.

Consistent with sound educational practice in general, and with the *Special Educational Needs and Disability Code of Practice: 0-25 years* (2014) in particular, teachers should not regard assessment as a single event, but rather as a continuing process. CoPS results should be considered together with other information about the student, including formal test data and informal observations made by the teacher. Strategies for intervention should not be regarded as set in stone but should be flexible and responsive to a student's progress (or lack of progress). When reviewing a student's progress, it may be helpful to reassess the student using CoPS, or, if the student is between 8 and 11 years by this time, LASS 8–11.

Guidance for interpretation table

Figure 32. Example of the Guidance for Interpretation section of the report

Guidance for interpretation

Rabbits	Average or above	No difficulties shown on the visual spatial sequential memory test.
Crayons	Average or above	No difficulties shown on the visual-verbal sequential memory test.
Toybox	Below Average	Moderate difficulties shown on the visual associative memory test. You may find the *Indications for Action* table helpful.
Letters	Average or above	No difficulties shown on the visual sequential memory test.
Letter names	Average or above	No difficulties shown on the visual-verbal associative memory test.
Races	Average or above	No difficulties shown on the auditory sequential memory test.
Rhymes	Slightly below average	Borderline difficulties shown on the phonological awareness test. You may find the *Indications for Action* table helpful.
Wock	Very Low	Severe difficulties shown on the auditory discrimination test. You may find the *Indications for Action* table helpful.
Clown	Below Average	Moderate difficulties shown on the colour discrimination test. You may find the *Indications for Action* table helpful.

The Guidance for Interpretation table on the report provides enhanced guidance for interpreting each student's results. Match the guidance to the CoPS Indications for Action Table found on the GL Ready Support website (www.glreadysupport.com). Interpreting the results from CoPS requires interpretation of the overall profile, and not just consideration of each individual subtest separately. Please see the Case Studies for further guidance on interpreting the whole profile.

Identifying dyslexia

What is dyslexia?

It is not possible here to give a detailed account of the nature of dyslexia. Readers are recommended to consult Reid (2016).

In 2007, the British Dyslexia Association adopted the following definition of dyslexia:

> *'Dyslexia is a specific learning difficulty that mainly affects the development of literacy and language related skills. It is likely to be present at birth and to be life-long in its effects. It is characterised by difficulties with phonological processing, rapid naming, working memory, processing speed, and the automatic development of skills that may not match up to an individual's other cognitive abilities. It tends to be resistant to conventional teaching methods, but its effect can be mitigated by appropriately specific intervention, including the application of information technology and supportive counselling.'*

The rationale behind CoPS is the identification of cognitive precursors of dyslexia and other problems in the development of literacy and numeracy, which the teacher can use (together with other information about the student) to formulate flexible intervention strategies with which to tackle the problems before they precipitate outright failure (see Singleton, 2002, 2003). This is entirely consistent with the Special Educational Needs and Disability Code of Practice: 0-25 years (2014) which stresses the importance of early identification of special educational needs.

Characteristics of dyslexia

Dyslexia is a variable condition and not all students with dyslexia will display the same range of difficulties or characteristics. Nevertheless, the following characteristics have been the most widely noted in connection with dyslexia.

- A marked inefficiency in the *working or short-term memory system* (Beech, 1997; Gathercole et al., 2006; Jeffries and Everatt, 2004; McLoughlin, Fitzgibbon and Young 1993; Rack, 1997; Thomson, 2001). Memory difficulties may result in problems of retaining the meaning of text (especially when reading at speed), failure to marshal learned facts effectively in examinations, disjointed written work or an omission of words and phrases in written examinations, because students have lost track of what they are trying to express.
- Inadequate *phonological processing abilities*, which affects the acquisition of phonic skills in reading and spelling so that unfamiliar words are frequently misread, which may in turn affect comprehension. Not only has it been clearly established that phonological processing difficulties are seen in the majority of children with dyslexia (Snowling, 2000; Catts et al., 2005), but research has also indicated that this occurs in many adults with dyslexia (Beaton, McDougall and Singleton, 1997a; Ramus et al., 2003).

CoPS results and dyslexia

The chapters that follow show how CoPS results can be used very effectively to identify dyslexia in most cases. Although the composition of the CoPS subtests was determined by statistical analysis of longitudinal research data (see *Research and statistical information*), it can be seen that CoPS nevertheless seems to fit the phonological deficit model more closely than it fits other alternative models of dyslexia. Hence it should be expected that CoPS will be at its most effective in identifying students with the 'classic' form of dyslexia – which includes by far the majority of the group – characterised by cognitive difficulties that most notably affect the mapping of graphemes onto phonemes. But CoPS is actually rather broader in its scope than first might meet the eye. Since it includes a number of key visual memory measures, CoPS is also adept at picking up 'atypical' cases of dyslexia where, instead of phonological deficits predominating, instead, the chief problem concerns visual memory. Finally, a valuable advantage of including the separately normed speed scores in CoPS is that speed of processing factors can also be taken into account. Thus, in various ways CoPS encompasses a wide range of psychological correlates of dyslexia which have theoretical support from different camps. As an all-round screening and assessment tool, therefore, it has substantial theoretical validity as well as excellent predictive validity, the latter having been established in the original longitudinal study.

Must children be labelled?

Labels for different special educational needs (especially the label 'dyslexia') have been controversial for some years. The *1981 Education Act*, which had encouraged a non-labelling approach to SEN, was superseded by the *1993 Education Act*, and the *Code of Practice for the Identification and Assessment of Special Educational Needs* (1994), which recognised labelling of SEN categories, including the category 'Specific Learning Difficulties (Dyslexia)'.

However, the 1994 *Code of Practice* was superseded by the 2001 *SEN Code of Practice*, which again moved away from use of labels and focused instead on areas of need and their impact on learning (DfES, 2001). The latest *SEND Code of Practice* (DfE, 2014) reiterates that 'The purpose of identification is to work out what action the school needs to take, not to fit a pupil into a category… The support provided to an individual should always be based on a full understanding of their particular strengths and needs and seek to address them all using well-evidenced interventions targeted at their areas of difficulty' [SEND Code of Practice, 2014].

Many teachers are justifiably worried that labelling a student – especially at an early age – is dangerous and can become a self-fulfilling prophecy. Fortunately, the CoPS approach does not demand that students be labelled, instead it promotes the awareness of students' individual learning abilities and encourages taking these into account when teaching. Since the CoPS report indicates a student's cognitive strengths as well as limitations, it gives the teacher important insights into their learning styles. In turn, this provides essential pointers for curriculum development, for differentiation within the classroom, and for more appropriate teaching techniques. Hence it is not necessary to use labels such as 'dyslexic' when describing a student assessed with CoPS, even though parents may press for such labels.

By identifying cognitive strengths and weaknesses it is easier for the teacher to differentiate and structure the student's learning experience in order to maximise success and avoid failure. The intention is that students who would be likely to fail and may subsequently attract the label 'dyslexic', never reach that stage.

Screening or assessment?

CoPS can be used both for routine screening of students who have no known difficulties in literacy and/or numeracy. It can also be used equally well to assess students who are known to have difficulties in literacy and/or numeracy or who are suspected of having dyslexia (e.g. because of a family history of the condition or because the students has experienced problems in language development such as pronunciation difficulties). The former approach has the benefit of possibly identifying students who are at risk of dyslexia that the teacher was totally unaware of. In such cases, low-key early intervention can make a remarkable difference to the student's development and prevent many agonies that would likely have occurred later. Whichever of these two approaches is adopted, the processes of interpretation of CoPS results are essentially the same.

When tests are used for screening, what is critical is that they can accurately discriminate between those who do and who do not possess the target characteristic (in this case, dyslexia).

Inaccuracy in screening is reflected in misclassifications, either 'false negatives' (e. g. cases where the test has inaccurately classified a student as not having dyslexia when actually they do) and 'false positives' (e. g. cases where the test has inaccurately classified a student as having dyslexia when in reality they do not). Singleton, Thomas and Horne (2000) reported a study in which the screening accuracy of CoPS was evaluated in comparison with various other measures. CoPS had an exceptionally low level of false negatives and false positives and performed better than all the alternative measures under consideration. This finding has been used to develop another program, Rapid, which gives an automatic interpretation of results in terms of probability of dyslexia. Results from Rapid can be exported into CoPS, so the two products can be used together effectively both to screen and then to follow up with a full diagnostic assessment where this is necessary for developing teaching strategies.

Essential factors to take into account

Not one test but several

When considering CoPS results, it is important to bear in mind that it is not one test which is being interpreted, but the performance of a student on a number of related subtests. This is bound to be a more complex matter than single test interpretation. Hence the normative information (about how a student is performing relative to other students of that age) must be considered together with the ipsative information (about how that student is performing in certain cognitive areas relative to that same student's performance in other cognitive areas). The pattern or profile of cognitive strengths and weaknesses is crucial.

Things that the computer cannot know

The computer is not all-seeing, all-knowing – nor is it infallible. For example, the computer cannot be aware of the demeanour and state of the student at the time of testing. Most students find the CoPS subtests interesting and show a high level of involvement in the tasks. In such cases the teacher can have confidence in the results produced. Occasionally, however, a few students do not show such interest or engagement and in these cases the results must be interpreted with more caution. Where a student produces a number of low scores a simple first precaution in the interpretative process is to note the date when those subtests were carried out. If it turns out that those subtests were all carried out on the same day, then there is cause for suspicion that some other, non-cognitive factors, are involved. It may be that the student was unwell on that day, or anxious, or simply wanted to be doing what the rest of the class were doing at that time (e.g. at playtime). Or it may be that the adult who was supervising the student was impatient to finish and the student sensed this. Speed (as opposed to accuracy) scores can often indicate if a student was not approaching the tasks with the right amount of application or concentration. Young children can easily become fatigued or bored with a task, and for this reason it is recommended that students should normally only attempt two or three CoPS subtests during a given session. Low accuracy scores with corresponding high speed scores usually suggests that the student was tired, bored, not concentrating properly, found the task too difficult, or for some reason was over-eager to finish. The implications of speed scores are discussed in *Speed scores*.

Cognitive ability not attainment

It is important to remember that the performance being interpreted with CoPS is based on tests of *cognitive ability* rather than *attainment*. Teachers are most familiar with tests of attainment, such as reading, spelling, and mathematics. Assessment of cognitive abilities, however, requires a broader interpretative approach. Although cognitive abilities underlie attainment, other factors are obviously involved in the determination of attainment, such as the student's general motivation towards education and opportunities for learning. CoPS subtests provide a very good prediction of later attainment but cannot provide an infallible prediction because of the intervention of these other factors. Of course, motivation is itself affected by attainment. Students lose interest in activities in which they are failing, and often develop strategies to avoid being exposed to further failure (especially if that failure is public). Consequently, if, for example, two students exhibited identical 'at risk' CoPS results, the one with the poorer motivation would be regarded as being at greatest risk (other things being equal). CoPS cannot measure motivation, but it is important for the teacher to take that factor into account.

Brief pointers for interpretation of results

Table 4 gives some brief pointers for interpretation of results. However, this is only intended as a very general introduction to the interpretation process. Teachers are strongly recommended to consult the relevant chapters on interpretation before drawing final conclusions about a student and formulating teaching plans.

Table 4. Brief interpretation guide to CoPS

Subtest name	**Cognitive skills measured**	**Simplified indications for action** In the case of children with low (less than SAS 85) or very low (less than SAS 75) scores in individual subtests.
Wock	Auditory discrimination (phonemes)	Could be a temporary or non-temporary problem. Refer for hearing assessment – possible glue ear. Auditory discrimination training will be necessary, even after treatment. Other auditory CoPS subtests will be affected – these may need to be re-assessed after treatment. Student will find phonics work difficult (confusions in letter-sound relationships and problems in blending) and may develop an over-reliance on visual strategies in reading – careful structuring and monitoring of phonics activities required. Learning activities should be differentiated to allow for auditory discrimination problems.
Rhymes	Phonological awareness (rhyming/ alliteration)	Check whether there are general auditory problems. Phonological awareness training needed – most students respond well to this, but the dyslexic student may have more persistent problems. Without phonological awareness training, the student will find phonics work difficult and may develop an over-reliance on visual strategies in reading.
Letter names	Visual-verbal *associative* memory (symbols and names)	Compare with the results of ***Races*** and with ***Toybox*** – has the student got a general *associative* memory difficulty or a general auditory/verbal memory difficulty? Check auditory discrimination skills (***Wock***) and phonological awareness (***Rhymes***). Student is likely to have difficulty with basic phonics (especially letter-sound association) which can lead to early discouragement and frustration. Spelling and writing also likely to be a problem. Early start to structured phonics work is recommended with ample practice (overlearning). Multisensory approach is best, building on any visual and kinaesthetic strengths. Auditory/verbal memory training should be helpful.
Races	Auditory *sequential* memory (names)	Compare with the results of the other sequential memory subtests — has the student got a general sequential memory difficulty, or just auditory sequential memory problems? Check auditory discrimination skills (***Wock***) and phonological awareness (***Rhymes***). Student will find phonics work difficult and may develop an over-reliance on visual strategies in reading. Careful structuring and monitoring of phonics activities required, with ample practice (overlearning). Multisensory phonics work is recommended, building on any visual and kinaesthetic strengths. Auditory/verbal memory training should be helpful.

Subtest name	Cognitive skills measured	Simplified indications for action In the case of children with low (less than SAS 85) or very low (less than SAS 75) scores in individual subtests.
Rabbits	Visual spatial *sequential* memory (spatial/ temporal)	Should be compared with the results of the other visual memory subtests and with ***Races***. Does the student have a general *sequential* memory difficulty, a general *visual* memory difficulty or only *visual sequential* memory problems? ***Rabbits*** is the most difficult subtest for the student to encode verbally so it provides a purer measure of *visual* memory skills. The student will have difficulty with visual whole word reading methods. Spelling and writing also likely to be a problem. Visual *sequential* memory training useful. Structured phonics work recommended with ample practice (overlearning). Multisensory approach is best, building on any auditory and kinaesthetic strengths.
Crayons	Visual-verbal *sequential* memory (colours)	Should be compared with the results of the other visual memory subtests. This subtest can be done non-verbally, but most students try to encode the colours verbally, so it can help to identify the student who has difficulty in applying verbal labels and holding them in working memory. Student will have difficulty with visual whole word reading methods. Spelling and writing likely to be a problem. Potential slow reader. Visual *sequential* memory training useful. Structured phonics work recommended with ample practice (overlearning). Multisensory approach is best, building on any auditory and kinaesthetic strengths.
Toybox	Visual *associative* memory and verbal encoding (colour/ shape)	Should be compared with the results of the other visual memory subtests and with ***Letter names***. Does the student have a general *associative* memory difficulty, a general *visual* memory difficulty or only *visual associative* memory problems? Student will have difficulty with visual whole word reading methods. Spelling and writing likely to be a problem. Visual *associative* memory training useful. Structured phonics work recommended with ample practice (overlearning). Multisensory approach is best, building on any auditory and kinaesthetic strengths.
Letters	Visual *sequential* memory (symbols)	Should be compared with the results of the other visual memory subtests (as with ***Rabbits*** and ***Crayons***). Student will have difficulty with visual whole word reading methods. Letter recognition and recall will be hard. Visual *sequential* memory training useful. Spelling and writing likely to be a problem. Structured phonics work recommended with ample practice (overlearning). Multisensory approach is best, building on any auditory and kinaesthetic strengths.
Clown	Colour discrimination	Student can be referred via GP for full assessment of colour blindness. Learning activities should be differentiated to allow for colour discrimination problems. Note that performance on ***Toybox*** and ***Crayons*** will probably be affected.

Interpreting results of the phonological subtests

The phonological subtests are:

- ***Wock*** – assesses auditory discrimination of phonemes
- ***Rhymes*** – assesses phonological awareness

Both of these skills are vitally important for good literacy development, especially for the acquisition of phonic skills, i.e. mapping of letters (graphemes) on to sounds (phonemes).

Wock

Wock assesses *auditory discrimination*. This ability is very important for acquisition of effective phonic skills and for many aspects of learning which depend on oral communication, including ordinary classroom activities. In literacy development, children first have to be able to hear and discriminate the fine differences between speech sounds in order to learn the relationships between those sounds and the letters of the alphabet. The brain learns to discriminate those speech sounds by experience and exposure to good models of speech in the early years.

In the CoPS research project, ***Wock*** correlated significantly with later literacy skills, listening skills and development of ability in phonics. It may therefore be concluded not only that it is a valid indicator but also a good predictor. ***Wock*** given at age 5 correlated with all phonics aspects of the *Middle Infant Screening Test* (MIST) given at age 6:6 (with a significance level of $p<0.01$); and the correlation with the *Word Recognition and Phonics Skills Test* (WRaPS) given at age 8 was 0.73 ($p<0.01$) and with the *Edinburgh Reading Test* at age 8 was 0.44 ($p<0.01$). Stepwise regression analyses showed that ***Wock***, together with ***Rhymes***, were among the best predictor variables. For further information on the statistical evidence see Singleton, Thomas and Leedale (1996) and Singleton, Thomas and Horne (2000).

Causes of poor performance on Wock

Poor performance on ***Wock*** can result from:

(a) Temporary factors:

- The student having a cold or ear infection at the time of testing
- Inattentiveness during testing
- Classroom distractions at the time of testing
- Being assessed in a noisy environment

Obviously if the poor performance is attributable to temporary factors then the solution is to retest the student at an appropriate time.

(b) Non-temporary factors:

- Congenital or acquired hearing impairment
- Lack of experience of the relevant auditory discriminations
- Glue ear
- Difficulty in processing information at the phoneme level

Congenital or acquired hearing impairment

Congenital or acquired hearing impairment can be *conductive* and/or *sensory*. In conductive impairment something impedes the movement of acoustic energy through the outer or middle ear (e.g. a malformation of the ear structure, or build-up of wax). In sensory impairment there is damage to the parts of the hearing mechanism involved in analysing sounds (e.g. through prolonged exposure to loud noise, or neural abnormalities of the auditory system due to maternal *Rubella*). *Conductive* impairments are often fluctuating and can often be rectified by treatment, whereas *sensory* losses are permanent although a hearing aid can help in many cases. Children with good auditory sensitivity for low sound frequencies but who have high-frequency loss are often detected late in childhood. This is because in a one-to-one situation or relatively quiet environment they may appear to hear satisfactorily, but in a noisy environment or typical classroom, many sounds are not heard properly, particularly weak high-frequency consonants (e.g. s, sh, f, th, v).

Lack of experience with English

Phonological discrimination difficulties can also arise in cases where children have had to rely on an inadequate or distorted model of English speech in the home. Children from home backgrounds where English is not spoken or is spoken with a foreign accent may not have had the opportunity to learn certain speech sound discriminations that are important in English. It is important to note that under the *Children and Families Act* (2014) a student must not be regarded as having a learning difficulty or disability solely because the language of the home is different from the language in which he or she is taught [Part 3: Section 20: 4]. Nevertheless, it is important for the teacher to have information on the phonological discrimination skills of students from such home backgrounds, because this pertains critically to the teaching of phonics in English. However, it should not be assumed that all students for whom English is an additional language (EAL) will perform poorly on ***Wock***. Studies of EAL and bilingual students have shown that in many cases they have heightened awareness of speech sounds and may perform very well on ***Wock***. For further information see *Interpreting profiles of students who have English as an additional language*.

Glue ear (Otitis media)

Glue ear (*Otitis media*) is a group of conditions in which there is fluid in the middle ear, often caused by colds or other infections, and which result in conductive hearing loss and, sometimes, earache. It is common in children up to the age of 6 years, but declines steadily in incidence thereafter. It should be suspected in any student who is frequently inattentive, often says 'What?' when asked a question, or who persistently turns up the volume on the television to a level which

other viewers find excessive. Children who suffer from glue ear will not have had good models because the sounds they have heard will have been distorted. The effects on phonological discrimination increase with the severity of the glue ear and the length of time for which it has persisted without effective treatment. Chronic glue ear before the age of three tends to delay speech development in a more pervasive manner. However, although the fundamentals of speech and language are already largely established prior to the age of three, there nevertheless seems to be a period from about 3 years to 7 years of age during which the process of learning to make fine phonological discriminations continues to be quite critical. Consequently, glue ear during this time tends to have more subtle but rather long-lasting effects on language and literacy development, even though no *gross* effects on speech production or reception may be apparent.

Difficulty in processing information at the phoneme level

The predominant theory of dyslexia focuses on the child's difficulty in processing phonological information (Snowling, 2000; Vellutino et al., 2004; Saksida et al., 2016). There is some evidence that this type of difficulty can also affect speech perception (Chiappe et al., 2001; Hurford and Sanders; 1990; Liu et al., 2009; Manis et al, 1997; McBride-Chang, 1996; Zhang and McBride-Chang, 2010). This is not altogether surprising, because when we perceive speech we have to store the stream of information in short-term memory in the form of a phonological code while we process it. In the ***Wock*** subtest, students have to hold two very similar words in short-term memory and then decide which one is the same as the target word, which is also held in short-term storage. It can be seen that if the student experiences an inherent difficulty in generating phonological codes or in phonological information processing (i.e. is dyslexic), this is liable to affect phonological discrimination tasks, such as ***Wock***.

Treatment for auditory discrimination difficulties

Students who have auditory discrimination difficulties or who show signs of glue ear should always be referred for medical examination if this has not already been done. Medical treatment (e.g. antibiotics to treat infections) or surgical interventions (e.g. draining excess fluid from the middle ear or fitting grommets to facilitate fluid drainage) may result in varying degrees of improvement. Unfortunately, a few children, even with treatment, continue to suffer from intermittent glue ear until adolescence or beyond. In general, however, the problems of glue ear tend to decline (or become less noticeable) as the child gets older. There appear to be various reasons for this – the child develops better resistance to infection, the Eustachian tube that drains the middle ear grows and may be less prone to blockage, or the child develops strategies to compensate for the hearing loss. However, even if the child's hearing is subsequently found to be satisfactory (i.e. pronounced 'normal' following audiometric assessment) it is essential that teachers realise that the student may still experience significant difficulties in discriminating some speech sounds when acquiring phonic skills in reading. This is because the brain has not had the opportunity to learn those discriminations during the critical period. It is the function of ***Wock*** to detect such difficulties.

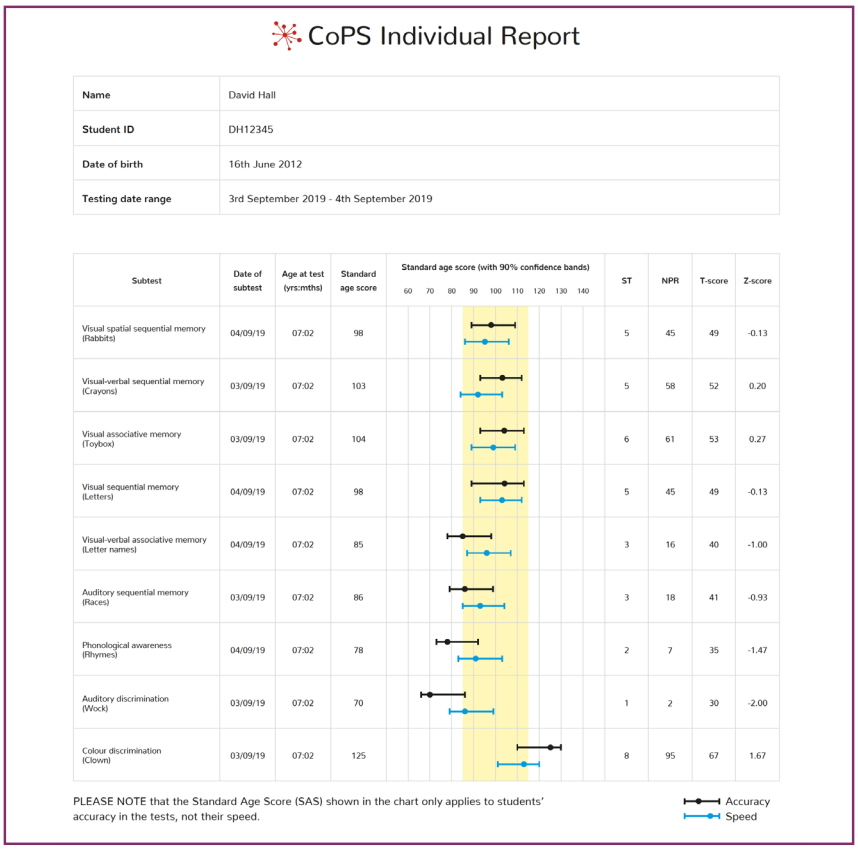
There are many classroom (and home) activities that can be used to develop auditory discrimination, and many of these are also good for promoting phonological awareness. These are described in *Teaching recommendations*.

Case study – auditory discrimination difficulties

An illustration of a case with auditory discrimination difficulties is shown in Figures 33a and 33b. David's phonological awareness (***Rhymes***) and auditory discrimination (***Wock***) skills are very weak, and this also seems to be affecting auditory memory to some extent (***Letter names*** and ***Races***). The recommendations would be (a) referral for hearing assessment (possible glue ear), and (b) regular training in both phonological awareness and auditory discrimination. It would be useful to assess the whole class to see if training could be done on a small group or even whole-class basis, to save time. In reading development, a well-structured multisensory phonic approach would help to avoid auditory confusions, although great care must be taken to ensure that David hears letter sounds and words clearly. If David receives treatment for glue ear, then the CoPS auditory subtests should be repeated at a suitable interval, because it will be necessary to establish whether his low scores on ***Races, Letter names*** and ***Rhymes*** were simply due to his auditory problems or whether they signal other underlying cognitive problems.

Of course, students with auditory discrimination weaknesses will also suffer other impediments to effective learning. In a typical busy classroom they often will not hear, or may misunderstand, the teacher's instructions, and so may carry out the wrong task or waste time waiting for instructions that have already been given. In group work, they often will not hear the speech of other students properly, and so may fail to follow group discussion, which can result in them being implicitly or explicitly excluded from real collaboration. The learning opportunities of these students will consequently be reduced. It is the teacher's job to ensure, as far as possible, that the student with auditory discrimination weaknesses, is not significantly handicapped by these factors. For further discussion of these issues see Watson et al. (1999).

Figure 33a. Case study – David



CoPS Individual Report

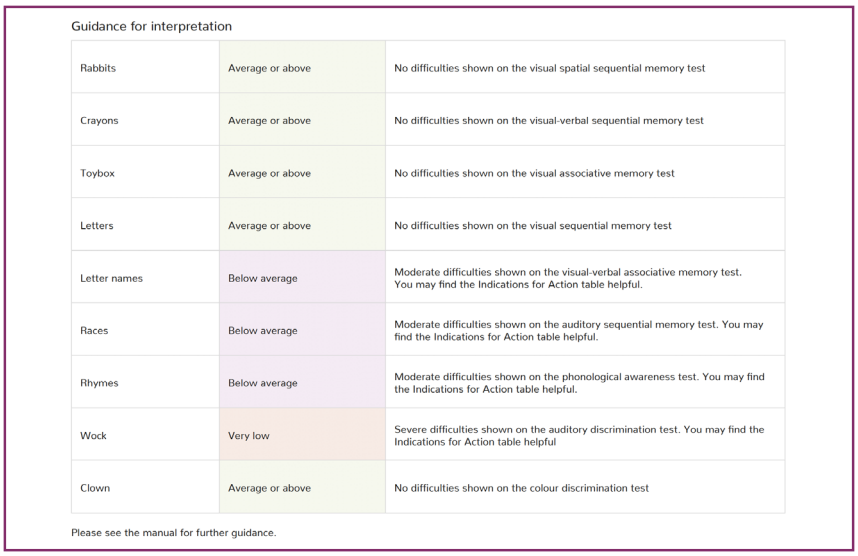
Name	David Hall
Student ID	DH12345
Date of birth	16th June 2012
Testing date range	3rd September 2019 - 4th September 2019

Subtest	Date of subtest	Age at test (yrs:mths)	Standard age score	Standard age score (with 90% confidence bands) 60 70 80 90 100 110 120 130 140	ST	NPR	T-score	Z-score
Visual spatial sequential memory (Rabbits)	04/09/19	07:02	98		5	45	49	-0.13
Visual-verbal sequential memory (Crayons)	03/09/19	07:02	103		5	58	52	0.20
Visual associative memory (Toybox)	03/09/19	07:02	104		6	61	53	0.27
Visual sequential memory (Letters)	04/09/19	07:02	98		5	45	49	-0.13
Visual-verbal associative memory (Letter names)	04/09/19	07:02	85		3	16	40	-1.00
Auditory sequential memory (Races)	03/09/19	07:02	86		3	18	41	-0.93
Phonological awareness (Rhymes)	04/09/19	07:02	78		2	7	35	-1.47
Auditory discrimination (Wock)	03/09/19	07:02	70		1	2	30	-2.00
Colour discrimination (Clown)	03/09/19	07:02	125		8	95	67	1.67

PLEASE NOTE that the Standard Age Score (SAS) shown in the chart only applies to students' accuracy in the tests, not their speed.

Accuracy
Speed

Figure 33b. Case study – David



Guidance for interpretation

Rabbits	Average or above	No difficulties shown on the visual spatial sequential memory test
Crayons	Average or above	No difficulties shown on the visual-verbal sequential memory test
Toybox	Average or above	No difficulties shown on the visual associative memory test
Letters	Average or above	No difficulties shown on the visual sequential memory test
Letter names	Below average	Moderate difficulties shown on the visual-verbal associative memory test. You may find the Indications for Action table helpful.
Races	Below average	Moderate difficulties shown on the auditory sequential memory test. You may find the Indications for Action table helpful.
Rhymes	Below average	Moderate difficulties shown on the phonological awareness test. You may find the Indications for Action table helpful.
Wock	Very low	Severe difficulties shown on the auditory discrimination test. You may find the Indications for Action table helpful
Clown	Average or above	No difficulties shown on the colour discrimination test

Please see the manual for further guidance.

Rhymes

Rhymes assesses *phonological awareness*. The phonological system is the part of language that is concerned with the ways in which sound patterns are used to communicate. As children learn to talk they develop increasingly sophisticated cognitive representations for phonological aspects of speech. They become aware that words can be segmented into syllables (e.g. that 'wigwam' is composed of 'wig' and 'wam'), and that different words can contain similar elements (i.e. similar *onsets* like **w**-ig and **w**-am, or similar *rimes* like w-**ig** and d-**ig**). The importance of this phonological awareness for early literacy development has been very well demonstrated in research (Snowling, 1995; Goswami, 1994, 1991, 2001; Goswami and Bryant, 1990; Rack, 1994; Savage, 2001; Ziegler and Goswami, 2005). Phonological awareness is often assessed by means of an oddity test in which the child has to pick out the one which is different from of list of similar sounding words, e.g. '*mop, hop, tap, lop*'; '*ham, tap, had, hat*' (Bradley and Bryant, 1983. Bradley, 1980; Goswami, 2012). Many teachers and researchers have observed that the oddity test is difficult to give, especially with very young students. Students tend to forget the items and may fail for reasons other than poor phonological awareness. ***Rhymes*** does not suffer from this limitation, because it incorporates pictures which help the student to remember the items.

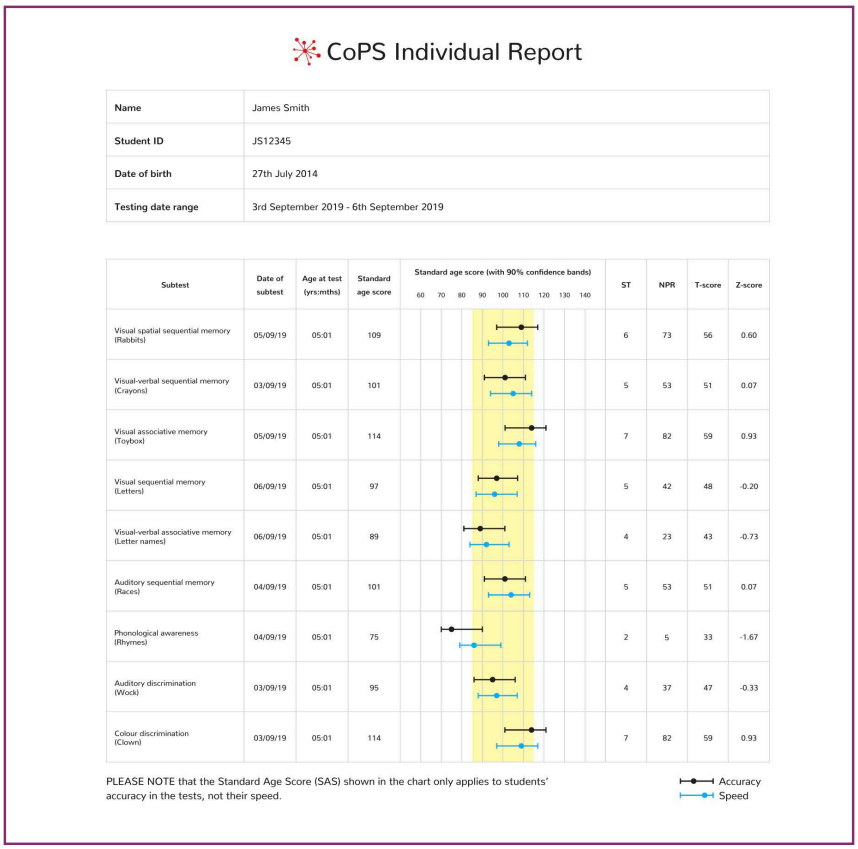
Dyslexic children are known generally to have poor phonological skills (Rack, Snowling and Olson, 1992; Holligan and Johnston, 1988). In the *phonological deficit model of dyslexia* (Hulme and Snowling, 1991; Snowling, 1995, 2000) it has been hypothesised that the status of children's underlying phonological representations determines the ease with which they learn to read, and that the poorly developed phonological representations of dyslexic children are the fundamental cause of their literacy difficulties. In the CoPS research ***Rhymes*** was found to be a highly significant predictor of later literacy skill. ***Rhymes*** (given at age 5) correlations with literacy skills were 0.54 (*BAS Word Reading* at 6:6), 0.58 (*Macmillan Individual Reading Analysis* (MIRA) at 6:6), 0.52 (*Edinburgh Reading Test* at 8:0), 0.45 (*Word Recognition and Phonics Skills Test* (WRaPS) at 8:0), and 0.50 (*BAS Spelling* at 8:0). All except WRaPS ($p<0.05$) were significant at the $p<0.01$ level. ***Rhymes*** also correlated with all phonics aspects of the *Middle Infant Screening Test* (MIST) given at age 6:6 ($p<0.01$). Stepwise regression analyses showed that ***Rhymes***, together with ***Wock***, were among the best predictor variables. For further information on the statistical evidence see Singleton, Thomas and Leedale (1996) and Singleton, Thomas and Horne (2000).

Case study - poor phonological awareness

The CoPS profile of James, aged 5, shows good or reasonably satisfactory scores in all areas except ***Rhymes***, which shows an SAS of 75 (see Figures 34a and 34b). His visual memory skills are fairly strong. Further investigation by his teacher showed that he had no idea about rhyming or alliteration or syllable segmentation at all. He could not generate any rhymes and did not recognise common nursery rhymes. Although his auditory discrimination skills were not all that strong, he was nevertheless generally able to detect when two words were identical and often – but not always – noticed when two words were not identical. It is likely that some auditory discrimination weakness has also affected James's performance on ***Letter names***, which demands quite close auditory attention. However, he seemed totally unable to determine similarities between syllables within sounds. It was as if he could not analyse words into constituent parts but heard them only as 'whole sounds'. Or perhaps he did analyse words into sounds but somehow could not avoid focusing on the points of difference between them, oblivious of any similarities. For example, James maintained that 'peg' and 'beg' were just different – he could not appreciate that they ended with the same sound. Nor was it the case that he was focusing on the onset of the words, because he could not appreciate that 'peg' and 'pet' began with similar sounds, either.

Although James's poor phonological awareness could be due to dyslexia, in the absence of evidence of other cognitive difficulties, it is most likely that it is due to lack of appropriate language experience in the pre-school period. He was a very shy, quiet student who had been upset by the noise and boisterousness of the play group and so his mother had withdrawn him and he seems to have spent most of his pre-school years at home on his own. He has very good constructional skills, which his mother said were developed through many hours of playing with Lego by himself.

Figure 34a. Case study – James



CoPS Individual Report

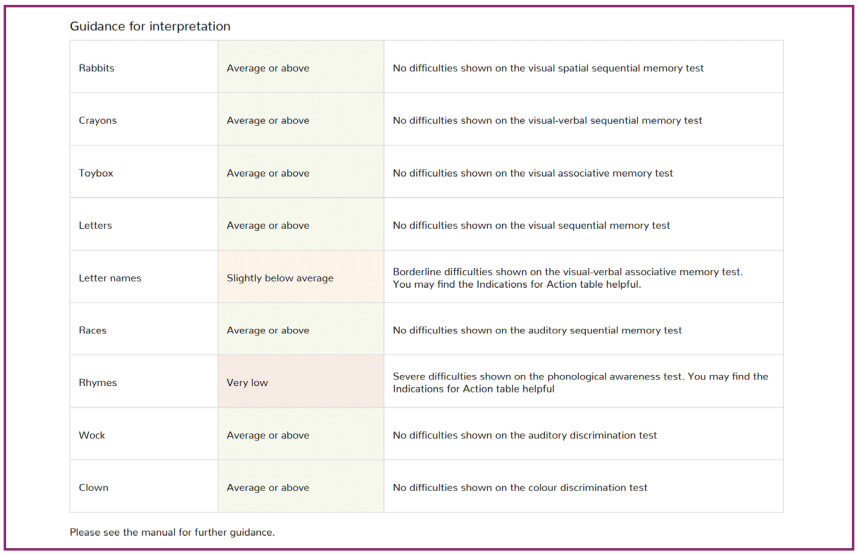
Name	James Smith
Student ID	JS12345
Date of birth	27th July 2014
Testing date range	3rd September 2019 - 6th September 2019

Subtest	Date of subtest	Age at test (yrs:mths)	Standard age score	Standard age score (with 90% confidence bands) 60 70 80 90 100 110 120 130 140	ST	NPR	T-score	Z-score
Visual spatial sequential memory (Rabbits)	05/09/19	05:01	109		6	73	56	0.60
Visual-verbal sequential memory (Crayons)	03/09/19	05:01	101		5	53	51	0.07
Visual associative memory (Toybox)	05/09/19	05:01	114		7	82	59	0.93
Visual sequential memory (Letters)	06/09/19	05:01	97		5	42	48	-0.20
Visual-verbal associative memory (Letter names)	06/09/19	05:01	89		4	23	43	-0.73
Auditory sequential memory (Races)	04/09/19	05:01	101		5	53	51	0.07
Phonological awareness (Rhymes)	04/09/19	05:01	75		2	5	33	-1.67
Auditory discrimination (Wock)	03/09/19	05:01	95		4	37	47	-0.33
Colour discrimination (Clown)	03/09/19	05:01	114		7	82	59	0.93

PLEASE NOTE that the Standard Age Score (SAS) shown in the chart only applies to students' accuracy in the tests, not their speed.

Accuracy
Speed

Figure 34b. Case study – James



Guidance for interpretation

Rabbits	Average or above	No difficulties shown on the visual spatial sequential memory test
Crayons	Average or above	No difficulties shown on the visual-verbal sequential memory test
Toybox	Average or above	No difficulties shown on the visual associative memory test
Letters	Average or above	No difficulties shown on the visual sequential memory test
Letter names	Slightly below average	Borderline difficulties shown on the visual-verbal associative memory test. You may find the Indications for Action table helpful.
Races	Average or above	No difficulties shown on the auditory sequential memory test
Rhymes	Very low	Severe difficulties shown on the phonological awareness test. You may find the Indications for Action table helpful
Wock	Average or above	No difficulties shown on the auditory discrimination test
Clown	Average or above	No difficulties shown on the colour discrimination test

Please see the manual for further guidance.

James's good visual memory will probably mean that he has no problems with whole-word methods of reading, and his average score for ***Races*** does not indicate a serious auditory memory difficulty. Nevertheless, he will tend to struggle with phonics, and may even avoid any analytical approach to reading. He will almost certainly have difficulties with writing and spelling. Phonological awareness and auditory discrimination training at this stage will give James a much better basis for literacy development, enabling him to benefit from phonics teaching and help to prevent literacy difficulties later on. Strategies for teaching the student with poor phonological awareness may be found in *Teaching recommendations*.

Interpreting results of the auditory memory subtests

The auditory memory subtests in CoPS are:

- ***Letter names*** – assesses the student's ability to associate visual symbols with verbal labels
- ***Races*** – assesses auditory sequential short-term memory

Both of these skills in short-term (working) memory are critical for literacy development, especially for the acquisition of phonic skills, i.e. mapping of letters (graphemes) on to sounds (phonemes), and for the storage of phonological codes in short-term memory during word recognition and processing of text. There is also a well-established connection between reading and memory (Baddeley, 1986; Beech, 1997; Brady, 1986; Jorm, 1983; Wagner and Torgesen, 1987). The predominant view in the research literature is that phonological processes underpin the development of a phonological recoding strategy in reading, and that working memory plays a significant role in this strategy, enabling constituent sounds and/or phonological codes to be held in short-term store until these can be recognised as a word and its meaning accessed in long-term memory (e.g. Gathercole and Baddeley, 1993; Wagner et al, 1993).

Races

Races is a *sequential* memory subtest (i.e. in which items have to be remembered in the correct order). It correlates significantly with later literacy development. The correlation of ***Races*** given at age 5 with *BAS Word Reading* at 6:6 was 0.50, with *Macmillan Individual Reading Analysis* (MIRA) at 6:6 was 0.58, with *Edinburgh Reading Test* at 8:0 was 0.52, and with *BAS Spelling* at 8:0 was 0.53. All were significant at the $p<0.01$ level. For further information on the statistical evidence see Singleton, Thomas and Leedale (1996) and Singleton, Thomas and Horne (2000).

Letter names

Letter names is an *associative* memory subtest, which simulates the situation of a student learning to associate letters and their names. Early letter name knowledge and speed of naming are both good predictors of later literacy development (Rack, 1994; Snowling, 1995; Evans et al., 2000; Kirby et al., 2008). Although good letter name knowledge at an early age is probably due in part to some students being taught letter names at home or in pre-school, those students with competent auditory memory skills will have an advantage in these aspects of learning over those students with memory weaknesses. For this reason, ***Races*** and ***Letter names*** are both important tests, although of the two, ***Races*** is the better predictor of later literacy skills. ***Letter names*** is quite a difficult test for younger students and demands considerable concentration (as well as good listening skills). Nevertheless, ***Letter names*** correlates significantly with later phonic skills. The correlation of ***Letter names*** given at age 5 with all phonics aspects of the *Middle Infant Screening Test* (MIST) given at age 6:6 were significant at the $p<0.05$ level. For further information on the statistical evidence see Singleton, Thomas and Leedale (1996) and Singleton, Thomas and Horne (2000).

The nature and causes of auditory memory difficulties

Short term auditory memory is sometimes called working memory because it is the system which we use when we have to hold information for a brief period of time while we process it. Working memory is a limited-capacity system, and unless rehearsed or transferred to longer-term storage, information in working memory is only retained for a few seconds (Baddeley, 1986). For example, in order to understand what a person is saying to us we have to hold their words in working memory until they get to the end of a sentence (or equivalent break), then we can process those words for their meaning. We cannot process each individual word for meaning as we hear it because by themselves words do not convey sufficient meaning. Furthermore, words heard later in an utterance can substantially alter the meaning of words heard earlier (e.g. 'The man opened the magazine – then he carefully extracted the remaining bullets it contained').

In the same way that it is necessary to hold spoken words in memory in conversation, the student must hold letters and syllables in memory when decoding words. This is very important in the development of phonic skills. The majority of dyslexic students have problems in this area of cognitive processing (Thomson, 1982). Awaida and Beech (1995) found that phonological memory at age 5 predicted non-word reading (i.e. phonics skills) at 6 years. When reading continuous text for meaning the student must also hold words in memory until the end of the phrase or sentence. Poor working memory will thus affect reading comprehension. Of course, *visual* memory skills will be involved in much of this cognitive activity, especially for more competent readers whose capacity for rapid visual recognition of words steadily increases with age. Nevertheless, auditory working memory remains a significant factor in reading development and in writing as well. Students with weaknesses in auditory working memory also tend have difficulty in monitoring their written output, and are inclined to miss letters, syllables and/or words out when they are writing (Baddeley, 1986; Brady, 1986; Jorm; 1983; Wagner and Torgeson, 1987.)

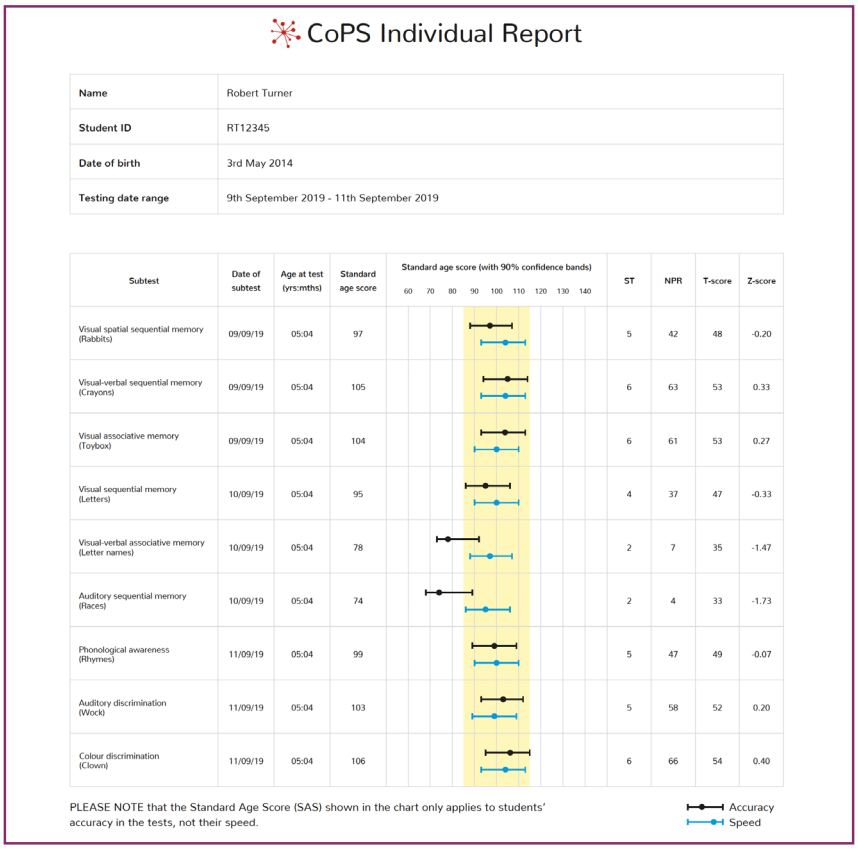
Further research has suggested a very close connection between auditory memory span and articulation (speech) rate (Avons and Hanna, 1995; McDougall and Hulme, 1994). It could well be that articulation rate is an index of the efficiency with which phonological representations of words can be located in memory and activated (i.e. spoken). In turn, this could be closely related to how quickly cognitive representations of words being read can be located in the orthographic and semantic lexicons and activated (i.e. recognised and understood). The three lexicons (phonological, orthographic and semantic) are all believed to be closely related (Rayner and Polatsek, 1989). The fact that ***Races*** was a significant predictor of later literacy skills (despite not involving the child in any speech) suggests that sequential processes in auditory working memory are nevertheless important in reading, independently of articulation rate.

Case study – auditory working memory difficulties

Inspection of Robert's report (see Figures 35a and 35b) suggests that he does not have any major problems in visual information processing. His phonological awareness (***Rhymes***) and auditory discrimination skills (***Wock***) are also satisfactory. On the other hand, he has major difficulties in auditory working memory, both associative (***Letter names***) and sequential (***Races***). Consequently, Robert would be expected to have problems in acquiring effective phonic skills. The recommendations would be for a well-structured multisensory phonic approach to literacy

learning with ample practice to compensate for his memory weakness, but using his strong visual channel to maintain confidence in his skills. He will almost certainly have problems in writing and spelling, especially with regular words and new or uncommon words. Word processing activities (especially with a talking word processor) would be a great help.

Figure 35a. Case study – Robert



CoPS Individual Report

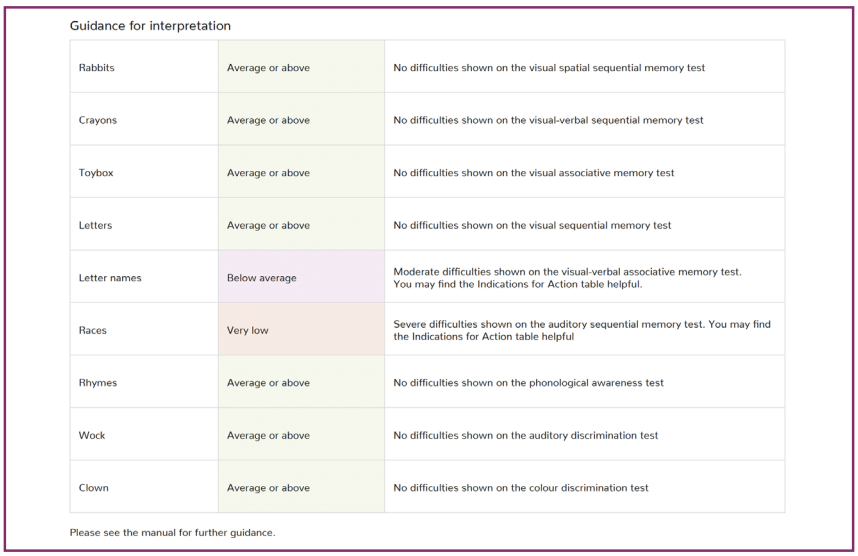
Name	Robert Turner
Student ID	RT12345
Date of birth	3rd May 2014
Testing date range	9th September 2019 - 11th September 2019

Subtest	Date of subtest	Age at test (yrs:mths)	Standard age score	Standard age score (with 90% confidence bands) 60 70 80 90 100 110 120 130 140	ST	NPR	T-score	Z-score
Visual spatial sequential memory (Rabbits)	09/09/19	05:04	97		5	42	48	-0.20
Visual-verbal sequential memory (Crayons)	09/09/19	05:04	105		6	63	53	0.33
Visual associative memory (Toybox)	09/09/19	05:04	104		6	61	53	0.27
Visual sequential memory (Letters)	10/09/19	05:04	95		4	37	47	-0.33
Visual-verbal associative memory (Letter names)	10/09/19	05:04	78		2	7	35	-1.47
Auditory sequential memory (Races)	10/09/19	05:04	74		2	4	33	-1.73
Phonological awareness (Rhymes)	11/09/19	05:04	99		5	47	49	-0.07
Auditory discrimination (Wock)	11/09/19	05:04	103		5	58	52	0.20
Colour discrimination (Clown)	11/09/19	05:04	106		6	66	54	0.40

PLEASE NOTE that the Standard Age Score (SAS) shown in the chart only applies to students' accuracy in the tests, not their speed.

Accuracy
Speed

Figure 35b. Case study – Robert



Guidance for interpretation

Rabbits	Average or above	No difficulties shown on the visual spatial sequential memory test
Crayons	Average or above	No difficulties shown on the visual-verbal sequential memory test
Toybox	Average or above	No difficulties shown on the visual associative memory test
Letters	Average or above	No difficulties shown on the visual sequential memory test
Letter names	Below average	Moderate difficulties shown on the visual-verbal associative memory test. You may find the Indications for Action table helpful.
Races	Very low	Severe difficulties shown on the auditory sequential memory test. You may find the Indications for Action table helpful
Rhymes	Average or above	No difficulties shown on the phonological awareness test
Wock	Average or above	No difficulties shown on the auditory discrimination test
Clown	Average or above	No difficulties shown on the colour discrimination test

Please see the manual for further guidance.

Interpreting results of the visual memory subtests

The visual memory subtests in CoPS are:

- ***Crayons*** – assesses visual-verbal sequential memory (colours)
- ***Rabbits*** – assesses visual spatial sequential memory (spatial/temporal position)
- ***Toybox*** – assesses visual associative memory (shape and colour)
- ***Letters*** – assesses visual sequential memory (symbols)

These four subtests of visual memory will be considered together, because the teacher needs to compare them when interpreting CoPS results. Visual memory is an essential component of literacy development, especially in rapid word recognition (particularly of irregular words for which a phonic strategy would not be appropriate), in fast processing of text, and in spelling (again, particularly where irregular words are concerned).

Visual memory and literacy development

Although auditory memory is usually regarded as being of greatest significance where literacy skills are concerned, there is good evidence that visual memory tasks can also give good indications of dyslexia and literacy difficulties (Awaida and Beech, 1995; Beech, 1997; Singleton, Thomas and Horne, 2000; Bogon et al., 2014). Stuart, Masterson and Dixon (2000) found that visual memory influences the acquisition of sight vocabulary in children aged 5 who displayed poor graphophonic skills (i.e. those who had not yet acquired the ability to segment words on the basis of their sounds and who displayed little or no knowledge of sound-to-letter mappings). For children with good graphophonic skills, however, no association between visual memory and word learning was found. In the CoPS study, the correlations between scores on ***Letters*** and single word reading (in the region of 0.28) were clearly not of the order reported by Stuart, Masterson and Dixon. Nevertheless, the results were statistically significant. It should also be borne in mind that in the Stuart, Masterson and Dixon study, the children had to learn to recognise words that were unfamiliar to them (e.g. leopard, haddock, canoe), whereas in the present study, the children were assessed on words that they had already acquired, and no distinction was made between children with good or poor graphophonic skills.

A study by Palmer (2000) found that children who maintained a visual representation of words alongside a phonological representation after age 7, were significantly worse readers than those for whom the ability to switch strategies by inhibiting the visual representation had fully developed. Children with good visual memory but poor auditory verbal memory would not only be expected to find acquisition of an effective phonological decoding strategy in reading rather difficult, but also be inclined to rely for a longer period on visual strategies. This approach is liable to run into trouble as the child's education progresses and the number of new words with which the child is confronted steadily increases.

Rabbits, Crayons, Toybox and Letters

Before attempting an interpretation of results from any of these individual subtests, it is advisable for the teacher first to look for confirmation from the other memory subtests. Obviously, where there is strong confirmation (e.g. a number of related subtests below the threshold of concern – SAS 85) then the teacher can be much more confident about the diagnosis. If only one subtest result is below SAS 85 (particularly in one of the memory subtests, which require a very high degree of concentration) when all others are average or above average for that student, this may simply be a chance result, and rarely indicates a real weakness. If in doubt, the teacher would be wise to re-test the student on that particular subtest. On the other hand, one subtest result below the threshold of risk (SAS 75) is more likely to indicate a real and significant difficulty.

The nature and causes of visual memory difficulties

Toybox assesses visual *associative* memory, whereas the other three visual subtests assess *sequential* memory. There is one other associative memory subtest in CoPS – ***Letter names***, which is an auditory subtest. The results of this should also be compared with those from ***Toybox***. The other three visual subtests (***Rabbits***, ***Crayons*** and ***Letters***) are all sequential memory tests. There is one other sequential memory subtest in CoPS – ***Races***, which is an auditory subtest. The results of this should also be compared with those from ***Rabbits***, ***Crayons*** and ***Letters***.

Hence, the teacher should check which of the following is the case:

- the student has general *associative* memory difficulties (visual as well as auditory)
- the student has general *sequential* memory difficulties (visual as well as auditory)
- the student has general visual memory difficulties
- the student has *specific* difficulties in *visual associative* memory
- the student has *specific* difficulties in *visual sequential* memory
- the student has a combination of some the above difficulties

Selection of appropriate teaching and training activities will depend to a large extent on the answers to this question, as well as on the severity of the difficulties. The more extensive and the more severe the memory problems, the more difficult they will be to remediate. Nevertheless, memory remediation activities should always be attempted.

However, there are other important differences between the various memory subtests of which the teacher should be aware. ***Toybox*** and ***Crayons*** are both tests where verbal encoding (of colour names) helps the student considerably. It is always important to rule out colour discrimination difficulties in cases of students with a low performance on ***Toybox*** and ***Crayons***. Hence, when students do score low on those subtests, if ***Clown*** has not already been administered to the student, then it should always be given as a precaution, before attempting to interpret the results of ***Toybox*** and ***Crayons***.

Psychologists often argue that there is no such thing as a pure test of visual memory, uncontaminated by verbal encoding, because most human beings will usually try to use verbal encoding strategies to assist memory. So ***Toybox*** and ***Crayons*** can help to identify the student who has difficulty in applying verbal labels and holding them in working memory. The results from ***Toybox*** and ***Crayons*** can indicate the student who is likely to have difficulty with visual whole word reading methods. Such a student is potentially a rather slow reader because the associative linkages are not so easily forged and the student may have to decode words that should have become familiar and recognised by sight. Spelling is also likely to be a problem and (especially in the early stages of writing) the student will probably have difficulties in remembering the letters that they need to use. By contrast, ***Rabbits*** is the most difficult of the CoPS subtests for the student to encode verbally – so it provides a purer measure of *visual* memory skills. It requires the student to remember spatial positions as well as temporal sequences.

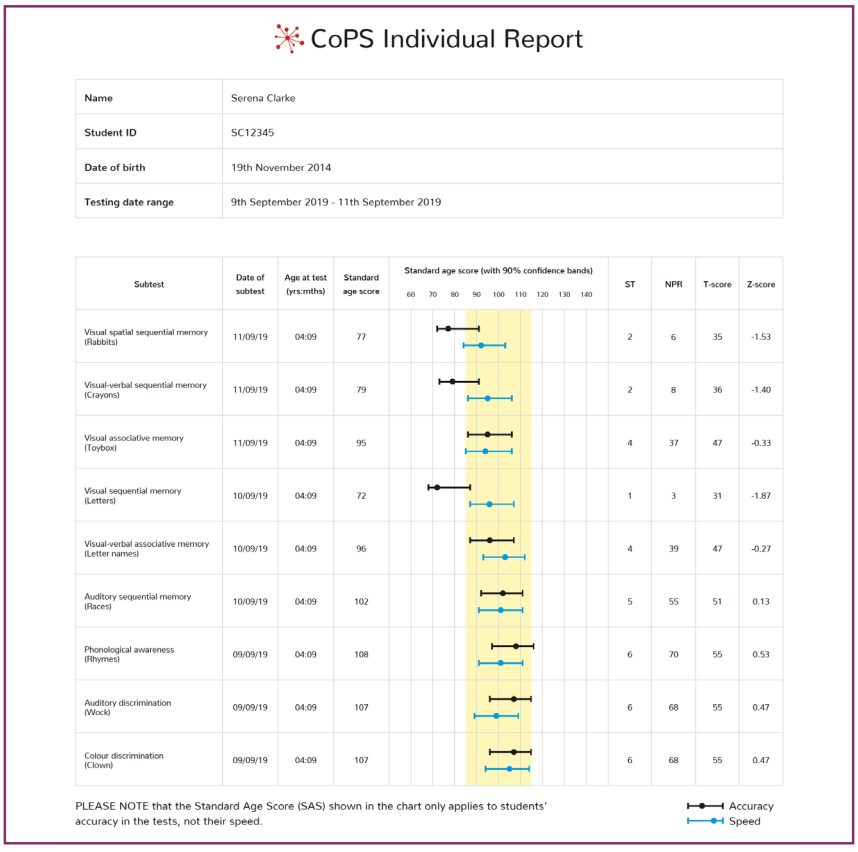
In the CoPS research project all four visual memory subtests were found to have significant correlations with later literacy development. Example correlations (from CoPS tests given at age 5 to literacy measures at age 8:0) for ***Rabbits*** were 0.40 (*Neale Analysis of Reading*), 0.39 (*Edinburgh Reading Test*) and 0.32 (*BAS Spelling*); for ***Crayons*** were 0.36 (*Edinburgh Reading Test*) and 0.36 (*BAS Spelling*); for ***Toybox*** 0.33 (*BAS Spelling*) and 0.32 (*Word Recognition and Phonics Skills Test*); for ***Letters*** 0.36 (*Neale Analysis of Reading*) and 0.43 (*BAS Spelling*). All are significant at the 0.05 level or better.

Case studies

Serena – visual sequential memory difficulties

Serena shows no problems of auditory information processing; in fact, her phonological awareness (***Rhymes***) and auditory discrimination (***Wock***) are both quite good (see Figures 36a and 36b). But she has clear weaknesses in visual sequential memory (***Rabbits***, ***Crayons*** and ***Letters***). Her associative memory is reasonably satisfactory (***Toybox*** and ***Letter names***). Serena would be expected to have problems building up visual word recognition skills. Confusion of letter order (e.g. 'was' vs. 'saw') is likely. Since her associative and auditory memory are satisfactory and she has good phonological awareness and auditory discrimination skills, a phonically-based approach to reading is indicated with, ideally, a multisensory strategy. Later difficulties must also be anticipated and catered for – e.g. expected problems in spelling (especially irregular words) and in rapid word recognition and text processing.

Figure 36a. Case study – Serena



CoPS Individual Report

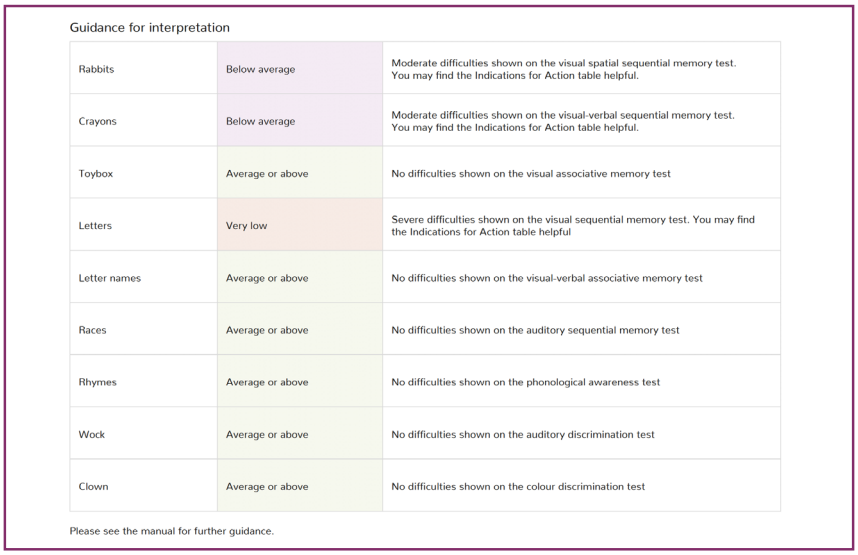
Name	Serena Clarke
Student ID	SC12345
Date of birth	19th November 2014
Testing date range	9th September 2019 - 11th September 2019

Subtest	Date of subtest	Age at test (yrs:mths)	Standard age score	Standard age score (with 90% confidence bands) 60 70 80 90 100 110 120 130 140	ST	NPR	T-score	Z-score
Visual spatial sequential memory (Rabbits)	11/09/19	04:09	77		2	6	35	-1.53
Visual-verbal sequential memory (Crayons)	11/09/19	04:09	79		2	8	36	-1.40
Visual associative memory (Toybox)	11/09/19	04:09	95		4	37	47	-0.33
Visual sequential memory (Letters)	10/09/19	04:09	72		1	3	31	-1.87
Visual-verbal associative memory (Letter names)	10/09/19	04:09	96		4	39	47	-0.27
Auditory sequential memory (Races)	10/09/19	04:09	102		5	55	51	0.13
Phonological awareness (Rhymes)	09/09/19	04:09	108		6	70	55	0.53
Auditory discrimination (Wock)	09/09/19	04:09	107		6	68	55	0.47
Colour discrimination (Clown)	09/09/19	04:09	107		6	68	55	0.47

PLEASE NOTE that the Standard Age Score (SAS) shown in the chart only applies to students' accuracy in the tests, not their speed.

Accuracy
Speed

Figure 36b. Case study – Serena



Guidance for interpretation

Rabbits	Below average	Moderate difficulties shown on the visual spatial sequential memory test. You may find the Indications for Action table helpful.
Crayons	Below average	Moderate difficulties shown on the visual-verbal sequential memory test. You may find the Indications for Action table helpful.
Toybox	Average or above	No difficulties shown on the visual associative memory test
Letters	Very low	Severe difficulties shown on the visual sequential memory test. You may find the Indications for Action table helpful
Letter names	Average or above	No difficulties shown on the visual-verbal associative memory test
Races	Average or above	No difficulties shown on the auditory sequential memory test
Rhymes	Average or above	No difficulties shown on the phonological awareness test
Wock	Average or above	No difficulties shown on the auditory discrimination test
Clown	Average or above	No difficulties shown on the colour discrimination test

Please see the manual for further guidance.

Olivia – general sequencing difficulties

Olivia's problems (see Figures 37a and 37b) are with sequencing, in both auditory and visual modes (note results for ***Rabbits***, ***Crayons***, ***Letters*** and ***Races***). There is a weakness in associative memory, too (see ***Toybox*** and ***Letter names***), but note that phonological awareness (***Rhymes***) and auditory discrimination (***Wock***) skills are quite competent. Olivia would be expected to have problems not only in acquiring effective phonic skills, but also have some difficulties in building up visual word recognition skills. She would have particular problems in spelling and writing, with sequencing errors being common. The recommendations would be that a highly structured multisensory phonic approach to literacy learning would be essential with ample practice to compensate for memory weakness. Structured learning software which facilitates practice of both auditory and visual sequencing in reading and writing would be especially useful, and regular word processing activities (especially with a talking word processor) would be a great help.

Figure 37a. Case study – Olivia

CoPS Individual Report

Name	Olivia Crane
Student ID	OC12345
Date of birth	12 January 2015
Testing date range	6th September 2019 - 9th September 2019

Subtest	Date of subtest	Age at test (yrs:mths)	Standard age score	Standard age score (with 90% confidence bands) 60 70 80 90 100 110 120 130 140	ST	NPR	T-score	Z-score
Visual spatial sequential memory (Rabbits)	09/09/19	04:07	81		2	10	37	-1.27
Visual-verbal sequential memory (Crayons)	09/09/19	04:07	78		2	7	35	-1.47
Visual associative memory (Toybox)	09/09/19	04:07	94		4	34	46	-0.40
Visual sequential memory (Letters)	09/09/19	04:07	77		2	6	35	-1.53
Visual-verbal associative memory (Letter names)	06/09/19	04:07	95		4	37	47	-0.33
Auditory sequential memory (Races)	06/09/19	04:07	72		1	3	31	-1.87
Phonological awareness (Rhymes)	06/09/19	04:07	102		5	55	51	0.13
Auditory discrimination (Wock)	06/09/19	04:07	106		6	66	54	0.40
Colour discrimination (Clown)	06/09/19	04:07	104		6	61	53	0.27

PLEASE NOTE that the Standard Age Score (SAS) shown in the chart only applies to students' accuracy in the tests, not their speed.

Accuracy
Speed

Figure 37b. Case study – Olivia

Guidance for interpretation

Rabbits	Below average	Moderate difficulties shown on the visual spatial sequential memory test. You may find the Indications for Action table helpful.
Crayons	Below average	Moderate difficulties shown on the visual-verbal sequential memory test. You may find the Indications for Action table helpful.
Toybox	Slightly below average	Borderline difficulties shown on the visual associative memory test. You may find the Indications for Action table helpful.
Letters	Below average	Moderate difficulties shown on the visual sequential memory test. You may find the Indications for Action table helpful.
Letter names	Average or above	No difficulties shown on the visual-verbal associative memory test
Races	Very low	Severe difficulties shown on the auditory sequential memory test. You may find the Indications for Action table helpful
Rhymes	Average or above	No difficulties shown on the phonological awareness test
Wock	Average or above	No difficulties shown on the auditory discrimination test
Clown	Average or above	No difficulties shown on the colour discrimination test

Please see the manual for further guidance.

Clown

Clown is a test of colour discrimination. A student who is having difficulties on ***Clown*** will probably have colour discrimination problems (but not necessarily so – see below), and may be colour blind. The student can be referred via the GP for full assessment for colour blindness.

The main function of ***Clown*** is to rule out colour discrimination difficulties in cases of students with a low performance on ***Toybox*** and ***Crayons***. Hence, when students *do* score low on those subtests, if ***Clown*** has not already been administered to the student, then it should always be given as a precaution, before attempting to interpret the results of ***Toybox*** and ***Crayons***. ***Clown*** need not be given if the teacher is confident that the student's colour discrimination is satisfactory. On the other hand, many teachers find ***Clown*** is a good introduction to the suite of subtests because most students find it very easy but enjoyable nonetheless.

The colour discriminations tested in ***Clown*** are:

- Yellow
- Red
- Purple
- Green
- Light Blue
- Dark blue

These are the colours used in ***Toybox*** and ***Crayons***. Of these colours, the most likely confusion in a student who is colour blind will be when trying to distinguish red and green. About 7.5% of males and less than 1% of females are colour blind, which reflects a sex-linked recessive inheritance.

Interpreting complex CoPS profiles

Low overall profile

CoPS, on its own, does not provide a completely clear distinction between the student with a *specific* learning difficulty (dyslexia) which is very severe, and the student with more general *moderate* learning difficulties. In theory, both types of student could produce similar profiles on CoPS – i.e. fairly low scores across most or all of the CoPS subtests. Although this dilemma rarely occurs in practice, teachers are usually able to distinguish the two because the student with moderate learning difficulties is commonly found to be slow in other aspects of learning and in many classroom activities. Their language comprehension may be poor, their thinking and reasoning skills weak, and they may also be poorly co-ordinated. On the other hand, the dyslexic student will generally be an unexpected discovery by the teacher – i.e. in classroom activities, reasoning, oral fluency, etc., seemed at least average, if not above average. If the teacher wants to be sure, then an independent check on the student's intellectual skills can be carried out, for example, using a test such as *Ability* or the *British Picture Vocabulary Scales—Third Edition*. If still in doubt, the student can be referred to an Educational Psychologist for full assessment.

However, it should not be assumed that CoPS has no value in cases of students with moderate learning difficulties. CoPS is a useful tool to identify these students' relative strengths so that teaching can be more effectively differentiated for them, and training activities more precisely targeted.

Case study

Sophia has general memory difficulties, with low performance on all except the phonological awareness (***Rhymes***) and auditory discrimination (***Wock***) subtests (see Figures 38a and 38b). She is unlikely to have moderate learning difficulties because those two subtests show reasonable scores, but the teacher might wish to check Sophia's intelligence level with a suitable test – see above. Sophia's profile is typical of the more severe case of dyslexia, and consequently she would be expected to have difficulties both in building up visual word recognition and in acquiring phonic skills. She will tend to experience problems in reading as well as in spelling and writing. A highly structured multisensory phonic approach to literacy learning would be essential for Sophia, with ample practice to compensate for these memory weaknesses. Structured learning software to give lots of practice in both auditory and visual memory components of reading and spelling would be very helpful, and regular word processing activities (especially with a talking word processor) would also be beneficial. Later on, difficulties in rapid word recognition and more advanced text processing should be anticipated because the speed of lexical access (word finding) is a limiting factor here and this is dependent on both auditory and visual memory. She will need help to develop good higher-order reading skills (skimming and scanning), otherwise she will always be a slow laborious reader and this will handicap her at Key Stages 3 and 4 and above.

Figure 38a. Case study – Sophia

CoPS Individual Report

Name	Sophia Nicholls
Student ID	SN12345
Date of birth	22nd March 2015
Testing date range	2nd September 2019 - 4th September 2019

Subtest	Date of subtest	Age at test (yrs:mths)	Standard age score	Standard age score (with 90% confidence bands) 60 70 80 90 100 110 120 130 140	ST	NPR	T-score	Z-score
Visual spatial sequential memory (Rabbits)	03/09/19	04:05	80		2	9	37	-1.33
Visual-verbal sequential memory (Crayons)	02/09/19	04:05	82		3	12	38	-1.20
Visual associative memory (Toybox)	03/09/19	04:05	79		2	8	36	-1.40
Visual sequential memory (Letters)	04/09/19	04:05	73		1	4	32	-1.80
Visual-verbal associative memory (Letter names)	04/09/19	04:05	70		1	2	30	-2.00
Auditory sequential memory (Races)	04/09/19	04:05	75		2	5	33	-1.67
Phonological awareness (Rhymes)	03/09/19	04:05	97		5	42	48	-0.20
Auditory discrimination (Wock)	02/09/19	04:05	102		5	55	51	0.13
Colour discrimination (Clown)	02/09/19	04:05	95		4	37	47	-0.33

PLEASE NOTE that the Standard Age Score (SAS) shown in the chart only applies to students' accuracy in the tests, not their speed.

Accuracy
Speed

Figure 38b. Case study – Sophia

Guidance for interpretation

Rabbits	Below average	Moderate difficulties shown on the visual spatial sequential memory test. You may find the Indications for Action table helpful.
Crayons	Below average	Moderate difficulties shown on the visual-verbal sequential memory test. You may find the Indications for Action table helpful.
Toybox	Below average	Moderate difficulties shown on the visual associative memory test. You may find the Indications for Action table helpful.
Letters	Very low	Severe difficulties shown on the visual sequential memory test. You may find the Indications for Action table helpful
Letter names	Very low	Severe difficulties shown on the visual-verbal associative memory test. You may find the Indications for Action table helpful
Races	Very low	Severe difficulties shown on the auditory sequential memory test. You may find the Indications for Action table helpful
Rhymes	Average or above	No difficulties shown on the phonological awareness test
Wock	Average or above	No difficulties shown on the auditory discrimination test
Clown	Average or above	No difficulties shown on the colour discrimination test

Please see the manual for further guidance.

High overall profile

CoPS could be useful in identifying exceptionally bright (or even 'gifted') students.

Such students sometimes have learning problems because they find the work they are given in school too easy and they swiftly become bored. They can become lazy or careless because they are accustomed to tasks being effortless. They may become naughty or start to disrupt the work of other students in order to create some excitement in their school lives. Very bright students also have special educational needs, and these should be addressed as early as possible. Teachers should try to ensure that very bright students are provided with educational stimulation and challenge appropriate to their abilities, and that special talents are encouraged.

On the other hand, a few exceptionally bright students have relative difficulties which may be hidden and which can cause learning problems.

Case study

Carl's report (see Figures 39a and 39b) shows that most subtest scores are in the upper range of scores, particularly in the visual subtests, with results for accuracy at or above SAS 110 on all except three subtests. Those three subtests have scores in the SAS range 95 to 100, which would not normally give the teacher any cause for concern. Indeed, at first sight, Carl's whole profile would not worry most teachers. On the other hand, Carl could be a very bright (or even 'gifted') student, and the teacher should try to check this. If Carl is bright, then he may have some difficulties for which he is able to compensate at this stage of education, but which may cause him problems later on. In other words, there may be a hidden difficulty. Teachers should try to consider the relative scores on the profile as well as investigating whether scores fall below the thresholds for concern or risk.

Actually, Carl's WISC IQ score was later found to be 127, which although not exceptionally high is nevertheless in the top 5% of students in intellectual terms. However, his phonological awareness (***Rhymes***) is relatively low for a student who seems so adept at the other subtests. One would have expected a student with all these other high scores and with very good auditory discrimination to have encountered no difficulty whatsoever with rhymes and obtained a perfect or near-perfect score. For some reason Carl did not, and the teacher should look into that. In Carl's case, it appears that home background factors were the most likely cause of his somewhat weak phonological awareness – the home was bilingual and there were some aspects of the English language which he had not had opportunities to discover.

Figure 39a. Case study – Carl

CoPS Individual Report

Name	Carl Burton
Student ID	CB12345
Date of birth	8th July 2013
Testing date range	3rd September 2019 - 5th September 2019

Subtest	Date of subtest	Age at test (yrs:mths)	Standard age score	Standard age score (with 90% confidence bands) 60 70 80 90 100 110 120 130 140	ST	NPR	T-score	Z-score
Visual spatial sequential memory (Rabbits)	03/09/19	06:01	122		8	93	65	1.47
Visual-verbal sequential memory (Crayons)	03/09/19	06:01	117		7	87	61	1.13
Visual associative memory (Toybox)	03/09/19	06:01	115		7	84	60	1.00
Visual sequential memory (Letters)	04/09/19	06:01	99		5	47	49	-0.07
Visual-verbal associative memory (Letter names)	04/09/19	06:01	100		5	50	50	0.00
Auditory sequential memory (Races)	04/09/19	06:01	112		7	79	58	0.80
Phonological awareness (Rhymes)	03/09/19	06:01	95		4	37	47	-0.33
Auditory discrimination (Wock)	05/09/19	06:01	110		6	75	57	0.67
Colour discrimination (Clown)	05/09/19	06:01	124		8	95	66	1.60

PLEASE NOTE that the Standard Age Score (SAS) shown in the chart only applies to students' accuracy in the tests, not their speed.

Accuracy
Speed

Figure 39b. Case study – Carl

Guidance for interpretation

Rabbits	Average or above	No difficulties shown on the visual spatial sequential memory test
Crayons	Average or above	No difficulties shown on the visual-verbal sequential memory test
Toybox	Average or above	No difficulties shown on the visual associative memory test
Letters	Average or above	No difficulties shown on the visual sequential memory test
Letter names	Average or above	No difficulties shown on the visual-verbal associative memory test
Races	Average or above	No difficulties shown on the auditory sequential memory test
Rhymes	Average or above	No difficulties shown on the phonological awareness test
Wock	Average or above	No difficulties shown on the auditory discrimination test
Clown	Average or above	No difficulties shown on the colour discrimination test

Please see the manual for further guidance.

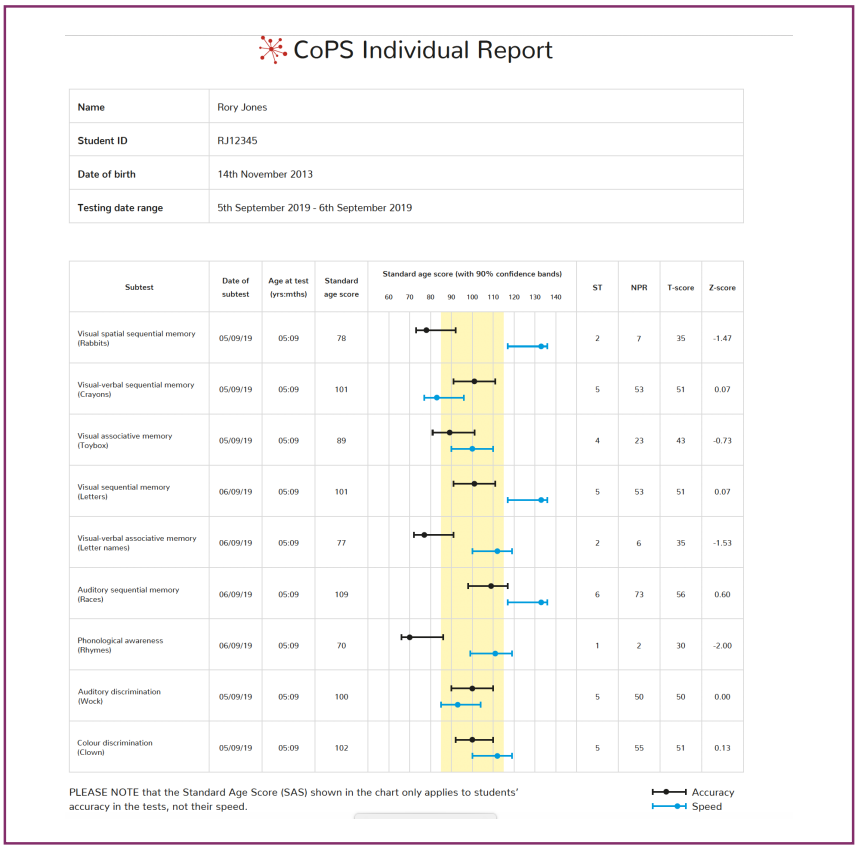
Other complex profiles

Many CoPS reports display a complex pattern of 'highs' and 'lows' and at first sight appear quite puzzling. When tackling such profiles, it is particularly important to bear in mind any extraneous factors which might have affected the student's performance. Examine the report to see on what days different tests were done. Motivation, ill-heath (actual or imminent), and impatience are often causes of a student under-performing. Or the student may simply have not understood the task (e.g. assuming that they have to do a subtest as quickly as possible when in fact it is accuracy which is most important). If the teacher is not confident about any particular result, then the safest course of action is to repeat the subtest(s) in question.

Case study – Rory

Rory's report (see Figures 40a and 40b), apart from the very low ***Rhymes*** result (suggesting poor phonological awareness), is rather difficult to interpret. Rory is aged 6 years 7 months. It might easily be assumed that his poor scores are the result of having attempted those particular subtests too quickly. However, the results of ***Races*** and ***Letters*** do not confirm this view, for the accuracy scores obtained on these subtests are average/good, despite fast speed scores. His results do not suggest an overall memory problem (***Races***, ***Crayons*** and ***Letters*** all being satisfactory), nor do they suggest a sequencing problem (***Crayons*** and ***Letters*** being satisfactory). Nevertheless, he was struggling in literacy work, despite being a fairly bright boy. He had developed a reasonable sight vocabulary, but could not seem to remember the letter-sound relationships in phonics.

Figure 40a. Case study – Rory



CoPS Individual Report

Name	Rory Jones
Student ID	RJ12345
Date of birth	14th November 2013
Testing date range	5th September 2019 - 6th September 2019

Subtest	Date of subtest	Age at test (yrs:mths)	Standard age score	Standard age score (with 90% confidence bands) 60 70 80 90 100 110 120 130 140	ST	NPR	T-score	Z-score
Visual spatial sequential memory (Rabbits)	05/09/19	05:09	78		2	7	35	-1.47
Visual-verbal sequential memory (Crayons)	05/09/19	05:09	101		5	53	51	0.07
Visual associative memory (Toybox)	05/09/19	05:09	89		4	23	43	-0.73
Visual sequential memory (Letters)	06/09/19	05:09	101		5	53	51	0.07
Visual-verbal associative memory (Letter names)	06/09/19	05:09	77		2	6	35	-1.53
Auditory sequential memory (Races)	06/09/19	05:09	109		6	73	56	0.60
Phonological awareness (Rhymes)	06/09/19	05:09	70		1	2	30	-2.00
Auditory discrimination (Wock)	05/09/19	05:09	100		5	50	50	0.00
Colour discrimination (Clown)	05/09/19	05:09	102		5	55	51	0.13

PLEASE NOTE that the Standard Age Score (SAS) shown in the chart only applies to students' accuracy in the tests, not their speed.

Accuracy
Speed

Figure 40b. Case study – Rory

Guidance for interpretation

Rabbits	Below average	Moderate difficulties shown on the visual spatial sequential memory test. You may find the Indications for Action table helpful.
Crayons	Average or above	No difficulties shown on the visual-verbal sequential memory test
Toybox	Slightly below average	Borderline difficulties shown on the visual associative memory test. You may find the Indications for Action table helpful.
Letters	Average or above	No difficulties shown on the visual sequential memory test
Letter names	Below average	Moderate difficulties shown on the visual-verbal associative memory test. You may find the Indications for Action table helpful.
Races	Average or above	No difficulties shown on the auditory sequential memory test
Rhymes	Very low	Severe difficulties shown on the phonological awareness test. You may find the Indications for Action table helpful
Wock	Average or above	No difficulties shown on the auditory discrimination test
Clown	Average or above	No difficulties shown on the colour discrimination test

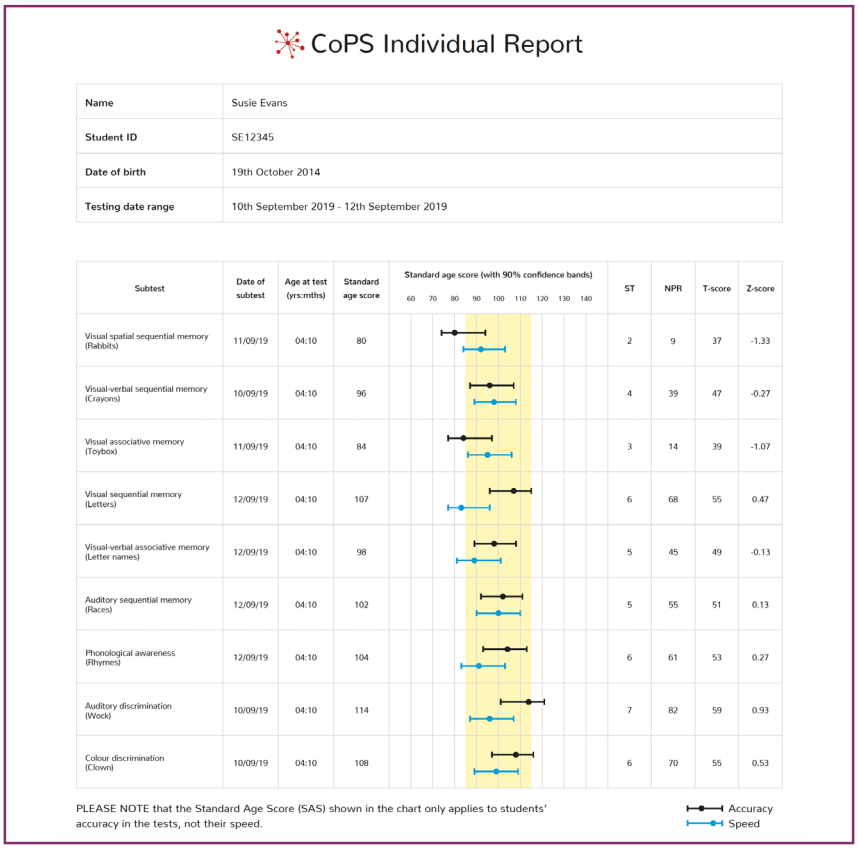
Please see the manual for further guidance.

It turned out that on the day when he was attempting Rabbits, the school was visited by a touring drama workshop, which created great excitement amongst the pupils. Rory had been under the impression that he would not be chosen to participate if he did not hurry up and finish the CoPS subtests, hence the poor result. When this subtest was repeated another day, he scored at SAS 103, which is average. However, a repeat of Letter names did not result in significant improvement (his score at the second attempt was SAS 84). However, it then became more obvious that he did seem to have a weakness in associative memory (Toybox and Letter names) – a pattern had emerged. His teachers and his parents began to do regular memory work with him (as well as rhyming activities) and his ability to remember letter-sound relationships began to show some improvement.

Case study – Susie

The report of Susie, aged 4 years 10 months, is also puzzling (see Figures 41a and 41b). It is obvious that she is not impulsive – in all probability she is fairly careful as her speed scores tend to be a little below the average, on the whole. And it is clear that she has strengths in auditory skills. But the results on the visual/perceptual side are not particularly consistent. Although her ***Rabbits*** score is low, her problem does not seem to be with visual sequencing as the results of ***Letters*** and ***Crayons*** are average/good. She does not appear to have a problem with using verbal labels to aid visual memory (***Crayons*** result is satisfactory). Only the ***Toybox*** and ***Rabbits*** results give cause for concern, and it is difficult to see what these have in common which might help us explain the profile. It subsequently turned out that the explanation for her difficulties on ***Toybox*** and ***Rabbits*** was a visual difficulty. She was found to be suffering from a form of amblyopia (lazy eye) in which the image from one eye was significantly out of focus. She thus was relying on the visual information from one eye. When she could focus her good eye on a stationary target (or a sequence of stationary targets), she was able to cope quite well. However, she found it very difficult to track a moving target accurately, to locate transient images in the visual field or to scan a row of images quickly. Thus she was experiencing problems on ***Rabbits*** (because the rabbit had usually moved on before she had located and registered its position) and ***Toybox*** (where she had to scan the row of shapes rapidly to find the one with the same colour as the target).

Figure 41a. Case study – Susie



CoPS Individual Report

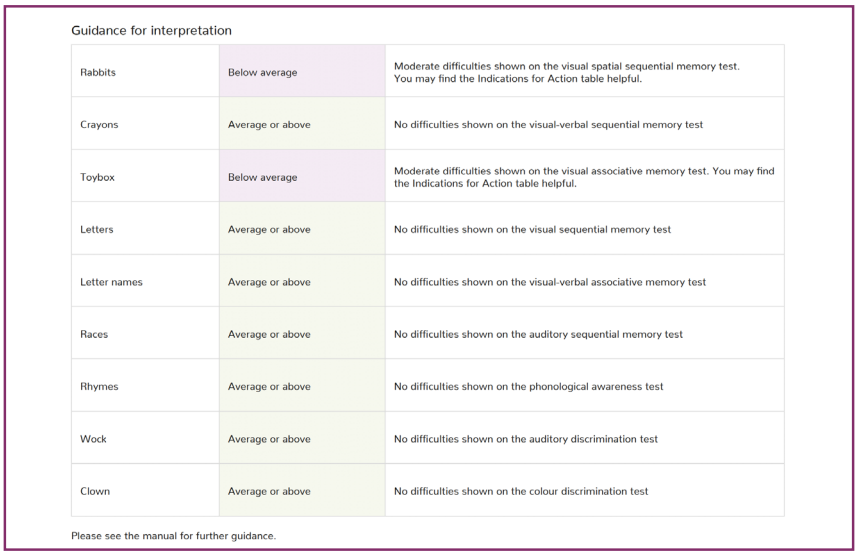
Name	Susie Evans
Student ID	SE12345
Date of birth	19th October 2014
Testing date range	10th September 2019 - 12th September 2019

Subtest	Date of subtest	Age at test (yrs:mths)	Standard age score	Standard age score (with 90% confidence bands) 60 70 80 90 100 110 120 130 140	ST	NPR	T-score	Z-score
Visual spatial sequential memory (Rabbits)	11/09/19	04:10	80		2	9	37	-1.33
Visual-verbal sequential memory (Crayons)	10/09/19	04:10	96		4	39	47	-0.27
Visual associative memory (Toybox)	11/09/19	04:10	84		3	14	39	-1.07
Visual sequential memory (Letters)	12/09/19	04:10	107		6	68	55	0.47
Visual-verbal associative memory (Letter names)	12/09/19	04:10	98		5	45	49	-0.13
Auditory sequential memory (Races)	12/09/19	04:10	102		5	55	51	0.13
Phonological awareness (Rhymes)	12/09/19	04:10	104		6	61	53	0.27
Auditory discrimination (Wock)	10/09/19	04:10	114		7	82	59	0.93
Colour discrimination (Clown)	10/09/19	04:10	108		6	70	55	0.53

PLEASE NOTE that the Standard Age Score (SAS) shown in the chart only applies to students' accuracy in the tests, not their speed.

Accuracy
Speed

Figure 41b. Case study – Susie



Guidance for interpretation

Rabbits	Below average	Moderate difficulties shown on the visual spatial sequential memory test. You may find the Indications for Action table helpful.
Crayons	Average or above	No difficulties shown on the visual-verbal sequential memory test
Toybox	Below average	Moderate difficulties shown on the visual associative memory test. You may find the Indications for Action table helpful.
Letters	Average or above	No difficulties shown on the visual sequential memory test
Letter names	Average or above	No difficulties shown on the visual-verbal associative memory test
Races	Average or above	No difficulties shown on the auditory sequential memory test
Rhymes	Average or above	No difficulties shown on the phonological awareness test
Wock	Average or above	No difficulties shown on the auditory discrimination test
Clown	Average or above	No difficulties shown on the colour discrimination test

Please see the manual for further guidance.

The main strategy for interpreting complex CoPS reports (or those that appear complex) is therefore to examine all possible reasons for any apparent area(s) of weakness, considering extraneous factors, and re-testing were necessary to check a result.

Interpreting profiles of students who have English as an additional language

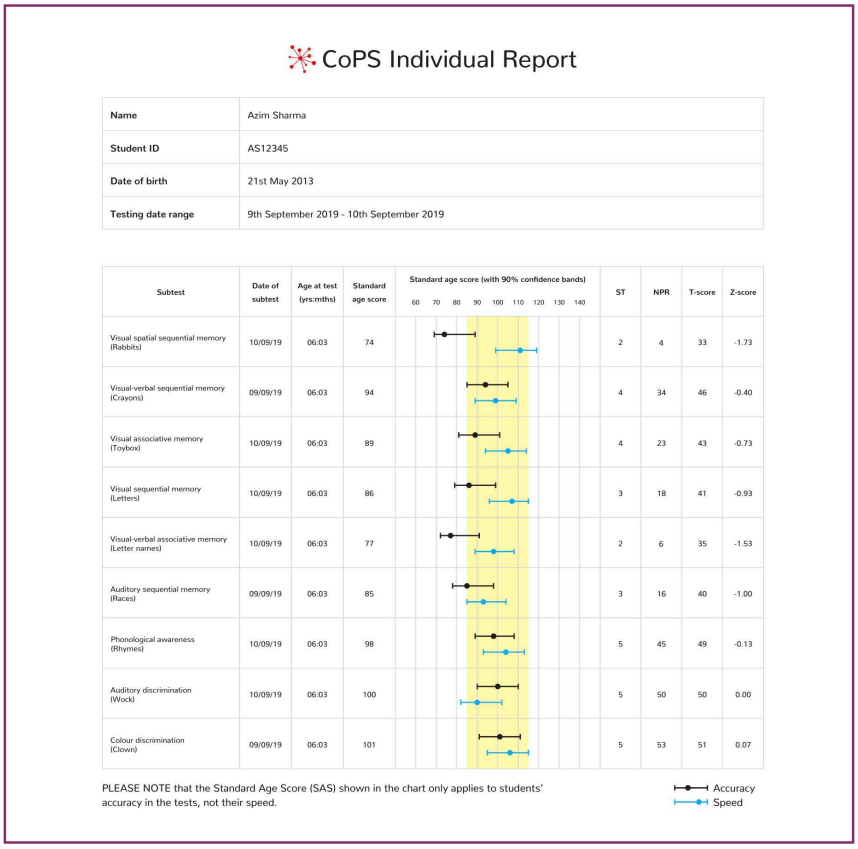
Assessment of any student who has limited proficiency in spoken English is always difficult. The approach to CoPS assessment of such students has already been discussed in *Assessing students who have English as an additional language*. This section shows CoPS reports of three quite different students for whom English is an additional language (EAL). All three attend one school in Birmingham, and the language of their homes is Punjabi.

Case studies

Azim

Figures 42a and 42b show the CoPS report for Azim, aged 6:3. His limited knowledge of verbal concepts in English is shown by his BPVS-3 Standard Score of 49, which is very low. His teachers are quite rightly worried about him, but his scores on ***Wock*** and ***Rhymes*** are quite satisfactory. However, his other CoPS results suggest that he has fairly serious memory difficulties, which could lie behind his poor progress in English and in other aspects of the curriculum.

Figure 42a. Case study – Azim (Age: 6 years 3 months)



CoPS Individual Report

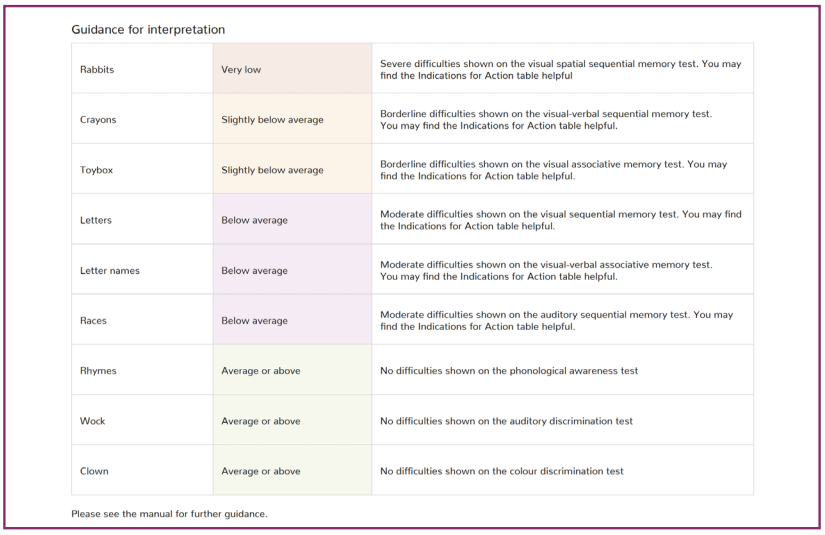
Name	Azim Sharma
Student ID	AS12345
Date of birth	21st May 2013
Testing date range	9th September 2019 - 10th September 2019

Subtest	Date of subtest	Age at test (yrs:mths)	Standard age score	Standard age score (with 90% confidence bands) 60 70 80 90 100 110 120 130 140	ST	NPR	T-score	Z-score
Visual spatial sequential memory (Rabbits)	10/09/19	06:03	74		2	4	33	-1.73
Visual-verbal sequential memory (Crayons)	09/09/19	06:03	94		4	34	46	-0.40
Visual associative memory (Toybox)	10/09/19	06:03	89		4	23	43	-0.73
Visual sequential memory (Letters)	10/09/19	06:03	86		3	18	41	-0.93
Visual-verbal associative memory (Letter names)	10/09/19	06:03	77		2	6	35	-1.53
Auditory sequential memory (Races)	09/09/19	06:03	85		3	16	40	-1.00
Phonological awareness (Rhymes)	10/09/19	06:03	98		5	45	49	-0.13
Auditory discrimination (Wock)	10/09/19	06:03	100		5	50	50	0.00
Colour discrimination (Clown)	09/09/19	06:03	101		5	53	51	0.07

PLEASE NOTE that the Standard Age Score (SAS) shown in the chart only applies to students' accuracy in the tests, not their speed.

Accuracy
Speed

Figure 42b. Case study – Azim (Age: 6 years 3 months)



Guidance for interpretation

Rabbits	Very low	Severe difficulties shown on the visual spatial sequential memory test. You may find the Indications for Action table helpful
Crayons	Slightly below average	Borderline difficulties shown on the visual-verbal sequential memory test. You may find the Indications for Action table helpful.
Toybox	Slightly below average	Borderline difficulties shown on the visual associative memory test. You may find the Indications for Action table helpful.
Letters	Below average	Moderate difficulties shown on the visual sequential memory test. You may find the Indications for Action table helpful.
Letter names	Below average	Moderate difficulties shown on the visual-verbal associative memory test. You may find the Indications for Action table helpful.
Races	Below average	Moderate difficulties shown on the auditory sequential memory test. You may find the Indications for Action table helpful.
Rhymes	Average or above	No difficulties shown on the phonological awareness test
Wock	Average or above	No difficulties shown on the auditory discrimination test
Clown	Average or above	No difficulties shown on the colour discrimination test

Please see the manual for further guidance.

Suraj

Figures 43a and 43b show the CoPS report for Suraj, aged 5:10. Like Azim, his English is rather poor (BPVS-3 Standard Score 76). Suraj has good scores for ***Wock*** (SAS 114) and ***Letters*** (SAS 127), and both ***Letter names*** (SAS 105) and ***Rabbits*** (SAS 95) are satisfactory; the latter three results suggesting competent visual memory skills. What is noticeable in his case are the poor scores for ***Crayons*** (SAS 89) and ***Toybox*** (SAS 83), which suggest difficulties with verbal encoding – specifically, in the use of colour labels. ***Clown*** performance was satisfactory, so these results were not due to colour discrimination problems. Finally, the ***Rhymes*** score is very low (SAS 70), indicating poor phonological awareness. The recommendations for Suraj are, essentially, continue with intensive language work, concentrating on phonological awareness and verbal encoding. His prognosis appears rather better than that of Azim, who seems to have more serious underlying memory difficulties.

Figure 43a. Case study – Suraj (Age: 5 years 10 months)

CoPS Individual Report

Name	Suraj Mehta
Student ID	SM12345
Date of birth	2nd November 2013
Testing date range	11th September 2019 - 13th September 2019

Subtest	Date of subtest	Age at test (yrs:mths)	Standard age score	Standard age score (with 90% confidence bands) 60 70 80 90 100 110 120 130 140	ST	NPR	T-score	Z-score
Visual spatial sequential memory (Rabbits)	11/09/19	05:10	95		4	37	47	-0.33
Visual-verbal sequential memory (Crayons)	11/09/19	05:10	89		4	23	43	-0.73
Visual associative memory (Toybox)	12/09/19	05:10	83		3	13	39	-1.13
Visual sequential memory (Letters)	12/09/19	05:10	127		9	96	68	1.80
Visual-verbal associative memory (Letter names)	13/09/19	05:10	105		6	63	53	0.33
Auditory sequential memory (Races)	13/09/19	05:10	94		4	34	46	-0.40
Phonological awareness (Rhymes)	12/09/19	05:10	70		1	2	30	-2.00
Auditory discrimination (Wock)	13/09/19	05:10	114		7	82	59	0.93
Colour discrimination (Clown)	11/09/19	05:10	123		8	94	65	1.53

PLEASE NOTE that the Standard Age Score (SAS) shown in the chart only applies to students' accuracy in the tests, not their speed.

Accuracy
Speed

Figure 43b. Case study – Suraj (Age: 5 years 10 months)

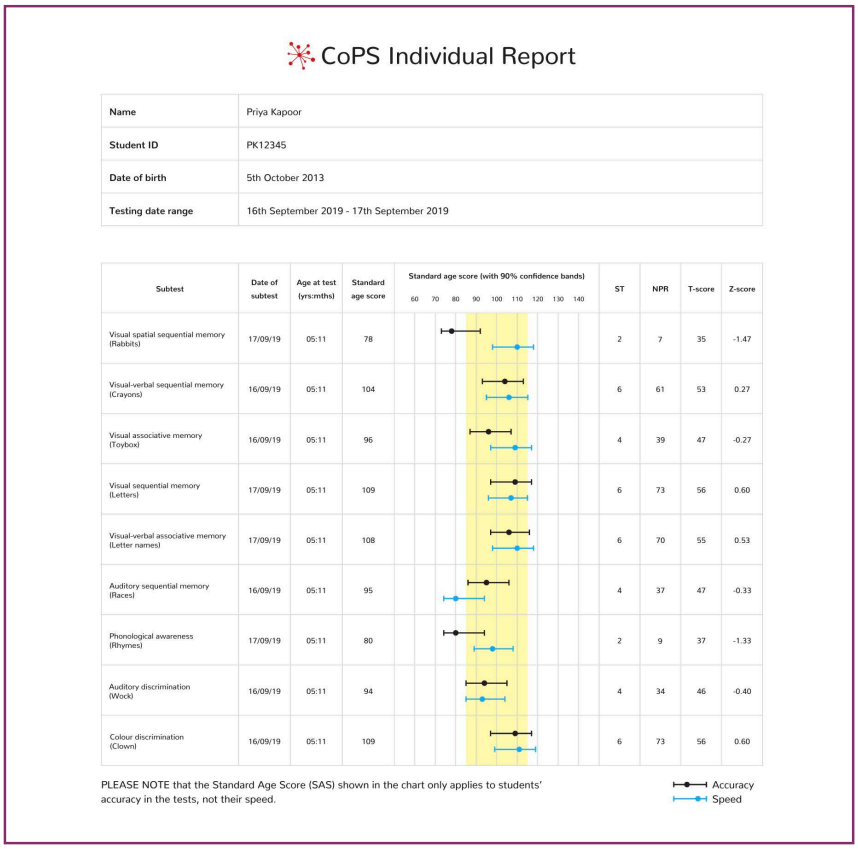
Guidance for interpretation

Rabbits	Average or above	No difficulties shown on the visual spatial sequential memory test
Crayons	Slightly below average	Borderline difficulties shown on the visual-verbal sequential memory test. You may find the Indications for Action table helpful.
Toybox	Below average	Moderate difficulties shown on the visual associative memory test. You may find the Indications for Action table helpful.
Letters	Average or above	No difficulties shown on the visual sequential memory test
Letter names	Average or above	No difficulties shown on the visual-verbal associative memory test
Races	Slightly below average	Borderline difficulties shown on the auditory sequential memory test. You may find the Indications for Action table helpful.
Rhymes	Very low	Severe difficulties shown on the phonological awareness test. You may find the Indications for Action table helpful
Wock	Average or above	No difficulties shown on the auditory discrimination test
Clown	Average or above	No difficulties shown on the colour discrimination test

Please see the manual for further guidance.

Priya

Figure 44a. Case study – Priya (Age: 5 years 11 month)



CoPS Individual Report

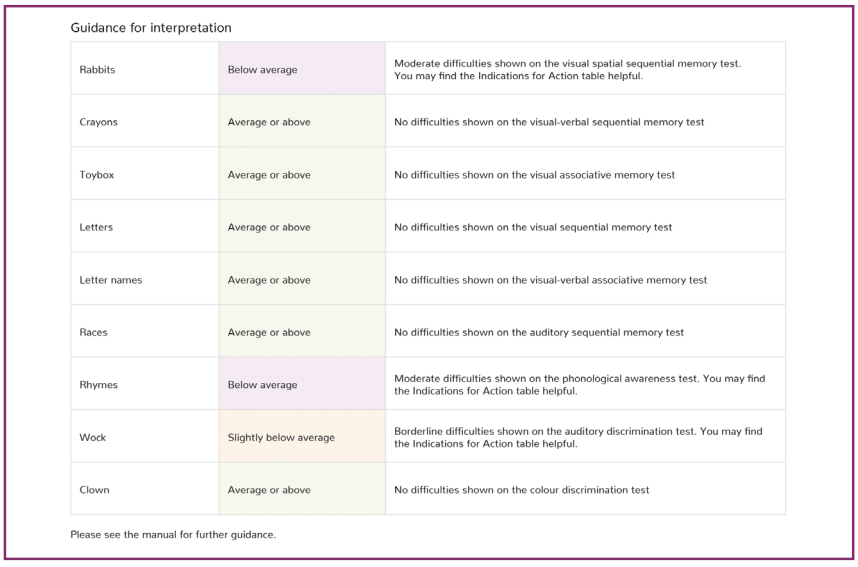
Name	Priya Kapoor
Student ID	PK12345
Date of birth	5th October 2013
Testing date range	16th September 2019 - 17th September 2019

Subtest	Date of subtest	Age at test (yrs:mths)	Standard age score	Standard age score (with 90% confidence bands) 60 70 80 90 100 110 120 130 140	ST	NPR	T-score	Z-score
Visual spatial sequential memory (Rabbits)	17/09/19	05:11	78		2	7	35	-1.47
Visual-verbal sequential memory (Crayons)	16/09/19	05:11	104		6	61	53	0.27
Visual associative memory (Toybox)	16/09/19	05:11	96		4	39	47	-0.27
Visual sequential memory (Letters)	17/09/19	05:11	109		6	73	56	0.60
Visual-verbal associative memory (Letter names)	17/09/19	05:11	108		6	70	55	0.53
Auditory sequential memory (Races)	16/09/19	05:11	95		4	37	47	-0.33
Phonological awareness (Rhymes)	17/09/19	05:11	80		2	9	37	-1.33
Auditory discrimination (Wock)	16/09/19	05:11	94		4	34	46	-0.40
Colour discrimination (Clown)	16/09/19	05:11	109		6	73	56	0.60

PLEASE NOTE that the Standard Age Score (SAS) shown in the chart only applies to students' accuracy in the tests, not their speed.

Accuracy
Speed

Figure 44b. Case study – Priya (Age: 5 years 11 month)



Guidance for interpretation

Rabbits	Below average	Moderate difficulties shown on the visual spatial sequential memory test. You may find the Indications for Action table helpful.
Crayons	Average or above	No difficulties shown on the visual-verbal sequential memory test
Toybox	Average or above	No difficulties shown on the visual associative memory test
Letters	Average or above	No difficulties shown on the visual sequential memory test
Letter names	Average or above	No difficulties shown on the visual-verbal associative memory test
Races	Average or above	No difficulties shown on the auditory sequential memory test
Rhymes	Below average	Moderate difficulties shown on the phonological awareness test. You may find the Indications for Action table helpful.
Wock	Slightly below average	Borderline difficulties shown on the auditory discrimination test. You may find the Indications for Action table helpful.
Clown	Average or above	No difficulties shown on the colour discrimination test

Please see the manual for further guidance.

Figures 44a and 44b show the CoPS report for Priya, aged 5:11. Her English proficiency and usage is quite good, although her understanding of verbal concepts in English is still somewhat limited (BPVS-3 Standard Score 88). In general, her profile indicates that she is not seriously at risk: apart from on ***Rabbits*** (which she may have attempted too quickly – this could be repeated if desired, in order to check this score), her scores on the memory subtests in CoPS are average or good. Auditory discrimination is also satisfactory (***Wock***), although phonological awareness is still limited (***Rhymes*** SAS 80). Priya needs time spent on rhyming and other phonological activities to give her a better start in literacy learning, but otherwise she gives no serious cause for concern.

Teaching recommendations

Use of CoPS does not imply any obligation to follow a particular line of teaching, and teachers, as professionals, will naturally wish to use their own judgement regarding what is, and is not, suitable for any given student. Nevertheless, it is strongly recommended that teachers read the teaching advice provided in this manual, as it is likely that they will find ideas and strategies that they had not previously considered. This is especially likely if the teacher is not very experienced in working with students who have specific learning difficulties.

The British Dyslexia Association also publishes information on recommended software and teaching materials (www.bdadyslexia.org.uk).

Approaches to teaching

CoPS results should always be considered in relation to two fundamental educational strategies:

- Remediation of cognitive weaknesses
- Differentiated teaching in basic skills

Cognitive abilities that are especially important for early literacy generally improve with the right type of practice. Where CoPS reveals limitation in these skills, the teacher knows where and with which students to give remediation. However, the objective of CoPS is not just the identification of specific cognitive weaknesses so that these can be given training. An equally important function of CoPS is to give the teacher insights into the student's pattern of cognitive strengths and weaknesses. This enables the teacher to make the literacy and basic skills learning programme for the student more individualised and more efficacious. It is important to stress that the two approaches (cognitive remediation and differentiated teaching) should be complementary and not contradictory. In other words, both strategies should be considered and will usually be implemented together. The best overall approach is one which attempts to remedy weaknesses whilst at the same time building on strengths.

Throughout this chapter, teachers will find recommendations regarding software and other resources. Teaching strategies and suggested software for pupils with dyslexia and other literacy difficulties have been reviewed by Reid (2016) Crivelli (2013), Keates (2002) and Stansfield (2012) and Shaywitz, Morris and Shaywitz (2008). The Rose report (Rose, 2009) also gives an overview of strategies for supporting students with dyslexia. For further suggestions on suitable software see the British Dyslexia Association New Technologies Committee website (www.bdatech.org) which is updated on a regular basis.

Remediation of cognitive weaknesses

The approach here is to use the CoPS subtests to identify cognitive weaknesses and then for the teacher to address these directly with suitable training activities. However, some cognitive weaknesses respond better to direct remediation than others, especially with younger students. Phonological awareness (***Rhymes***) and auditory discrimination weaknesses (***Wock***), for example, generally respond better to training than do memory difficulties.

Training can be carried out individually or in group work, in the classroom or at home. Examples of training activities are given later in this section. It is important that progress is properly monitored to ensure that the techniques being used are effective. As far as possible, it is better to use measures or techniques other than CoPS for this purpose. Although CoPS can be used for monitoring progress, care must be taken not to over-test the student. Any test will show a practice effect with repeated testing and the apparent improvement in test performance may not always give a true reflection of the more generalised cognitive improvement that is being sought.

However, it is important to stress that remediation of cognitive weaknesses should generally be used in conjunction with differentiated literacy teaching. Cognitive remediation is unlikely to be a successful strategy by itself unless the weaknesses are very minor and/or can be treated swiftly in a manner which has already been proven to be effective. For example, in the case of a student from an impoverished language background, who has scored low on ***Rhymes*** (phonological awareness) but has a satisfactory performance on all the other CoPS tests. Phonological training using rhyming, alliterative and syllable segmentation activities have a very good chance of success with such a student, as long as the help can be provided early enough and intensively enough (Bryant and Bradley, 1985; Goswami and Bryant, 1990; Bode and Content, 2011; Kjeldsen et al., 2014; Falth et al., 2017). However, it must always be borne in mind that whilst cognitive remediation is being carried out, the student is still likely to be involved in early literacy work in the classroom. If that literacy work is not differentiated for the student in a manner which takes account of their cognitive strengths and weaknesses, they are likely to experience failure and frustration which will be a barrier to learning. They will quickly perceive that their progress is not as good as that of other students and this will affect motivation. There is good evidence, however, that phonological training is most effective when combined with structured teaching of reading (Hatcher, Hulme and Ellis, 1994; Hatcher, Hulme and Snowling, 2004).

Differentiated teaching in basic skills

The approach here is to use CoPS to identify the student's cognitive strengths as well as limitations, and for the teacher then to use this information to design a literacy learning programme which is differentiated for that particular student, taking those strengths and limitations into account. By recognising difficulties which the student is likely to encounter, the teacher is in a better position to structure the student's learning experiences in such a way that success is maximised, and failure is minimised. Examples of this approach are given later in this section.

It can be appreciated, therefore, that CoPS is not just a device for assessing the risk of dyslexia. It can be used as a form of early screening on school entry, to identify all students' cognitive strengths and weaknesses, and to shape learning schemes more appropriately. Alternatively, CoPS can be used later in school to assess students who are experiencing problems in reading,

writing or maths, to help uncover the causes of the difficulty. However, this latter approach is perhaps not as desirable as using CoPS to screen all students, because it will not enable the teacher to identify at an early age – and before they have begun to fail – those students whose difficulty is unexpected (which is the case with most dyslexic students).

Auditory discrimination problems

Auditory discrimination training

The responsiveness of auditory discrimination difficulties to training largely depends on their severity. The severity of such weaknesses is affected by the degree and duration of the student's hearing difficulty or impoverished experience, and the effectiveness of any medical interventions which have been carried out (e.g. fitting of grommets in cases of glue ear). It is generally easier to improve auditory discrimination of four- or five-year olds than of six- or seven-year olds, because the older students will usually have had a longer duration of disturbance in hearing or inadequate language experience, which has deprived the brain of the opportunity to learn the fine differences between speech sounds.

Suggested games and activities for auditory discrimination training are described below:

- ***I spy*** – either conventionally (alliterative) or *Rhyming I Spy.*
- **Word families** – i.e. putting words in to families based on different sound components (e.g. *made, paid, glade; flower, flan, flock; trip, grit, crib; tan, fat, sad*).
- **Spot the difference** – can the student detect the difference between similar sounding words (e.g. *town–down, pat–pad, bag–sag, shot–shop*)? By inserting some identical pairs in the game (e.g. *show–show*) you can play an individual or group game which encourages careful listening. If possible, students should try to identify the difference as well as detect it. This can be recorded in advance, which circumvents the problem of students lip-reading the teacher (alternatively, students can face away from the teacher).
- **Computer programs** – there are computer programs that provide training in sound and speech recognition and discrimination, such as ***Fast ForWord***.

Teaching the student with auditory discrimination difficulties

As far as the development of literacy is concerned, the principal problem for the student with auditory discrimination difficulties, whatever their cause, is developing phonic skills. Auditory discrimination training will help, but at the same time the teacher should appreciate that the student will still require very careful teaching in phonics. If the student also has good visual memory skills, then there may be an inclination to rely predominantly, or even exclusively, on visual strategies in reading which may give an erroneous impression that the child is reading well. Neglect of the problem at this stage will only exacerbate difficulties that will have to be addressed later in schooling. A well-structured multisensory teaching approach is recommended, with care being taken to ensure that the student is hearing the sounds properly. The student will also require plenty of additional practice in phonics activities to counteract the tendency to be confused by similar sounds. For further information on teaching phonics see *Teaching phonics*.

Students with auditory discrimination problems may also experience difficulties hearing instructions given by the teacher. Noisy classroom environments will exacerbate this problem. If a student has not heard or understood instructions they may carry out the wrong task, daydream, or interfere with the work of other students, perhaps in the attempt to discover what they should be doing. The teacher should therefore seat the student as close to the front of the class as possible, making sure to check that the student has heard and understood instructions, and monitor the student regularly to ensure that they remain on-task. Snowling and Stackhouse (2006) provide a useful compendium of recommendations on teaching dyslexic students with speech and language difficulties.

Poor phonological awareness

The evidence that training in phonological skills facilitates literacy development is extremely strong (see Bryant and Bradley, 1985; Goswami and Bryant, 1990; and Rack, 1994). However, auditory discrimination may also require training, so firstly the teacher should check the child's auditory discrimination abilities (using ***Wock***) and take appropriate action. Lundberg, Frost and Peterson (1988) showed that relatively short daily sessions of phonological activities (15–20 minutes) carried out with kindergarten children resulted in improved phonological skills and significant gains in reading and spelling (compared with a control group) through at least to their second year of schooling. In this particular study, activities progressed from simple listening and rhyming games, to segmentation of sentences into words, words into syllables and, finally, syllables into phonemes. In the Cumbria study, Hatcher, Hulme, and Ellis (1994) found that integrated sound-categorisation and letter-knowledge training produced the largest improvements in reading and spelling of a group of seven-year-olds who were failing in reading.

Phonological awareness can be developed by a variety of methods. For example:

- **Rhyming** and **alliteration** – suitable techniques range from simple rhyming songs and games to more structured activities involving making books with rhyming or alliterative themes, playing rhyming snap or 'odd-one-out' games with pictures and objects; using plastic letters to discover and create rhyming word families
- **Deletion** of the first sound (e.g. *near–ear*) or of the last sound (e.g. *party–part*), or of whole syllables (e.g. *saying alligator without the all*)
- **Elision** of the middle sound (e.g. *snail–sail*) or syllable (*alligator* without the *ga*).
- **Correspondence** – e.g. tapping out the number of syllables in a word.

Many of these activities are very suitable for playing at home, so parental involvement is strongly encouraged. Many phonological discrimination activities are also useful for phonological training. For ideas on phonological awareness activities see Goswami and Bryant (1990); Layton and Upton (1992); Layton, Deeney, Tall and Upton (1996); James, Kerr and Tyler (1994); Yopp (1992). *Sound Linkage* (Hatcher, Duff and Hulme, 2014) is based on the Cumbria project on phonological awareness (Hatcher, Hulme and Ellis, 1994) and includes materials for testing and training. Snowling and Stackhouse (2006) provide a useful compendium of recommendations on teaching dyslexic students with speech and language difficulties.

Recommended computer-based activities for practising phonological skills include ***Tizzy's Toybox*** and ***Talking Animated Alphabet*** (Sherston); ***Letterland***; and ***Sounds and Rhymes*** (Xavier).

In general, younger students respond well to phonological training activities and skills swiftly improve. However, some dyslexic students may have more persistent difficulties that will require particularly careful literacy teaching. In such cases, a well-structured multisensory approach incorporating plenty of practice in phonic skills (over-learning) is recommended. Examples of suitable schemes are given later. Without phonological awareness training, many students with such weaknesses are liable to develop an over-reliance on visual (whole word) and contextual strategies in reading (especially if they are bright). They can easily slip through the net, only to re-appear as a student who is failing in reading and spelling later in their schooling.

Poor auditory working memory

When interpreting results from ***Races*** and ***Letter names***, comparison should be made with the other memory subtests in CoPS as well as the other auditory tests. The teacher should ask which of the following is the case?

- the student has general *associative* memory difficulties (visual as well as verbal)
- the student has general *sequential* memory difficulties (visual as well as verbal)
- the student has general auditory memory difficulties
- the student has *specific* difficulties in auditory *associative* memory
- the student has *specific* difficulties in auditory *sequential* memory
- the student has general auditory processing difficulties
- the student has a combination of some the above difficulties

Selection of appropriate teaching and training activities will depend to a large extent on the answers to this question, as well as on the severity of the difficulties. The more extensive and the more severe the memory problems, the more difficult they will be to remediate. Nevertheless, memory remediation activities should always be considered. It is tempting to suggest that because a student has auditory processing difficulties of some kind then the solution is to teach the child to use only visual strategies for reading instead of teaching phonic decoding skills. However, this could result in the student having greater difficulties later on.

Auditory memory training activities

Commonly, weaknesses in either phonological awareness or auditory discrimination are easier to improve through direct training than memory limitations are, especially with younger students. On the other hand, older students can respond well to *metacognitive* approaches to memory improvement, i.e. techniques designed to promote understanding of their own memory limitations and to develop appropriate compensatory strategies (Buzan, 2006; Reid, 2016). However, that does not mean that memory training is not worthwhile with young students. Indeed, it may well be the case that with improved training techniques, remediation of memory weaknesses could turn out to be a much more promising approach in the future. The emphasis should be on variety and

on stretching the student steadily with each training session. The tasks should not be too easy for the student (which would be boring) nor much too difficult (which would be discouraging), but they should give just the right amount of challenge to motivate the student to maximum effort. Use of prizes, star charts for improvement etc., should all be used if these will help motivation. Activities can usually be carried out at home as well as in school. Competition can be motivating for some students, but it can also be discouraging for the student with severe difficulties, because they will easily perceive and be embarrassed by the discrepancy between their performance and that of others.

Auditory memory training activities include:

- **I went to the supermarket** – teacher says sentences of increasing length and complexity and the student has to repeat these back verbatim (e.g. *'I went to the supermarket and bought three tins of beans, one loaf of bread, a carton of milk, a packet of sweets, two bars of chocolate...'* etc.)
- **Find the changed (or missing) word** – teacher says a sequence of words to the student (e.g. *dog, cat, fish, monkey, spider*) and then repeats it changing one (or missing one out altogether), either slightly or more obviously (e.g. *dog, cat, fox, monkey, spider*) and the student has to identify the change.
- **What's their job?** – Teacher says a list of name-occupation associations (e.g. *'Mr Pearce the painter, Mrs Jolly the teacher, Mr Fish the hairdresser, Miss Brown the electrician'*) and then asks for recall of one (e.g. *'Who was the teacher?'* or *'What is Miss Brown's job?'*).
- **Word repetition** – teacher says sequences of unrelated words to the student (e.g. *hat, mouse, box, cup, ladder, tree, biscuit, car, fork, carpet*) and the student has to repeat them in the correct order. The length of the list can be gradually extended. If the words are semantically related it is more difficult, and if they are phonologically related (e.g. *fish, film, fog, fun, phone, finger*) it is more difficult still.
- **Phoneme repetition** – as word repetition, but with phonemes ('*oo, v, s, er, d*'). Note that phonologically similar lists will be much more difficult (e.g. '*p, b, k, d, t*')
- **Letter name repetition** – as word repetition, but with letter names.
- **Digit repetition** – as word repetition, but with digits. About one per second is maximum difficulty for short sequences. Slightly faster or slower rates are both, generally, easier to remember, but dyslexics tend to find a slower sequence harder (because their rehearsal processes in working memory are deficient).

Recommended computer software for developing auditory memory includes *Mastering Memory* (CALSC), which is a very flexible tool for practising memory strategies, but it does require quite a lot of teacher input. Use of the phonic teaching system ***AcceleRead***, ***AcceleWrite*** (Iansyst) has also been found to improve working memory ability (Miles, 2000).

Teaching phonics

For the reasons explained above, the student who displays major difficulties in *auditory* memory is likely to have problems in acquiring effective phonic skills. The recommendations here would be for a highly-structured *multisensory phonic approach* to literacy learning. This should not only provide

ample practice to compensate for memory weakness, but it should also make use of the student's strong visual skills in order to reinforce learning and help to maintain confidence.

Examples of well-structured phonics schemes suitable for younger students with dyslexic difficulties include: ***Alpha to Omega, Toe by Toe, The Bangor Dyslexia Teaching System, The Phonics Handbook, Sound Linkage, Spelling Made Easy, The Hickey Multisensory Language Course, Star Track Reading and Spelling, Sounds-Write*** and ***Sound Discovery***.

Good computer software for practising phonic skills includes: ***Wordshark5, Talking Animated Alphabet, Nessy*** and ***Lexia***. ***Wordshark5*** offers 60 different computer games which use sound, graphics and text to teach and reinforce word recognition and spelling. The program includes phonics, onset and rime, homophones, spelling rules, common letter patterns, visual and auditory patterns, prefixes, suffixes, roots, word division, high frequency words, use of words in context, alphabet and dictionary skills and more. In an evaluation of ***Wordshark*** in 403 schools (Singleton and Simmons, 2001), teachers reported significant benefits to reading, spelling and confidence in using the program. ***Talking animated alphabet*** helps young children develop their knowledge of the shapes, sounds and names of the alphabet. ***Nessy Reading and Spelling*** is an online program including 100 structured lessons for students (aged 5–12) to work through. ***Lexia*** (suitable for Reception to Year 6) provides explicit, systematic, personalised learning in six areas of reading instruction (phonological awareness, phonics, structural analysis, automaticity/fluency, vocabulary and comprehension). ***Lexia*** is web-enabled, allowing students to access the software seamlessly between school and home.

Use of a talking word processor is beneficial because it gives the student auditory feedback and encourages them to pay attention to the phonic components of words when writing. For example: ***Clicker 7, DocsPlus, SymWriter 2*** and ***Texthelp Read and Write***.

A generic structured learning scheme such as ***AcceleRead***, ***AcceleWrite*** (Iansyst) can be used with any good talking word processor. Further information on techniques for teaching the dyslexic child can be found in Augur (1996); Cooke (2002); Crombie (2018); Hornsby (1995); Pollock, Waller and Politt (2004); Reid (2016); Thomson and Watkins (2007).

Visual memory difficulties

It is widely acknowledged that the predominant problems found in dyslexic students are phonological rather than visual (Pumfrey and Reason, 1991; Snowling, 2000; Snowling and Thomson, 1991). Indeed, dyslexic individuals often have excellent visual skills (West, 2009). Nevertheless, teachers and educational psychologists are not infrequently confronted by cases of young students who appear to have inordinate difficulties in remembering various types of information presented visually.

Structured phonics work, with ample practice (over-learning) will compensate for visual memory weaknesses. A multisensory approach is strongly recommended, building on any auditory and kinaesthetic strengths.

Visual memory training activities

- **Find the missing part** – create pictures of everyday things with parts of the pictures missing (e.g. doll with one arm, table with only three legs) and ask the student to identify what is missing. To do this the student has to recall visual images of the relevant objects.
- **What's wrong here** – use pictures of everyday things with parts of the pictures wrong (e.g. house with the door halfway up the wall; person with feet pointing backwards instead of forwards) and ask the student to identify what is wrong. To do this the student has to recall visual images of the relevant objects.
- **Kim's game** – place an array of familiar objects on a tray (or picture of an array of objects). The student scans this for two minutes (or whatever period of time is appropriate) and then has to remember as many as possible.
- **Symbols** – show the student a sequence of symbols, letters or shapes of increasing length, and then jumble them up and the student has to rearrange them in the correct order. Remember that this can become more of a verbal task than a visual task – if you want to practice visual skills then it is best to have stimuli which are not easily verbally coded, like the ones in ***Letters***. NB: the exact symbols from ***Letters*** should not be used otherwise this test will not be suitable for monitoring the student's progress.
- **Who lives here?** – make a set of pictures of people (these may be cut from magazines) and a set of houses of different colours, or different appearance in some way. The people are matched with the houses, and then jumbled up. The student has to rearrange them in the correct relationship. If the people are given names, then the task becomes more verbal.
- **Pelmanism** – put pairs of cards upside down and jumble them up. Pelmanism is a game of remembering matching pairs of cards from a set, where cards are individually turned over and then turned back. The student has to remember where the other one of the pair is, and if both are located these are removed from the set, and so on.
- **Card games** – e.g. Snap, Happy Families.

A recommended computer program for developing visual memory skills is ***Mastering Memory***.

Colour discrimination difficulties

Colour vision deficiencies are important because they can be a contributory factor in learning difficulties. Although they are not treatable, teachers and parents can help students adjust to this condition. Learning activities in the classroom must be adapted to allow for any colour vision problems detected in the student. In rare cases, dyslexic students can suffer from *colour anomia* – i.e. a neurological deficit which affects the extent and speed with which they are able to name colours. About 10% of dyslexic students have been reported to have this difficulty, which appears to be connected with visual and verbal memory in some way (Mattocks and Hynd, 1986).

Research and statistical information

Research background

Many students with dyslexia are not identified until they are about 10–12 years of age, by which time they have experienced so much failure that their motivation and self-confidence will have been seriously eroded. The *Special Educational Needs and Disability Code of Practice: 0-25 years* (Department for Education, 2014) places a legal duty on schools to identify and address all special educational needs (including dyslexia) as early as possible in the student's school career.

There is a well-established research literature documenting the principal underlying cognitive difficulties associated with the condition. These are in the areas of memory, sequential information processing, phonological awareness, and in some cases, visual-perceptual difficulties (Ellis and Large, 1987; Goswami and Bryant, 1990; Jorm et al., 1986; Pumfrey and Reason, 1991; Singleton, 1987, 1988; Singleton and Thomas, 1994a; Thomson, 1989; Snowling, 2000). The CoPS project used this scientific knowledge of the cognitive precursors of dyslexic difficulties to formulate *objective* early identification procedures that could be used easily by teachers in the ordinary classroom. The precision, objectivity and flexibility of the computer made it an appropriate and cost-effective tool for assessing such cognitive abilities and deficits, as well as enabling the creation of tests in the form of games which increases the child's motivation and interest in the task (Singleton, 1997b, 2001, 2003). The overall rationale for the CoPS project was that early intervention with students identified as being at risk of dyslexia or literacy difficulties is not just desirable on educational grounds. It is also more cost effective than waiting until these students have experienced several years of failure and have lagged so far behind their peers that very expensive specialist remediation has to be provided. The early intervention approach means that appropriately structured teaching can be provided in the ordinary classroom.

The longitudinal study 1990–1995

The research that led to the development of CoPS was carried out in a 5-year longitudinal study conducted at the Department of Psychology, University of Hull, UK.

Twenty-seven computer tests were created in order to assess various cognitive abilities, including visual, verbal, associative, sequential and spatial memory skills, as well as phonological awareness, auditory discrimination, visual processing capacity and other important linguistic and perceptual skills. A total of 400 students, aged 5 years, in 24 schools were administered these computer tasks, and their literacy, numeracy and intellectual development was followed up over the next four years, using a variety of standardised psychological measures. The follow-up data was then used to determine which of the computer tests were most effective predictors of dyslexia and other learning difficulties.

It is important to note that this system does not involve labelling students as 'dyslexic' at the age of five years. Rather, the purpose of the tests is to identify students who are likely to experience significant difficulty in acquiring literacy skills because of underlying cognitive deficits which are known to be associated with dyslexia. Some of these students may well be giving cause for concern for other reasons (e.g. because they have a history of speech and language problems) but many of them would otherwise be liable to pass undetected for some time. The hope is that such students can be given appropriate teaching and support so that their cognitive difficulties do not significantly impede their literacy development.

Results of the longitudinal study

The results of the longitudinal study showed that some of the computer tests gave a highly satisfactory prediction of students who later were found to be experiencing literacy difficulties and dyslexia. These computer tests produced significant correlations with reading development, many of which had higher correlation coefficients than were found between intelligence (verbal and non-verbal) and reading development. Over 90% of students who subsequently were found to be experiencing significant literacy difficulties were successfully predicted by the computer tests alone on school entry. Since CoPS is designed to be used as a screening device it is important to specify the levels of false negatives and false positives; CoPS produced 16.7% false negatives and 2.3% false positives. This compares very favourably with other screening devices (Singleton, 1997a). 'False negatives' and 'false positives' are the two types of classification error in screening. False negatives are cases where the screening device fails to identify a risk when a risk does in fact exist; false positives are cases where the screening device has identified a risk when a risk does not in fact exist. Various statistical techniques were used to determine which of the computer tests were most effective in predicting later difficulties (predictive validity), and eight of these were selected for the final software suite. For details of the statistical analyses carried out see Singleton, Thomas and Horne (2000).

Composition of the CoPS suite of subtests

The composition of the final suite of subtests in CoPS is shown in Table 5. To the eight subtests giving the most useful prediction of later literacy difficulties and dyslexia, a ninth supplementary subtest (***Clown***) was added, in order to assess colour discrimination. The purpose of this was to determine cases where students may score low on either or both of the two visual memory tests ***Crayons*** and ***Toybox***, which depend on the student having competent colour discrimination (although not necessarily the ability to name colours). In such cases, if the student experiences colour discrimination difficulties then these, rather than memory limitations, could result in low scores.

Table 5. The nine subtests in CoPS

Subtest name	Cognitive skills being assessed
Rabbits	Visual spatial sequential memory (spatial/temporal position)
Crayons	Visual-verbal sequential memory (colours)
Toybox	Visual associative memory (shape and colour/pattern)
Letters	Visual sequential memory (symbols)
Letter names	Visual-verbal associative memory (names and symbols)
Races	Auditory sequential memory (animal names)
Rhymes	Phonological awareness (rhyming and alliteration)
Wock	Auditory discrimination (phonemes)
Clown	Colour discrimination

Standardisation of CoPS

CoPS underwent a full national re-standardisation in May – July 2019. The standardisation was conducted in 43 schools (England n = 32; Northern Ireland n = 8; Wales n = 1; Scotland n = 1; Republic of Ireland n = 1). Of those schools where an Ofsted assessment has been published, 27% were rated as Outstanding, 64% were rated as Good and 9% were rated as Requiring Improvement (which compares reasonably well to national figures for the 2018/19 academic year: 20% Outstanding; 66% Good; 11% Requires improvement). The number of students on the roll for the sample schools ranged from 30 to 683, with an average of 262.

School characteristics (where these were available on Gov.uk or the equivalent websites for Scotland, Wales, Northern Ireland and the Republic of Ireland) for the sample schools were compared to the national average (for English state-funded Primary schools) – see Table 6. It can be seen that the schools overall included a slightly higher proportion of girls than the national average and a slightly lower proportion of pupils with an ECHP than the national average.

Table 6. Characteristics of schools within the standardisation sample

School characteristic	School sample Mean	National average
Girls on roll	51.8%	48.7%
Pupils with an SEN Education, Health and Care Plan	2.0%	3.1%
SEN Support	12.8%	12.2%
Pupils whose first language is not English	20.5%	21.3%
Pupils eligible for free school meals at any time during the past 6 years	23.7%	24.3%

Within the selected schools, students were included in the standardisation on an entire class basis, to avoid any selection bias. The number of students completing each subtest, within each age group of the standardisation sample, are shown in Table 7.

Table 7. Students per age group for each subtest

Subtest	Age 4	Age 5	Age 6	Age 7	Total
Rabbits	131	260	428	603	1422
Crayons	92	187	302	509	1090
Toybox	148	276	440	641	1505
Letters	138	277	438	631	1484
Letter names	140	285	442	642	1509
Races	142	267	443	611	1463
Rhymes	126	262	432	599	1419
Wock	139	267	436	582	1424
Clown	164	308	472	725	1669

Demographic information concerning the students within the standardisation sample are given in Table 8 (note that information was not provided for all students). Population parameters are also provided, but these are based only on English state-funded Primary schools, whereas the sample also includes students from Northern Ireland, Wales, Scotland and the Republic of Ireland, so the comparisons are limited. It can be seen that the sample included a slightly higher proportion of female students than the national average for English state-funded Primary schools. With regards to ethnicity, the sample has a higher proportion of Asian students than is found in the population and lower proportions of White and Black students, although ethnicity information was not provided for 12.6% of the sample (proportions of Mixed and Other ethnicity students within the sample is representative of population parameters). The number of students within the sample who are eligible for Free School Meals is similar to that within the population. With regard to language, the percentage of students within the sample speaking English as an Additional Language is slightly higher than the population average. The proportion of students within the sample with a diagnosed SEN is similar to that within the population, whereas those with an Education, Health and Care plan is a little lower than the national average. However, the CoPS sample only includes students aged 4–7, who are less likely to have an EHCP already in place than those within the full primary age range, which the population parameters are based on.

Table 8. Demographic details of sample

Variable	Classification	Percentage of sample	Population parameters*
Gender	Male	44.7%	51.3%
	Female	51.2%	48.7%
	Not available	4.1%	
Ethnicity	White	52.5%	73.6%
	Asian	23.8%	11.7%
	Black	2.4%	5.5%
	Mixed	7.0%	6.3%
	Other	1.7%	2.0%
	Not available	12.6%	1.0%
Free School Meals (FSM)	Eligible for FSM	14.8%	15.8%
	Not eligible for FSM	76.3%	
	Not available	8.9%	
English as an Additional Language (EAL)	EAL	24.2%	21.2%
	Not EAL	53.5%	
	Not available	22.3%	
Special Educational Need / Disability (SEND)	Diagnosed SEND	13.2%	14.2%
	Suspected SEND	2.1%	
	No SEND	82.2%	
	Not available	2.5%	
Education, Health and Care Plan (EHCP)	Has EHCP	0.9%	1.6%
	No EHCP	91.5%	
	Not available	7.6%	

* Based on DfE school census data for English state-funded Primary schools, January 2019

Of the standardisation sample, 91% undertook the tests using desktop computers, whilst 9% used tablets. Analysis showed that on seven of the eight main tests (not including ***Clown***), there was evidence of a platform effect, with students using desktops outperforming those using tablets. However, it is possible that these differences are due to school effects, with the schools that used tablets showing higher proportions of students being eligible for free school meals, and more students with SEND support/ECHPs than the schools using desktops.

The sample data has been weighted according to age, gender and SEND proportion against population parameters. Using a non-parametric age-standardisation model, the raw scores for each age group were transformed into Standardised Age Scores (SAS) with a mean of 100 and a standard deviation of 15. This builds on previous work conducted by Schagen (1990). SAS scores for the subtests range from 65 to 135, although on subtests where there is a ceiling effect, the SAS is capped at the upper end. However, the caps do not distort the scoring at the lower end of abilities, which are those most commonly interested in.

Table 9 shows the correlations between the main CoPS subtests (i.e. all except ***Clown***). The correlations range from .194 to .491. All correlations are significant at the p<.001 level. The CoPS subtests all measure distinct constructs. However, the table indicates that those subtests where there is some overlap in the underlying skills (e.g. ***Rabbits, Crayons*** and ***Letters*** all being visual subtests) show higher levels of correlation than those subtests utilising entirely different skills (e.g. ***Rhymes*** and ***Letter names***; or ***Wock*** and ***Letters***).

Table 9. Intercorrelations between subtests

	Rab	Cr	To	Le	LN	Rac	Rh	Wo
Rabbits (Rab)	1							
Crayons (Cr)	.437* (987)	1						
Toybox (To)	.376* (1333)	.299* (998)	1					
Letters (Le)	.403* (1330)	.491* (1012)	.330* (1375)	1				
Letter names (LN)	.311* (1329)	.340* (1022)	.194* (1381)	.283* (1385)	1			
Races (Rac)	.378* (1293)	.440* (983)	.311* (1370)	.339* (1347)	.317* (1354)	1		
Rhymes (Rh)	.270* (1261)	.350* (965)	.284* (1348)	.291* (1309)	.194* (1304)	.363* (1315)	1	
Wock (Wo)	.304* (1259)	.325* (952)	.262* (1360)	.245* (1302)	.295* (1306)	.376* (1306)	.278* (1288)	1

* all correlations are significant at p<.001; (N is shown in brackets)

In order to check for any gender bias, comparisons were made between males and females (where gender had been identified) on each subtest (see Table 10). A small effect was found on ***Crayons*** slightly favouring girls. There were no other gender effects.

Table 10. Gender differences

Subtest	Gender	N	Mean	SD	SE of Mean	Cohen's d*
Rabbits	Female	752	101.44	15.244	0.556	0.01
	Male	618	101.34	15.252	0.614	
Crayons	Female	597	101.66	14.549	0.595	0.20
	Male	454	98.63	15.204	0.714	
Toybox	Female	784	102.12	15.097	0.539	0.09
	Male	670	100.83	14.835	0.573	
Letters	Female	784	101.87	15.334	0.548	0.09
	Male	651	100.49	14.540	0.570	
Letter names	Female	786	101.97	15.080	0.538	0.05
	Male	669	101.23	14.613	0.565	
Races	Female	764	101.55	14.798	0.535	0.12
	Male	648	99.80	14.871	0.584	
Rhymes	Female	744	101.23	13.013	0.477	0.19
	Male	625	98.75	13.097	0.524	
Wock	Female	742	102.46	14.633	0.537	0.00
	Male	634	102.40	15.121	0.601	

* Cohen's d is a measure of effect size of the difference between two means

Checks were also made for ethnic group bias. Due to the small numbers in some ethnic minority groups, comparisons were made between White students and Other ethnic groups combined (where ethnicity had been identified) on each subtest (see Table 11). Small effects were found on ***Races*** and ***Rhymes***, slightly favouring White students. There were no other ethnicity effects.

Table 11. Ethnic group differences

Subtest	Ethnicity	N	Mean	SD	SE of Mean	Cohen's d*
Rabbits	White	790	102.08	15.180	0.540	0.04
	Other	447	101.50	15.464	0.731	
Crayons	White	607	100.43	14.778	0.600	0.03
	Other	341	100.05	15.600	0.845	
Toybox	White	835	101.07	14.902	0.516	0.13
	Other	481	102.96	14.935	0.681	
Letters	White	824	101.74	14.922	0.520	0.10
	Other	476	100.24	15.011	0.688	
Letter names	White	849	102.40	14.879	0.511	0.09
	Other	473	101.03	15.035	0.691	
Races	White	802	102.37	14.840	0.524	0.21
	Other	473	99.21	14.618	0.672	
Rhymes	White	775	101.25	12.081	0.460	0.24
	Other	457	98.07	13.412	0.627	
Wock	White	783	103.79	14.649	0.524	0.18
	Other	459	101.12	15.144	0.707	

* Cohen's d is a measure of effect size of the difference between two means

Reliability

'Reliability' generally refers to the extent to which a test can be expected to give the same results when administered on a different occasion (test-retest reliability) or to which the components of a test give consistent results (internal consistency).

Internal consistency is a measure of whether each item in a test measures the same concept. There are several methods of calculating this, although the most commonly used is Cronbach's alpha, which is based on the ratio of the sum of the individual item variances to the overall subtest score variance. However, Cronbach's alpha presumes a complete set of responses to the items, since all items need to contribute to the factor score equally, which is not case with all the CoPS subtests. Therefore, the formula used is the standardised Cronbach's alpha (shown below), which is based on the average non-redundant item correlation.

$$\alpha\ standardised = \frac{\text{(Number of items x mean of non redundant correlations)}}{\text{(1+((Number of items-1) x mean of non redundant correlations))}}$$

Table 12 shows the standardised Cronbach's alpha estimates for 4–6-year olds and 7-year-olds – these are given separately due to different test items being delivered to the two age groups (except for ***Clown***). An internal consistency of $\alpha > .7$ is generally considered to be adequate, whilst $\alpha > .8$ is deemed as good, and $\alpha > .9$ as excellent. It can be seen from Table 12 that ***Toybox*** shows an excellent level of internal consistency, with the majority of the remaining subtests showing a good level, and a few at an adequate level. ***Letter names*** is showing a lower level of internal consistency due to the limited number of items on this particular subtest.

Table 12. Internal consistency

Subtest	Standardised α Ages 4-6	Standardised α Ages 7
Rabbits	.841	.818
Crayons	.822	.736
Toybox	.927	.897
Letters	.673	.768
Letter names	.457	.535
Races	.786	.730
Rhymes	.856	.823
Wock	.737	.735
Clown	.815	.815

Test-retest reliability estimates the degree to which a test provides stable measurements over time. A small subset of the CoPS standardisation sample (n = 80) repeated the CoPS subtests 4-6 weeks after the first administration. Correlations (using Pearson's r) between scores on the two sittings are given in Table 13. A correlation of .60 is considered to be an adequate level of test-retest reliability, and .70 considered as good. As can be seen in Table 13, ***Rhymes*** shows a good level of test-retest reliability. The remaining subtests are mostly within or around the acceptable level, although ***Letter names*** and ***Wock*** are a little below. This may be due to the limited number of items, and an enhanced practice effect (due to prior exposure to the symbol-name pairings), on ***Letter names*** and a slight ceiling effect on both of these subtests.

Table 13. Test-retest reliability

Subtest	Pearson's r
Rabbits	.51
Crayons	.63
Toybox	.62
Letters	.61
Letter names	.43
Races	.53
Rhymes	.76
Wock	.36

Validity

Given that only a very small proportion of dyslexic students are diagnosed prior to the age of 8, construct validity based on differences between dyslexics and non-dyslexics on the CoPS subtests would not be viable.

However, the predictive validity of CoPS is shown through the original longitudinal study which indicates that CoPS gives a highly satisfactory prediction of students who were later found to be experiencing literacy difficulties and dyslexia. The CoPS subtests produced significant correlations with reading development. Over 90% of students who subsequently were found to be experiencing significant literacy difficulties were successfully predicted on school entry by the CoPS subtests alone.

References

A

American Psychiatric Association (2013) *Diagnostic and Statistical Manual for Mental Disorders* (5th edition) (DSM-V). Washington, DC: APA.

Amor, L.B., Grizenko, N., Schwartz, G., Lageix, P., Baron, C., Ter-Stepanian, M., Zappitelli, M., Mbekou, V. and Joober, R. (2005) Perinatal complications in children with attention-deficit hyperactivity disorder and their unaffected siblings. *Journal of Psychiatry and Neuroscience, 30(20)*, 120-126.

Anderson, D.M. and Fairgrieve, E. (1996) Assessment of sensori-motor impairments. In L. Harding and J.R. Beech (Eds.) *Assessment in Neuropsychology*. London: Routledge, pp. 82-96.

Augur, J. (1996) *This book doesn't make sense.* Second edition. London: Whurr.

Avons, S.E. and Hanna, C. (1995) The memory-span deficit in children with specific reading disability: is speech rate responsible? *British Journal of Developmental Psychology, 13*, 303-311.

Awaida, M. and Beech, J.R. (1995). Children's lexical and sublexical development while learning to read. *Journal Experimental Education, 63*, 97-113.

Ayres, A.J. (1985) *Developmental Dyspraxia and Adult Onset Dyspraxia*. Torrance, CA: Sensory Integration International.

Ayres, A. J. (1988) *Sensory integration and praxis tests*. Los Angeles: Western Psychological Services.

B

Baddeley, A.D. (1986) Working memory, reading and dyslexia. In E. Hjelmquist and L. Nilsson (Eds.) *Communication and handicap: aspects of psychological compensation and technical aids*. Amsterdam: Elsevier.

Barnett, A., Henderson, S.E. and Sugden, D.A. (2007) *Movement Assessment Battery for Children – Second Edition*. Oxford: Pearson Assessment.

Beardsworth, E. and Harding, L. (1996) Developmental neuropsychology and the assessment of children. In L. Harding and J.R. Beech (Eds.) *Assessment in Neuropsychology*. London: Routledge, pp.16-46.

Beech, J.R. (1997) Assessment of memory and reading. In J. Beech and C.H. Singleton (Eds.) *The Psychological Assessment of Reading*, 143-159. London: Routledge.

Beery, K.E., Beery, N.A. and Buktenica, N.A. (2010) *Developmental Test of Visual-Motor Integration – Sixth Edition*. Oxford, UK: Pearson Assessment.

Bode, S. and Content, A. (2011) Phonological awareness in Kindergarten: A field study in Luxembourgish schools. *European Journal of Psychology of Education, 26*(1), 109-128.

Bogon, J., Finke, K., Schulte-Korne, G., Muller, H.J., Schneider, W.X. and Stenneken, P. (2014) Parameter-based assessment of disturbed and intact components of visual attention in children with developmental dyslexia. *Developmental Science, 17*(5), 697-713.

Boon, M. (2010) *Understanding dyspraxia: A guide for parents and teachers*. London: Jessica Kingsley Publishers.

Brady, S. (1986) Short-term memory, phonological processing and reading ability. *Annals of Dyslexia, 36*, 138-153.

Bradley, L. (1980) *Assessing reading difficulties*. Windsor: NFER-Nelson.

Bradley, L. and Bryant, P.E. (1983) Categorising sounds and learning to read: a causal connection. *Nature, 271*, 746-747.

Bryant, P.E. and Bradley, L. (1985) *Children's reading problems: psychology and education*. London: Blackwell.

Buzan, A. (2006) *Use your memory: Understand your mind to improve your memory and mental power*. London: BBC Books.

C

Catts, H.W., Adlof, S.M., Hogan, T. and Weismer, S.E. (2005) Are specific language impairment and dyslexia distinct disorders? *Journal of Speech, Language and Hearing Research, 48*(6), 1378-1396.

Cooke, A. (2002) *Tackling dyslexia – Second Edition*. Chichester: Wiley.

Chiappe, P., Chiappe, D.L. and Siegel, L.S. (2001) Speech perception, lexicality and reading skill. *Journal of Experimental Child Psychology, 80*(1), 58-74.

Cline, T. (2000) Multilingualism and dyslexia: Challenges for research and practice. *Dyslexia: An international journal of research and practice, 6*(1), 3-12.

Cline, T. and Frederickson, N. (1999) Identification and assessment of dyslexia in bi/multilingual children. *International Journal of Bilingual Education and Bilingualism, 2*(2), 81-93.

Cline, T. and Shamsi, T. (2000) *Language Needs or Special Needs? The Assessment of Learning Difficulties in Literacy Among Children Learning English as an Additional Language: A Literature Review*. Norwich: DfEE.

Cooper, P. and Bilton, K. M. (2002) *Attention Deficit / Hyperactivity Disorder: A practical guide for teachers (Second Edition)*. London: Routledge.

Crivelli, V. (2013) *Using technology to support dyslexic pupils*. Bracknell, UK: British Dyslexia Association.

Crombie, M. (2018) *Dyslexia: A practical guide for teachers*. Wakefield, UK: SEN Books.

D

Durkin, C. (2000) Dyslexia and bilingual children – Does recent research assist identification? *Dyslexia: An international journal of research and practice, 6*(4), 248-267.

E

Ellis, N.C. and Large, B. (1987) The development of reading. *British Journal of Psychology, 78*, 1-28.

Evans, M.A., Shaw, D. and Bell, M. (2000) Home literacy activities and their influence on early literacy skills. *Canadian Journal of Experimental Psychology, 54*(2), 65-75.

F

Falth, L., Gustafson, S. and Svensson, I. (2017) Phonological awareness training with articulation promotes early reading development. *Education, 137*(3), 261-276.

Fisher, A. G., Murray, E. A. and Bundy, A.C. (1991) *Sensory integration, theory and praxis*. Phil, PA: F.A. Davis.

G

Gathercole, S.E. and Baddeley, A.D. (1993) Phonological working memory: A critical building block for reading development and vocabulary acquisition? *European Journal of Psychology of Education, 8*(3), 259-272.

Gathercole, S.E., Packiam-Alloway, T., Willis, C. and Adams, A-M. (2006) Working memory in children with reading disabilities. *Journal of Experimental Child Psychology, 93*(3), 265-281.

Germano, E., Gagliano, A. and Curatolo, P. (2010) Comorbidity of ADHD and dyslexia. *Developmental Neuropsychology, 35*(5), 475-493.

Goldstein, S. and Goldstein, M. (1993) *Hyperactivity – why won't my child pay attention?* New York: John Wiley and Sons, Inc.

Goldstein, S. and Goldstein, M. (1998) *Managing attention deficit hyperactivity disorder in children: a guide for practitioners*. New York: John Wiley and Sons, Inc.

Goswami, U. (1994) Onsets and rimes as functional units in reading. In E.M.H. Assink (Ed.) *Literacy acquisition and social context*. Hemel Hempstead: Harvester Wheatsheaf, pp. 47-69.

Goswami, U. (1999) Causal connections in beginning reading: The importance of rhyme. *Journal of Research in Reading, 22*(3), 217-240.

Goswami, U. (2001) Rhymes are important: a comment on Savage. *Journal of Research in Reading, 24*(1), 19-29.

Goswami, U. (2012) Reading and spelling: revisiting Bradley and Bryant's study. In A.M. Slater & P.C. Quinn (Eds) *Developmental Psychology: Revisiting the classic studies* (pp. 132-147). London: Sage Publications.

Goswami, U. and Bryant, P.E. (1990) *Phonological skills and learning to read*. London: Erlbaum.

Gueze, R.H. (2007) Characteristics of DCD: On problems and prognosis. In R.H. Gueze (Ed.) *Developmental Coordination Disorder: A review of current approaches*. Marseille, France: Solal.

H

Hatcher, P.J., Duff, F.J. and Hulme, C. (2014) *Sound linkage: an integrated programme for overcoming reading difficulties (Third Edition)*. Chichester, UK: John Wiley and Sons.

Hatcher, P.J, Hulme, C., and Ellis, A.W. (1994) Ameliorating early reading failure by integrating the teaching of reading and phonological skills. *Child Development, 65*, 41-57.

Hatcher, P.J., Hulme, C. and Snowling, M. (2004) Explicit phoneme training combined with phonic reading instruction helps young children at risk of reading failure. *Journal of Child Psychology and Psychiatry, 45*(2), 338-358.

Hoare, D. and Larkin, D. (1991) Coordination problems in children. *National Sports Research Centre Review, 18*, 1-16.

Holligan, C. and Johnston, R. (1988) The use of phonological information by good and poor readers in memory and reading tasks. *Memory and Cognition, 16*, 522-532.

Holmes, J., Hilton, K.A., Place, M., Alloway, T.P., Elliott, J.G. and Gathercole, S.E. (2014) Children with low working memory and children with ADHD: same or different? *Frontiers in Human Neuroscience, 8*, 976.

Hornsby, B. (1995) *Overcoming dyslexia: A straightforward guide for families and teachers*. London: Random House.

Hulme, C. and Snowling, M.J. (1991) Phonological deficits in dyslexia: A 'sound' re-appraisal of the verbal deficit hypothesis? In N. Singh and I. Beale (Eds.) *Progress in Learning Disabilities*. Berlin: Springer-Verlag.

Hurford, D.P. and Sanders, R.F. (1990) Assessment and remediation of a phoneme discrimination deficit in reading disabled second and fourth graders. *Journal of Experimental Child Psychology, 50*, 396-415.

J

James, F., Kerr, A., and Tyler, B. (1994) Sounds interesting: *Practical ideas for developing phonics in the classroom*. Ipswich: Suffolk County Council Education Department.

Jeffries, S. and Everatt, J. (2004) Working memory: Its role in dyslexia and other specific learning difficulties. *Dyslexia, 10*(3), 196-214.

Jorm, A.F. (1983) Specific reading retardation and working memory: a review. *British Journal of Psychology, 74*, 311-342.

Jorm, A.F., Share, D.L., MacLean, R. and Matthews, R. (1986) Cognitive factors at school entry predictive of specific reading retardation and general reading backwardness: a research note. *Journal of Child Psychology and Psychiatry, 27*, 45-54.

K

Keates, A. (2002) *Dyslexia and Information and Communication Technology: A Guide for Teachers and Parents*. London: Routledge.

Kirby, J.R., Desrochers, A., Roth, L. and Lai, S.S.V. (2008) Longitudinal predictors of word reading development. *Canadian Psychology, 49*(2), 103-110.

Kjeldsen, A-C., Karna, A., Niemi, P., Olofsson, A. and Witting, K. (2014) Gains in training in phonological awareness in Kindergarten predict reading comprehension in Grade 9. *Scientific Studies of Reading, 18*(6), 452-467.

Knuckey, N.W. and Gubbay, S. S. (1983) Clumsy children: a prognostic study. *Australian Paediatric Journal, 19*, 9-13.

L

Layton, L., Deeney, K., Tall, G. and Upton, G. (1996) Researching and promoting phonological awareness in the nursery class. *Journal of Research in Reading, 19*(1), 1-13.

Layton, L. and Upton, G. (1992) Phonological training and the pre-school child. *Education 3-13*, 20, 34-36.

Liu,W., Shu, H. and Yang, Y. (2009) Speech perception deficits by Chinese children with phonological dyslexia. *Journal of Experimental Child Psychology, 103*(3), 338-354.

Lord, R. and Hulme, C. (1987) Kinaesthetic sensitivity of normal and clumsy children. *Developmental Medicine and Child Neurology, 29*, 720-725.

Losse, A., Henderson, S.E., Elliman, D., Hall, D., Knight, E. and Jongmans, M. (1991) Clumsiness in children – do they grow out of it? A ten year follow-up study. *Developmental Medicine and Child Neurology, 33*, 55-68.

Lundberg, I., Frost, J. and Peterson, O. (1988) Effects of an intensive program for stimulating phonological awareness in pre-school children. *Reading Research Quarterly, 23*, 263-284.

M

McLoughlin, D., Fitzgibbon, G. and Young, V. (1994) *Adult Dyslexia: Assessment, Counselling and Training*. London: Whurr.

Manis, F.R., McBride-Chang, C., Seidenberg, M.S., Keating, P., Doi, L.M., Muson, B. and Petersen, A. (1997) Are speech perception deficits associated with developmental dyslexia? *Journal of Experimental Child Psychology, 56*, 64-84.

Mattocks, L. and Hynd, G.W. (1986) Color anomia: Clinical, developmental and neuropathological issues. *Developmental Neuropsychology, 2*(2) 101-112.

McBride-Chang, C. (1996) Models of speech perception and phonological processing in reading. *Child Development, 67*, 1836-1856.

McDougall, S. and Hulme, C. (1994) Short-term memory, speech rate and phonological awareness as predictors of learning to read. In C. Hulme and M. J. Snowling (Eds.) *Reading Development and Dyslexia*. London: Whurr.

Miles, M. (2000) *Using talking computers to help children experiencing literacy difficulties*. Unpublished Ph.D. thesis, University of Exeter.

Mortimore, T., Hansen, L., Hutchings, M., Northcote, A., Fernando, J., Horobin, L., Saunders, K. and Everatt, J. (2012) *Dyslexia and multilingualism: Identifying and supporting bilingual learners who might be at risk of developing SpLD / dyslexia*. British Dyslexia Association and the Lottery Fund. Research Reports for External Bodies. Bracknell, UK: The British Dyslexia Association.

N

Nicolson, R. I. (1990) *Hypermedia: An enabling technology for empirical psychology*. Unpublished.

P

Palmer, S. (2000) Development of phonological recoding and literacy acquisition: a four-year cross-sequential study. *British Journal of Developmental Psychology, 18*(4), 533-55.

Peer, L. and Reid, G. (Eds) (2016) *Multilingualism, literacy and dyslexia: Breaking down barriers for educators (Second edition)*. London: Routledge.

Piek, J. P. and Edwards, K. (1997) The identification of children with developmental coordination disorder by class and physical education teachers. *British Journal of Educational Psychology, 67*, 55-67.

Pollack, J., Waller, E. and Politt, R. (2004) *Day-to-day dyslexia in the classroom (Second Edition)*. London: Routledge.

Pumfrey, P.D. and Reason, R. (1991) *Specific Learning Disabilities (Dyslexia): Challenges and Responses*. NFER-Nelson.

R

Rack, J.P. (1994) Dyslexia: the phonological deficit hypothesis. In A. Fawcett and R. Nicholson (Eds.) *Dyslexia in children: multidisciplinary perspectives*. London: Harvester Wheatsheaf, pp. 5-38.

Rack, J. (1997) Issues in the assessment of developmental dyslexia in adults: theoretical and applied perspectives. *Journal of Research in Reading, 20*, 1997, 66-76.

Rack, J.P., Snowling, M.J. and Olson, R. K. (1992) The nonword reading deficit in developmental dyslexia: a review. *Reading Research Quarterly, 27*, 28-53.

Ramus, F., Rosen, S., Dakin, S.C., Day, B.L., Castellote, J.M., White, S. and Frith, U. (2003) Theories of developmental dyslexia: Insights from a multiple case study of dyslexic adults. *Brain, 126*, 841-865.

Rayner, K. and Polatsek, A. (1989) *The Psychology of Reading*. Hillsdale, N.J.: Erlbaum.

Reid, G. (2016) *Dyslexia: a practitioner's handbook* (5th Edition). Chichester, UK: Wiley.

Ripley, K., Daines, B. and Barrett, J. (1997) Dyspraxia: *A guide for teachers and parents*. London: Fulton.

Rose, J. (2009) *Identifying and teaching children and young people with dyslexia and literacy difficulties*. London: DCSF.

S

Saksida, A., Iannuzzi, S., Bogliotti, C., Chaix, Y., Démonet, J.-F., Bricout, L., ... Ramus, F. (2016) Phonological skills, visual attention span, and visual stress in developmental dyslexia. *Developmental Psychology, 52*(10), 1503-1516.

SASC (2013) *Updated guidance on the assessment of DCD / dyspraxia*. Evesham, UK: SpLD Assessment Standards Committee.

Savage, R. (2001) A re-evaluation of the evidence for orthographic analogies: a reply to Goswami (1999). *Journal of Research in Reading, 24*(1), 1-18.

Schagen,I.P. (1990) A method for the age standardization of test scores. *Applied Psychological Measurement, 14*(4), 387-393.

Shaywitz, S.E., Morris, R. and Shaywitz, B.A. (2008) The education of dyslexic children from childhood to young adulthood. *Annual Review of Psychology, 59*, 451-475.

Singleton, C.H. (1987) Dyslexia and cognitive models of reading. *Support for Learning, 2*, 47-56.

Singleton, C.H. (1988) The early diagnosis of developmental dyslexia. *Support for Learning, 3*, 108-121.

Singleton, C.H. (1997a) Screening for literacy. In J.R.Beech and C.H.Singleton (Eds) *Psychological Assessment of Reading*. London: Routledge.

Singleton, C.H. (1997b) Computer-based assessment of reading. In J.R.Beech and C.H.Singleton (Eds) *Psychological Assessment of Reading*. London: Routledge.

Singleton C. H. (2001) Computer-based assessment in education. *Educational and Child Psychology, 18*(3), 58-74.

Singleton, C.H. (2002) Dyslexia: Cognitive factors and implications for literacy. In G. Reid and J. Wearmouth (Eds.) *Dyslexia and Literacy: Theory and Practice*. London: Wiley, pp. 115-129.

Singleton, C.H. (2003) Using computer-based assessment to identify learning problems. In L. Florian and J. Hegarty (Eds.) *ICT and Special Educational Needs*. Open University Press.

Singleton, C.H. and Simmons, F.R. (2001) An evaluation of Wordshark in the classroom. *British Journal of Educational Technology, 32*(3), 317-330.

Singleton, C.H. and Thomas, K.V. (1994) Computerised screening for dyslexia, in C.H. Singleton (Ed.) *Computers and Dyslexia: Educational applications of new technology*, Dyslexia Computer Resource Centre, Univ. of Hull, pp. 172-184.

Singleton, C.H., Thomas, K.V. and Horne, J.K. (2000) Computer-based cognitive assessment and the development of reading. *Journal of Research in Reading, 23*(2), 158-180.

Snowling, M. J. (1995) Phonological processing and developmental dyslexia. *Journal of Research in Reading, 18*(2), 132-138.

Snowling, M. J. (2000) *Dyslexia* (Second edition). Oxford: Blackwell.

Snowling, M.J. and Stackhouse, J. (Eds.) (2006) *Dyslexia, Speech and Language: A Practitioner's Handbook* (Second Edition). Chichester, UK: Whurr Publishers Ltd.

Snowling, M.J. and Thomson, M. (Eds.) (1991) *Dyslexia: Integrating theory and practice*. London: Whurr.

Stansfield, J. (2012) *Dyslexia: Early identification*. Reading, UK: British Dyslexia Association.

Stuart, M., Masterson, J. and Dixon, M. (2000) Spongelike acquisition of sight vocabulary in beginning readers? *Journal of Research in Reading, 23*, 12-27.

T

Thomson, M. (1993) *Developmental Dyslexia* (Third edition). London: Whurr.

Thomson, M.E. (2001) *The Psychology of Dyslexia: A handbook for teachers*. London: Whurr.

Thomson, M.E. and Watkins, W. (2007) *Dyslexia: A teaching handbook* (Second Edition). Chichester, UK: Wiley.

Tsagari, D. and Spanoudis, G. (Eds) (2013) *Assessing L2 students with learning and other disabilities*. Newcastle upon Tyne: Cambridge Scholars Publishing.

V

Vellutino, F. R., Fletcher, J. M., Snowling, M. J. and Scanlon, D. M. (2004) Specific reading disability (dyslexia): What have we learned in the past four decades? *The Journal of Child Psychology and Psychiatry, 45*(1), 2-40.

W

Wagner, R., and Torgesen, J. (1987) The nature of phonological processing and its causal role in the acquisition of reading skills. *Psychological Bulletin., 101*, 192-212.

Watson, L., Powers, S. and Gregory, S. (1999) *Deaf and hearing impaired pupils in mainstream schools*. Abingdon, Oxon: Routledge.

West, T.G. (2009) *In the mind's eye: Creative visual thinkers, gifted dyslexics and the rise of visual technologies*. Buffalo, NY: Prometheus Books.

Willcutt, E.G. (2012) The prevalence of DSM-IV Attention Deficit / Hyperactivity Disorder: A meta-analytic review. *Neurotherapeutics, 9*(3), 490-499.

Y

Yopp, H.K. (1992) Developing phonemic awareness in young children. *The Reading Teacher, 45*, 698-708.

Z

Zhang, J. and McBride-Chang, C. (2010) Auditory sensitivity, speech perception, and reading development and impairment. *Educational Psychology Review, 22*(3), 323-338.

Ziegler, J.C. and Goswami, U. (2005) Reading acquisition, developmental dyslexia and skilled reading across languages: A psycholinguistic grain size theory. *Psychological Bulletin, 131*, 3-29.

Zwicker, J. G., Missiuna, C., Harris, S. R. and Boyd, L. A. (2012) Developmental coordination disorder: A review and update. *European Journal of Paediatric Neurology, 16*(6), 573-581.