Lucid Research Ltd
3 Spencer Street
BEVERLEY
East Yorkshire
HU17 9EG
United Kingdom

T: +44 (0)1482 882121
F: +44 (0)1482 882911
Office@lucid-research.com

Lucid CoPS Interpretation Guide

Brief pointers for interpretation of results

Error! Reference source not found. 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 child and formulating teaching plans.

TEST NAME	COGNITIVE SKILLS MEASURED	SIMPLIFIED INDICATIONS FOR ACTION In the case of children with low (less than 20th centile) or very low (less than 5th centile) scores in individual tests (except ***Clown***).
Wock	Phoneme discrimination	Could be *temporary* or *non-temporary* problem. Refer for hearing assessment — possible glue ear. Auditory discrimination training will be necessary, even after treatment. Other auditory/verbal CoPS tests will be affected — these may need to be re-assessed after treatment. Child 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)	Check whether there are *general* auditory problems. Phonological awareness training needed — most children respond well to this, but the dyslexic child may have more persistent problems. Without phonological awareness training, the child will find phonics work difficult and may develop an over-reliance on visual strategies in reading.
Zoid's Letter Names	Auditory/ verbal *associative* memory (symbols and names)	Compare with the results of ***Races*** and with ***Toybox*** — has the child got a general *associative* memory difficulty or a general auditory/verbal memory difficulty? Check auditory discrimination skills (***Wock***) and phonological awareness (***Rhymes***). Child is likely to have difficulty with basic phonics (especially letter-sound association) which can lead to early discouragement and frustration. Starting with whole-word ('look and say') methods not inappropriate but difficulties could be encountered. 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/ verbal *sequential* memory (names)	Compare with the results of the other sequential memory tests — has the child got a general sequential memory difficulty, or just auditory/verbal sequential memory problems? Check auditory discrimination skills (***Wock***) and phonological awareness (***Rhymes***). Child 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.

TEST NAME	COGNITIVE SKILLS	SIMPLIFIED INDICATIONS FOR ACTION
Rabbits	Visual *sequential* memory (spatial/ temporal)	Should be compared with the results of the other visual memory tests and with ***Races.*** Has the child got a general *sequential* memory difficulty, a general *visual* memory difficulty or only *visual sequential memory* problems? ***Rabbits*** is the most difficult test for the child to encode verbally so it provides a purer measure of *visual* memory skills. The child will have difficulty with visual whole word ('look and say') methods which can lead to early discouragement and frustration. Spelling and writing also likely to be a problem. Visual *sequential* memory training useful. Early start to structured phonics work recommended with ample practice (overlearning). Multisensory approach is best, building on any auditory and kinaesthetic strengths.
Zoid's Friends	Visual *sequential* memory and verbal encoding (colours)	Should be compared with the results of the other visual memory tests. This test can be done non-verbally, but most children try to encode the colours *verbally*, so it can help to identify the child who has difficulty in applying verbal labels and holding them in working memory. Child will have difficulty with visual whole word ('look and say') methods which can lead to early discouragement and frustration. Spelling and writing likely to be a problem. Potential slow reader. Visual *sequential* memory training useful. Early start to 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 tests and with ***Zoid's Letter Names.*** Has the child got a general *associative* memory difficulty, a general *visual* memory difficulty or only *visual associative memory* problems? Child will have difficulty with visual whole word ('look and say') methods, which can lead to early discouragement and frustration. Spelling and writing likely to be a problem. Visual *associative* memory training useful. Early start to structured phonics work recommended with ample practice (overlearning). Multisensory approach is best, building on any auditory and kinaesthetic strengths.
Zoid's Letters	Visual *sequential* memory and verbal encoding (symbols)	Should be compared with the results of the other visual memory tests (as with ***Rabbits*** and ***Zoid's Friends***). Child will have difficulty with visual whole word ('look and say') methods which can lead to early discouragement and frustration. Letter recognition and recall will be hard. Visual *sequential* memory training useful. Spelling and writing likely to be a problem. Early start to structured phonics work recommended with ample practice (overlearning). Multisensory approach is best, building on any auditory and kinaesthetic strengths.
Clown	Colour discrimination	A criterion referenced test without norms. Refer to the data table for details of colours the child is has difficulty with. Child can be referred via GP to child development unit or hospital eye clinic for full assessment of colour blindness. Learning activities should be differentiated to allow for colour discrimination problems. Note that performance on ***Toybox*** and ***Zoid's Friends*** will probably be affected.

Interpreting results of the phonological tests

1.1. Introduction

The phonological tests are:

- WOCK — assesses phonological discrimination
- 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).

1.2. WOCK

Wock assesses *phonological 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 0.01 level or better, 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).

1.2.1. Causes of poor performance on Wock

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

(a) Temporary factors:

- The child 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 re-test the child 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

1.2.1.1. 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).

1.2.1.2. 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 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 *1996 Education Act* a child must not be regarded as having a *learning difficulty* solely because the language of the home is different from the language in which he or she is taught. Nevertheless, it is important for the teacher to have information on the phonological discrimination skills of children from such home backgrounds, because this pertains critically to the teaching of phonics in English. However, it should not be assumed that all children for whom English is an additional language (EAL) will perform poorly on ***Wock***. Studies of EAL and bilingual children have shown that in many cases they have heightened awareness of speech sounds and may perform very well on ***Wock***.

1.2.1.3. 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 child 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. Some persons with dyslexia have discovered to their amazement well into adulthood that certain words which they had always believed were spoken and spelled identically (homonyms) were, in fact, quite different (e.g. *exclaimed* and *explained*).

Of course, by no means all children who suffer, or have suffered, from glue ear show dyslexic-type difficulties in memory and other areas of cognition. However, there is a statistical association between glue ear and dyslexia, as there is between dyslexia and disorders of the immune system such as asthma, eczema and allergies, and so there may be a causal overlap between all these conditions (Galaburda, 1993). Hence teachers need to be alerted to the *possibility* of glue ear in any child showing dyslexic difficulties and *vice versa.*

1.2.1.4. Difficulty in processing information at the phoneme level

The predominant theory of dyslexia focuses on the child's difficulty in processing phonological information (for review see Snowling, 2000). There is some evidence that this type of difficulty can also affect speech perception (e.g. Hurford and Sanders; 1990; Manis et al, 1997; McBride-Chang, 1996). 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*** test, children 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 child 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***.

1.2.2. Treatment for auditory discrimination difficulties

Children 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 child *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.

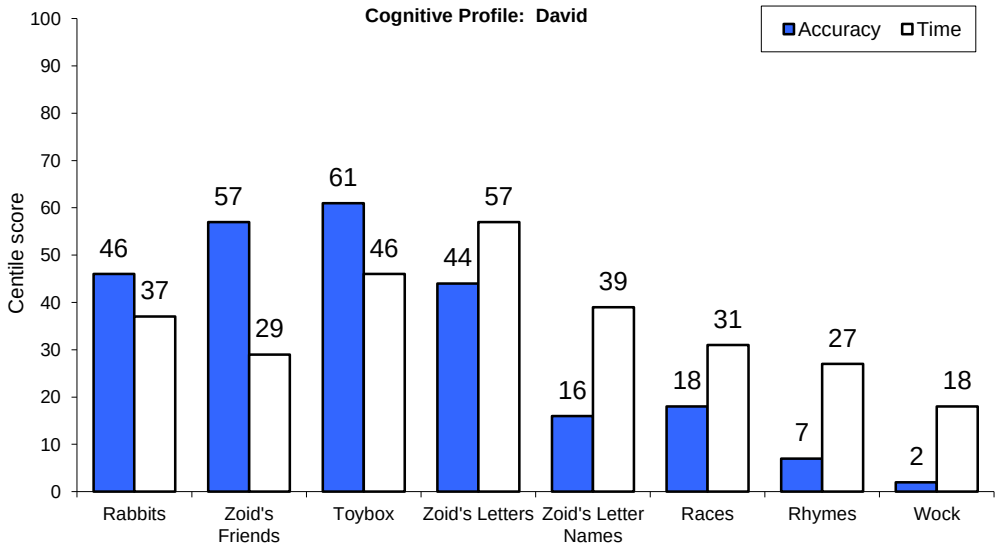
There are many classroom (and home) activities that can be used to develop auditory discrimination, and many of these are also good for promoting phonological awareness.

Case study — phoneme discrimination difficulties

An illustration of a case with auditory discrimination difficulties is shown in Figure 1. David's phonological awareness (***Rhymes***) and auditory discrimination (***Wock***) skills are very weak, and this also seems to be affecting auditory/verbal memory to some extent (***Zoid's Letter Names*** and ***Races***). The recommendations would be (a) referral for hearing assessment (possible glue ear), and (b) an early introduction of 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 it would be a mistake just to concentrate on utilising his visual strengths, because he will then encounter major difficulties later on. Instead, 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/verbal tests should all be repeated at a suitable interval, because it will be necessary to establish whether his low scores on ***Races, Zoid's Letter Names*** and ***Rhymes*** were simply due to his auditory problems or whether they signal other underlying cognitive problems.

Of course, children 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 children 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 children will consequently be reduced. It is the teacher's job to ensure, as far as possible, that the child with auditory discrimination weaknesses, is not significantly handicapped by these factors. For further discussion of these issues see Webster and Ellwood (1985).

Figure 1 Case study—David



1.3. 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 p-**ig**). The importance of this phonological awareness for early literacy development has been very well demonstrated in research carried out all over the world in the past twenty years (for reviews see Snowling, 1995; Goswami, 1994; Goswami and Bryant, 1990; Rack, 1994; Goswami, 1999, 2001; Savage, 2001). Phonological awareness is often assessed by means of an 'oddity task' 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). Many teachers and researchers have observed that the oddity test is difficult to give, especially with very young children. Children tend to forget the items and may fail for reasons other than poor phonological awareness. The CoPS ***Rhymes*** Test does not suffer from this limitation, because it incorporates pictures which help the child 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) 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 0.01 level or better. ***Rhymes*** also correlated with all phonics aspects of the *Middle Infant Screening Test* (MIST) given at age 6:6, and were significant at the 0.01 level or better. 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).

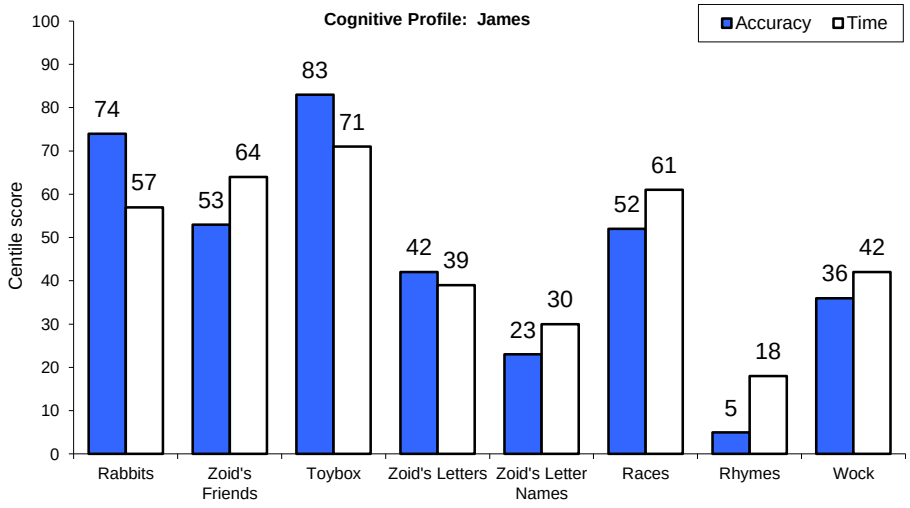
Although the CoPS phonological awareness test (***Rhymes***) involves *rhyming* this should not be taken to mean that other aspects of phonological awareness (such as alliteration and syllable segmentation) are not important for early literacy development. The CoPS research version included an alliteration test as well as a rhymes test, but when predicting from CoPS given at age 5 to literacy skills at age 8 years ***Rhymes*** proved to be a better predictor than alliteration, so rhyming items were preferred for the original CoPS suite for DOS and Acorn. In the Windows version, the original 2 practice and 8 test rhyming items have been retained for children aged under 7 years but for children aged 7 years and over, the rhyming component has been reduced to 4 items and a further 8 alliteration items have been added This makes the test more sensitive for children in the older age group. However, it is important to stress that when the teacher is addressing the development or facilitation of the language and literacy skills of young children *all* possible aspects of phonological awareness should be taken into account, including rhyming, alliteration and other skills (e.g. syllable segmentation, deletion and elision).

Case study — poor phonological awareness

The CoPS profile of James, aged 5, shows good or reasonably satisfactory scores in all areas except ***Rhymes***, which is on the 5th centile (see Figure 2). 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 ***Zoid's Letter Names,*** which demands quite close auditory attention. However, he seemed totally unable to determine *similarities* between syllables within sounds. It was 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 child 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 had very good constructional skills, which his mother said was developed through many hours of playing with Lego by himself.

Figure 2 Case study—James



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/verbal memory difficulty. Nevertheless, he will tend to struggle with phonics, and may even avoid any analytical approach to reading, which is likely to create problems later in his schooling. He could even manage to get by on purely visual strategies in reading but 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, enable him to benefit from phonics teaching and help to prevent literacy difficulties later on. At the same time, an assured start can be made in 'look-and-say' which should give James encouragement to tackle the complexities of phonics as soon as he is judged to be ready for this. If desired, ***Rhymes*** and ***Wock*** (and ***Zoid's Letter Names*** as well if the teacher wishes) can be re-administered in a few months to ascertain whether James has made the progress necessary to begin phonics teaching with confidence.

Interpreting results of the auditory-verbal memory tests

1.4. Introduction

The auditory-verbal memory tests in CoPS are:

- ***Zoid's Letter Names*** — assesses the child'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 (for reviews, see 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, 1993a; Wagner et al, 1993).

1.5. RACES

Races is a *sequential* memory test (i.e. in which items have to be remembered in the correct order). It correlates significantly with those sub-test of WISC-III which are widely used as diagnostic indicators of dyslexia, namely Arithmetic, Coding, Information and Digit Span (ACID profile). (Thomson, 1989). Correlations of ***Races*** given at age 5 with WISC-III^{UK} given at 8 years were: Arithmetic 0.49, Coding 0.47, Information 0.58, Digit Span 0.36. All were significant at the 0.05 level or better. It also 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 0.01 level or better. For further information on the statistical evidence see Singleton, Thomas and Leedale (1996) and Singleton, Thomas and Horne (2000).

1.6. ZOID'S LETTER NAMES

Zoid's Letter Names is an *associative* memory test, which simulates the situation of a child 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). Although good letter name knowledge at an early age is probably due in part to some children being taught letter names at home or in the pre-school, those children with competent verbal/auditory memory skills will have an advantage in these aspects of learning over those children with memory weaknesses. For this reason, ***Races*** and ***Zoid's Letter Names*** are both important tests although of the two, ***Races*** is the better predictor of later literacy skills. ***Zoid's Letter Names*** is quite a difficult test for younger children and demands considerable concentration (as well as good listening skills). It is probably a better measure for older children (7–8 year-olds) than it is for younger ones, but until more data is available, conclusions on this matter must remain tentative. Nevertheless, ***Zoid's Letter Names*** correlated significantly with later phonic skills. The correlation of ***Zoid's 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 0.05 level or better. For further information on the statistical evidence see Singleton, Thomas and Leedale (1996) and Singleton, Thomas and Horne (2000).

1.7. The nature and causes of auditory/verbal memory difficulties

Short term auditory/verbal 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"). Other examples of working memory include trying to hold a telephone number in mind while we dial it, and carrying out mental arithmetic.

The relevance of auditory/verbal working memory to literacy skills should be obvious — in the same way that it is necessary to hold spoken words in memory in conversation, the child must hold *letters and syllables* in memory when decoding words. This is very important in the development of phonic skills. The majority of dyslexic children have problems in this area of cognitive processing (Thomson, 1989). 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 child 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 beginning readers who have not progressed to phonics, and also for more competent readers whose capacity for rapid visual recognition of words steadily increases with age. Nevertheless, auditory/verbal working memory remains a significant factor in reading development and in writing as well. Children with weaknesses in auditory/verbal 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. (For reviews of research on the connections between verbal memory and reading see Baddeley, 1986; Brady, 1986; Jorm; 1983; Wagner and Torgeson, 1987.)

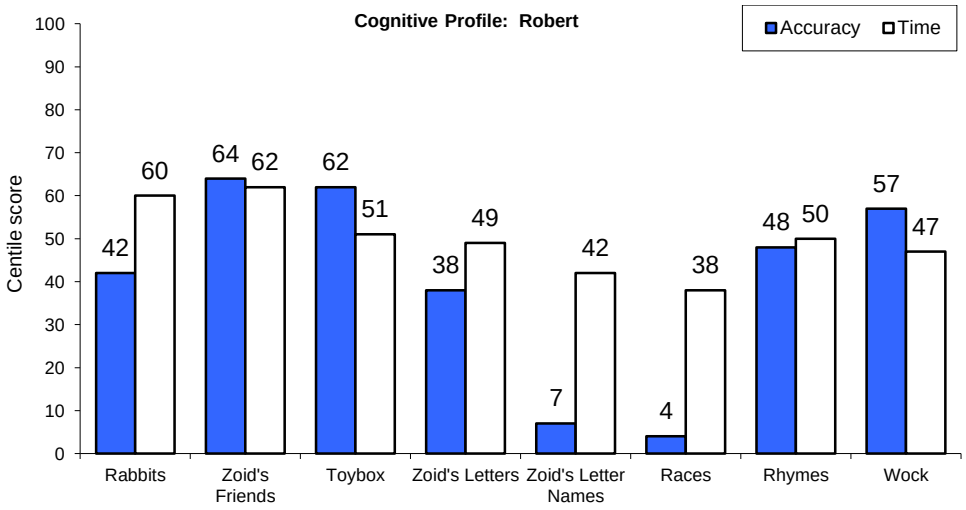
More recently, further research has suggested a very close connection between auditory memory span and articulation (speech) rate (Avons and Hanna, 1995; McDougall and Hulme, 1994). It could well be that articulation rate is an index of the efficiency with which phonological representations of words 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/verbal working memory are nevertheless important in reading, independently of articulation rate.

1.7.1. Case study — auditory/verbal working memory difficulties

Inspection of Robert's cognitive profile (see Figure 3) 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/verbal working memory, both associative (***Zoid's Letter Names***) and sequential (***Races***). Consequently, Robert would be expected to have problems in acquiring effective phonic skills, but may make satisfactory progress in the early stages of reading, where the emphasis tends to be on building up simple visual word recognition skills. For this reason, it would be easy to overlook Robert's problems and assume that because a good early start has been made that everything else will follow automatically. In fact, Robert would probably learn to rely almost exclusively on visual strategies in reading and he could be as old as 9 or 10 before his real problems really become noticeable, by which time so much learning opportunity has been wasted. The recommendations would be for a fairly early introduction of 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 3 Case study—Robert



Interpreting results of the visual memory tests

1.8. Introduction

The visual memory tests in CoPS are:

- ***Zoid's Friends*** — assesses visual/verbal sequential memory (colours)
- ***Rabbits*** — assesses visual/spatial sequential memory (spatial / temporal position)
- ***Toybox*** — assesses visual/verbal associative memory (shape and colour)
- ***Zoid's Letters*** — assesses visual/verbal sequential memory (symbols)

These four tests 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 also in spelling (again, particularly where irregular words are concerned).

1.9. Visual memory and literacy development

Models of reading acquisition suggest that visual memory is particularly important in the earliest stages of learning to read, usually referred to as the pre-alphabetic or logographic phase (e.g. Ehri, 1995; Frith, 1985). Conclusions reported by Passenger, Stuart and Terrell (2000) from their study of 80 preliterate children during their first year of formal schooling lend some support for this view. Stuart, Masterson and Dixon (2000) also 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 ***Zoid's 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.

There is also evidence that poor readers have a bias towards visual encoding of words. Johnston and Anderson (1998) reported that poor readers showed a preference for using pictorial rather than verbal information, which they suggest may arise from previous difficulties in learning to attach verbal labels to visual stimuli. Ellis, McDougall and Monk (1996) reported that dyslexics aged 10 years were significantly faster on some visual processing tasks (e.g. picture categorisation) than other groups, including reading age (RA) controls. On word recognition tasks in which the words are paired with either visually similar cues or phonological similar cues, poor readers are known to perform *better* than reading age controls on the visually similar cue items but not on the phonological similar cue items (Holligan and Johnston, 1988; Rack, 1987). In other words, they display a less pronounced phonological similarity effect and a more pronounced visual similarity effect (Katz, 1986; Mann and Liberman, 1984).

Palmer (2000) used the *Corsi Blocks* test to measure visuospatial span in three groups of 14 year-old students: dyslexics, RA controls, and chronological age (CA) controls with normal reading ability. The *Corsi Blocks* test comprises a set of nine blocks fixed to a base in a predetermined pattern. The test administrator touches the blocks in a set

sequence and the testee is required to recall that sequence by touching the same blocks in the same order. This has a direct parallel with the *Rabbits* test in the *CoPS* suite. Palmer found that the dyslexic group significantly outperformed the RA controls on this test. The results also suggested that while all participants showed evidence of using phonological coding to remember pictures, only those in the dyslexic group used visual coding.

Another study by Palmer (2000) provides further evidence that it is useful for teachers to know about children's visual memory skills. In this experiment, it was 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 an 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.

1.10. RABBITS, ZOID'S FRIENDS, TOYBOX and ZOID'S LETTERS

Before attempting an interpretation of results from any of these individual tests it is advisable for the teacher first to look for confirmation from the other memory tests. Obviously, where there is strong confirmation (e.g. a number of related tests at or below the *threshold of concern* —20th centile) then the teacher can be much more confident about the diagnosis. If only one test result is below the 20th centile (particularly in one of the memory tests, which require a very high degree of concentration) when all others are average or above average for that child, 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 child on that particular test. On the other hand, one test result below the *threshold of risk* (5th centile) is more likely to indicate a real and significant difficulty.

1.11. The nature and causes of visual memory difficulties

Toybox assesses visual *associative* memory, whereas the other four visual tests assess *sequential* memory. There is one other associative memory test in CoPS — ***Zoid's Letter Names***, which is an auditory/verbal test. The results of this should also be compared with those from ***Toybox***. The other three visual tests (***Rabbits, Zoid's Friends,*** and ***Zoid's Letters)*** are all *sequential* memory tests. There is one other sequential memory test in CoPS — ***Races***, which is an auditory/verbal test. The results of this should also be compared with those from ***Rabbits, Zoid's Friends,*** and ***Zoid's Letters***. Hence, the teacher should ask which of the following is the case:

- the child has general *associative* memory difficulties (visual as well as verbal)
- the child has general *sequential* memory difficulties (visual as well as verbal)
- the child has general visual memory difficulties
- the child has *specific* difficulties in visual *associative* memory
- the child has specific difficulties in visual sequential memory
- the child 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 tests of which the teacher should be aware. ***Toybox*** and ***Zoid's Friends*** are both tests where verbal encoding (of colour names) helps the child considerably. It is always important to rule out colour discrimination difficulties in cases of children with a low performance on ***Toybox*** and ***Zoid's Friends***. Hence when children do score low on those tests, if ***Clown*** has not already been administered to the child, then it should always be given as a precaution, before attempting to interpret the results of ***Toybox*** and ***Zoid's Friends***.

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. (Of course, one could try to prevent this by asking the individual to recite something at the same as they attempted to remember visual items, although this would make the task rather artificial and possibly uncontrolled — perhaps appropriate in the psychology laboratory, but not to be recommended as part of a psychometric test.) So ***Toybox*** and ***Zoid's Friends*** can help

to identify the child who has difficulty in applying verbal labels and holding them in working memory. The result from ***Toybox*** and ***Zoid's Friends*** can indicate the child who is likely to have difficulty with visual whole word ('look and say') methods, which can lead to early discouragement and frustration. Such a child is potentially a rather slow reader because the associative linkages are not so easily forged and the child 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 child will probably have difficulties in remembering the letters that he/she needs to use. By contrast, ***Rabbits*** is the most difficult of the CoPS tests for the child to encode verbally — so it provides a 'purer' measure of *visual* memory skills. It requires the child to remember spatial positions as well as temporal sequences.

In the CoPS research project all four tests 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 ***Zoid's Friends*** 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 ***Zoid's Letters*** 0.36 *(Neale Analysis of Reading*) and 0.43 *(BAS Spelling)*. All are significant at the 0.05 level or better.

The importance of working memory in reading has already been discussed above. Although working memory is typically conceptualised as being a phonological system subserving speech, a visual equivalent known as the 'visuo-spatial scratch pad' has been hypothesised (Baddeley, 1996). This is believed to enable us to keep small amounts of visual information in short-term memory. Such a system is important in developing visual strategies in reading, especially those used by beginning readers ('look and say'). It is also essential in rapid retrieval of visual whole-word representations from the mental lexicon by older and more fluent readers when reading text, and in retrieving visual sequences of letters in the correct order when spelling.

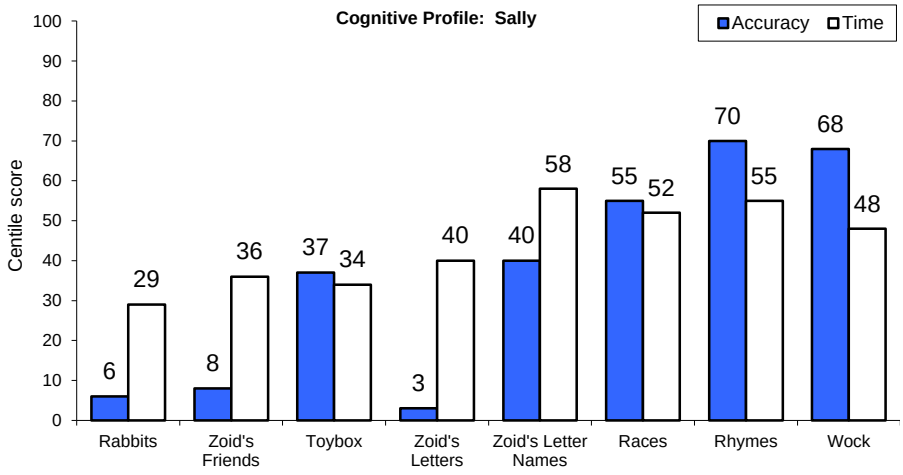
Some teachers and psychologists assume that problems with short-term memory are entirely verbal rather than visual. However, research suggests otherwise. Awaida and Beech (1995) found that ability to remember letter-like forms (similar to those in ***Zoid's Letters*** and ***Zoid's Letter Name****s*) at four years of age correlated with reading skills one year later. There is a substantial literature on subtypes of dyslexia, in which visual deficits predominate (Thomson, 1989; Pumfrey and Reason, 1991). Some tests for dyslexia incorporate visual memory tests, e.g. *The Aston Index* (Newton and Thomson, 1982) and the *Coding* sub-test of WISC-III^{UK} ,which is one of the key elements of the A–C–I–D profile that is often used as an indicator of dyslexic difficulties (Thomson, 1989). In the CoPS project, WISC Coding given at age 8:0 correlated 0.36 ($p<0.05$) with ***Rabbits*** administered at age 5. Fein, Davenport, Yingling and Galin (1988) found that visual memory is a factor which may be separated from verbal memory in some cases of dyslexia. Finally, there are a variety of other research themes focusing on more physiological aspects of 'visual dyslexia', including work on visual discomfort (e.g. Wilkins, 1991); atypical eye movements in reading (e.g. Pavlidis, 1985); ocular dominance (e.g. Stein, 1991, 1994); and defects in the transient visual system (e.g. Lovegrove, 1991,1993, 1994). However, perhaps with the exception of visual discomfort (sometimes referred to as the 'Irlen syndrome', after Irlen; 1991) the evidence on some of these physiological issues at the present time seems to be equivocal and more research is required before they can be of practical value in diagnosis and education (Stanley, 1994).

1.11.1. Case studies

1.11.1.1. Sally — visual sequential memory difficulties

Sally shows no problems of auditory/verbal information processing; in fact, her phonological awareness (***Rhymes***) and auditory discrimination (***Wock***) are both quite good (see Figure 4). But she has clear weaknesses in visual sequential memory (***Rabbit, Zoid's Friends*** and ***Zoid's Letters*****)**. Her associative memory is reasonably satisfactory (***Toybox*** and ***Zoid's Letter Names***). Sally would be expected to have problems in the very early stages of reading, where the emphasis tends to be on building up simple visual word recognition skills. Confusion of letter order (e.g. "was" vs. "saw") is likely. Since her associative and verbal memory are satisfactory and she has good phonological awareness and auditory discrimination skills, a phonically-based approach to reading is indicated from the beginning with, ideally, a multisensory strategy. If conventional 'look-and -say' approach is adopted, early difficulties would be expected, leading to loss of confidence and erosion of motivation. 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.

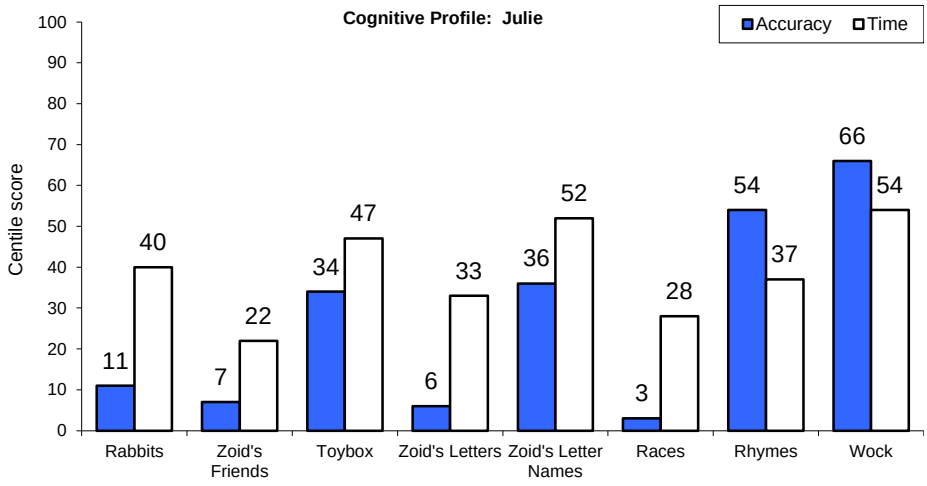
Figure 4 Case study—Sally



Julie — general sequencing difficulties

Julie's problems (see Figure 5) are with sequencing, in both auditory and visual modes (note results for ***Rabbit, Zoid's Friends, Zoid's Letters*** and ***Races***). There is a weakness in associative memory, too (see ***Toybox*** and ***Zoid's Letter Names***), but note that phonological awareness (***Rhymes***) and auditory discrimination (***Wock***) skills are quite competent. Julie would be expected to have problems not only in acquiring effective phonic skills, but also have some difficulties in the early stages of reading, where the emphasis tends to be on building up simple 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 5 Case study—Julie



1.12. CLOWN

Clown is a test of colour discrimination. At present this is a criterion referenced test without norms, although data will be collected for standardisation during 1996. A child who is having difficulties on ***Clown*** will probably have colour discrimination problems (but not necessarily so — see below), and *may* be colour blind, but as yet there are no data against which ***Clown*** can be validated as test of *colour blindness*, so teachers must not jump to conclusions. The teacher should refer to the data table for details of which colours the child is experiencing difficulty with. The child can be referred via the GP to a child development unit or hospital eye clinic for full assessment for colour blindness.

The main function of ***Clown*** was to rule out colour discrimination difficulties in cases of children with a low performance on ***Toybox*** and ***Zoid's Friends***. Hence when children *do* score low on those tests, if ***Clown*** has not already been administered to the child, then it should always be given as a precaution, before attempting to interpret the results of ***Toybox*** and ***Zoid's Friends***. The ***Clown*** test need not be given if the teacher is confident that the child's colour discrimination is satisfactory. On the other hand, many teachers find ***Clown*** is a good introduction to the suite of tests because most children find it very easy but enjoyable nonetheless. However, teachers should be aware of the problems of the child with poor mouse control — see below.

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

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

These are the colours used in ***Toybox*** and ***Zoid's Friends***. Of these colours, the most likely confusion in a child 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.

1.12.1. Interpreting results of the Clown test

The ***Clown*** test requires six items (separate colour discriminations) to paint the clown fully. These are the six colours given in the list above***.*** The test allows a *maximum* of four attempts at each item. On the fourth attempt the colour chosen is accepted, regardless of whether or not it is the correct colour. When the teacher inspects the data table for the test, the number of attempts which the child made at each colour can be determined. *One error on any colour should not necessarily be regarded as significant, because this could result from carelessness or poor mouse control. However, if a child has two or more errors on a given colour then this should be regarded as suspicious.*

Teachers should be aware that some younger children or pupils with poor mouse control may obtain spuriously low scores on ***Clown*** because they are not pointing the mouse pointer directly on the correct colour on the palette. If this is suspected it is acceptable for the teacher to take over the mouse and ask the child to point at the colour that they want to select and say '*That one'*. (Be careful that the child points *distinctly*; do not assume they are choosing a colour just because their finger lingers in its vicinity for a moment — they may be looking for cues from you.) If a teacher wants to make sure about any suspected colour discrimination problem, then ***Clown*** can be repeated with that child on another occasion.

Where the results of ***Clown*** shows that the child has colour discrimination difficulties, the results of ***Toybox*** and ***Zoid's Friends*** may not be valid. It depends on the nature and extent of the colour problem. Teachers will have to inspect the data tables and use their own judgement.

Interpreting complex CoPS profiles

1.13. Low overall profile

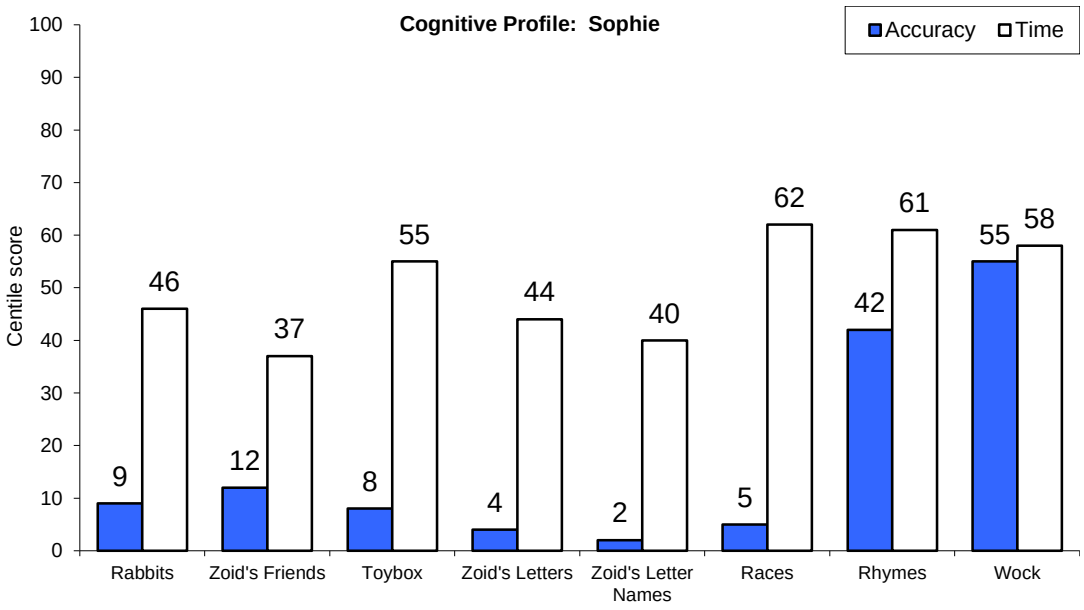
At the present time CoPS does not provide a completely satisfactory distinction between the child with a *specific* learning difficulty (dyslexia) which is very severe, and the child with more general *moderate* learning difficulties. In theory, both types of child *could* produce similar profiles on CoPS — i.e. fairly low scores across most or all of the CoPS tests. Although this dilemma rarely occurs in practice, teachers are usually able to distinguish the two because the child 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. (Hyperactive children will tend to have fast times and low accuracy.) On the other hand, the dyslexic child 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 child's intellectual skills can be carried out, for example, using a test such as the *British Picture Vocabulary Scales—Second Edition* (Dunn et al, 1982). If still in doubt, the child can be referred to an Educational Psychologist for full assessment.

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

1.13.1. Case study

Sophie has general memory difficulties, with low performance on all except the phonological awareness (***Rhymes***) and auditory discrimination (***Wock****)* tests (see Figure 6). She is unlikely to have moderate learning difficulties because those two tests show reasonable scores, but the teacher might wish to check Sophie's intelligence level with a suitable conventional test. Sophie's profile is typical of the more severe case of dyslexia, and consequently she would be expected to have difficulties both in the early stages of reading, where the emphasis tends to be on building up simple visual word recognition, and also later 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 Sophie, 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 6 Case study—Sophie



High overall profile

At the present time, data on the relationship between high CoPS profiles and high general ability has yet to be analysed, and further research is also necessary. CoPS (particularly with the addition of the new tests for verbal and non-verbal reasoning) could be useful in identifying exceptionally bright (or even 'gifted') children.

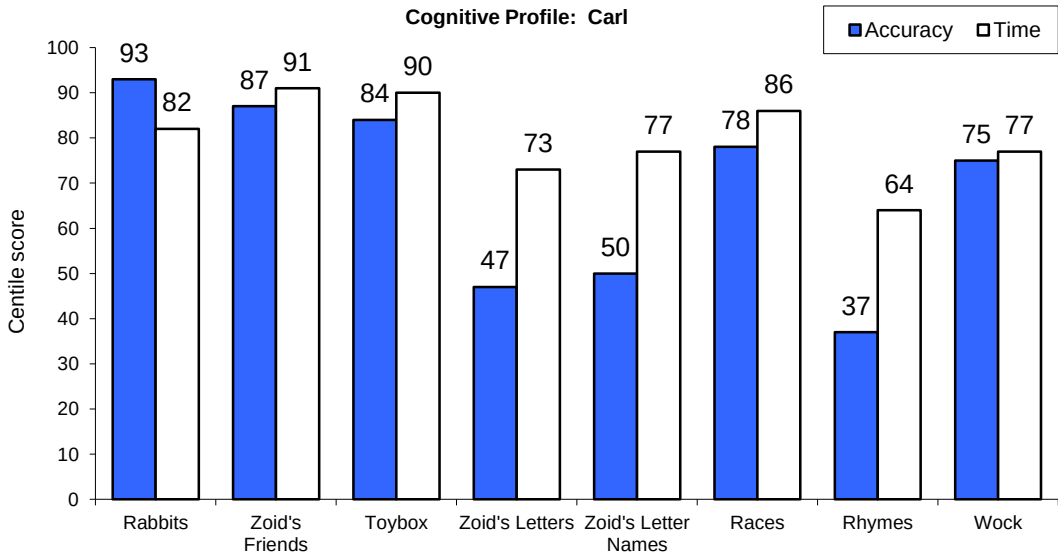
Such children sometimes have learning problems because they find the work they are given in school too easy and they swiftly become bored. They can become lazy or careless because they are accustomed to tasks being effortless. They may become naughty or start to disrupt the work of other children in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

1.13.2. Case study

Carl's profile (see Figure 7) shows that most test scores are in the upper range of the chart, particularly in the visual tests, with results for accuracy above the 75th centile on all except three tests. Those three tests have scores in the centile range 37 to 50, 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') child, 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 score 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 children in intellectual terms. However, his phonological awareness (***Rhymes***) is *relatively* low for a child who seems so adept at the other tests. One would have expected a child 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 try to 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 7 Case study—Carl



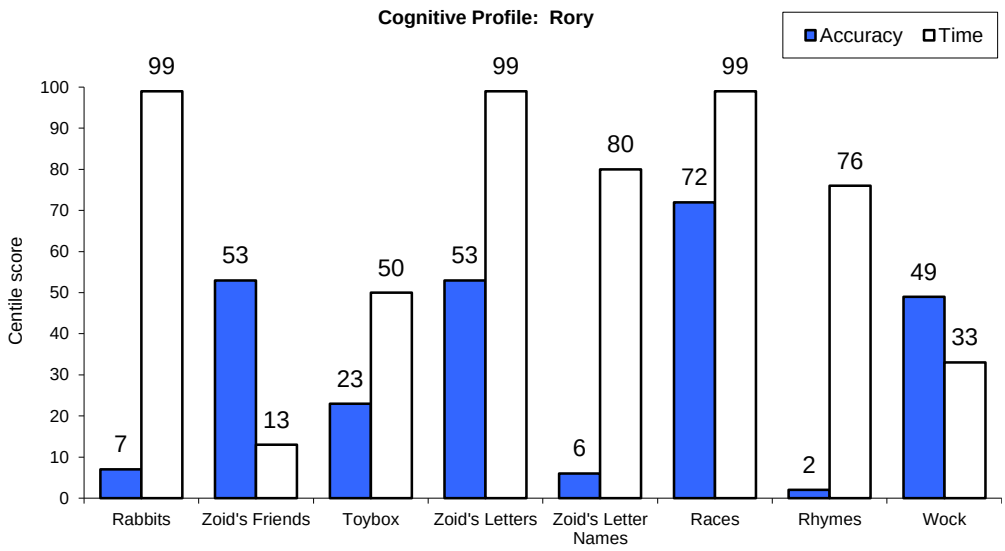
Other complex profiles

Many CoPS profiles 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 child's performance. Examine the data to see on what days and times different tests were done. Motivation, ill-heath (actual or imminent), and impatience are often causes of a pupil under-performing. Or the child may simply have 'got the wrong end of the stick' (e.g. assuming that they have to do a test 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 test(s) in question.

Case study – Rory

Rory's profile (see Figure 8), 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 tests too quickly. However, the results of Races and ***Zoid's Letters*** do not confirm this view, for the accuracy scores obtained on these test are average/good, despite time scores at the 99th centile. His results do not suggest an overall memory problem (***Races, Zoid's Friends*** and ***Zoid's Letters*** all being satisfactory), not do they suggest a sequencing problem (***Zoid's Friends*** and ***Zoid's 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 seem to remember the letter-sound relationships in phonics.

Figure 8 Case study—Rory

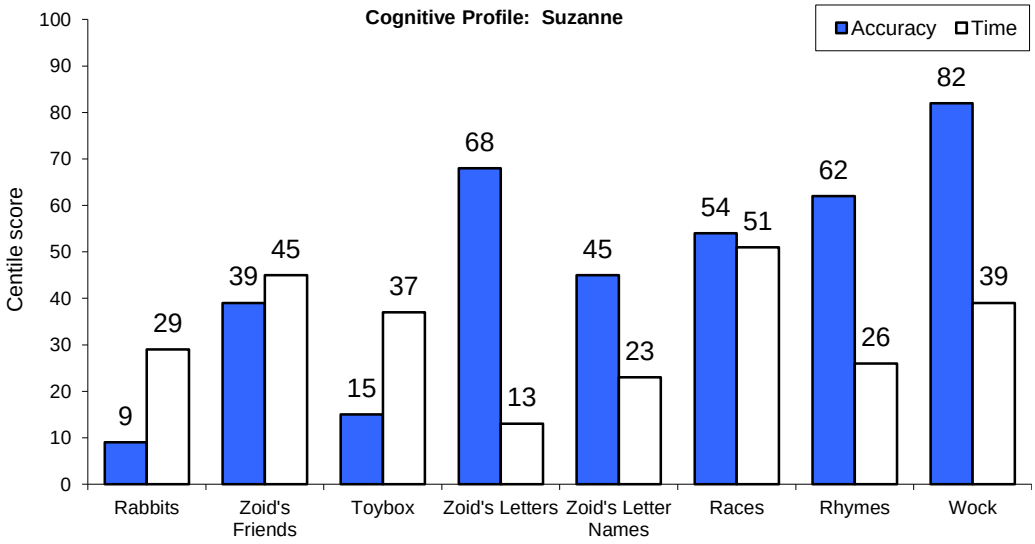


It turned out that on the day when he was attempting ***Rabbits***, the school was visited by a touring drama workshop, which created great excitement amongst the pupils. Rory had been under the impression that he would not be chosen to participate if he did not hurry up and finish the CoPS tests, hence the poor result. When this test was repeated another day, he scored at the 57th centile, which is average. However, a repeat of ***Zoid's Letter Names*** did not result in significant improvement (his score at the second attempt was at the 14th centile). However, it then became more obvious that he did seem to have a weakness in associative memory (***Toybox*** and ***Zoid's 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.

1.13.3. Case study – Suzanne

The profile of Suzanne, aged 4 years 10 months, is also puzzling (see Figure 9). It is obvious that she is not impulsive — in all probability she is fairly careful as her time scores tend to be a little below the average, on the whole. And it is clear that she has strengths in auditory/verbal 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 ***Zoid's Letters*** and ***Zoid's Friends*** are average/good. She does not appear to have a problem with using verbal labels to aid visual memory (***Zoid's Friends*** 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, but 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 9 Case study—Suzanne



The main strategy for interpreting complex CoPS profiles (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 results of children who are outside the CoPS norms range

CoPS is normed for use with children in the age range 4 years 0 months to 8 years 11 months. Over the age of 8:11, CoPS raw scores will not be normally distributed as many children will achieve a maximum or near-maximum performance (in statistical jargon this is sometimes referred to as a *'ceiling effect'*). Similarly, below 4:0, most children will obtain very low scores on the CoPS tests which will create a bunching of scores at the lower end of the distribution (sometimes called a '*floor effect'*). When ceiling and floor effects occur in any test, it is not a good discriminator between children with differing abilities. Most children younger than 4 years are not developmentally mature enough to cope with the requirements of CoPS and so it is not recommended for use below 4 years.

The norms for CoPS *only extend to 8:11*, so it can *only* be used *psychometrically* (i.e. to compare a given child's performance with that of other children of the same age) up to that age. However, over this age range it can have a certain limited value if used *clinically* (i.e. to identify children with particular difficulties), or *ipsatively* (i.e. to compare a given child's performance on one test with the same child's performance on another). When employed in this way with older individuals, it should always be used with *extreme caution*, and then only by experienced professionals who fully appreciate the limits within which they are working. Many older individuals with significant cognitive problems (e.g. dyslexia) are likely to experience difficulties on some CoPS tests (e.g. a 12 year old with a history of glue ear will tend to struggle with ***Wock***; and even many adult dyslexics with severe memory difficulties find tests like ***Zoid's Letter Names*** very hard indeed). Nevertheless, this is not *necessarily* the case. When used with older individuals, absence of any indications of difficulty on CoPS tests must *never* be taken as evidence that there *are no* underlying difficulties because the tests may just not be sensitive enough. In any case, older persons typically develop strategies by which they can compensate for any cognitive limitations, and these can have a masking effect, preventing any limitations from showing up in assessments.

Under exceptional circumstances, age equivalent scores can be used when assessing children outside the norm range.

The preferred solution to assessment of children older than 8 years 11 months is to use **LASS 8-11** (age 8:0 – 11:11) or **LASS 11-15** (11:0 – 15:11). For more information visit our website (www.lucid-research.com).