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User guide to accompany

The 1970 British Cohort Study 2004 data on the assessment of symptoms associated with dyslexia

Samantha Parsons

September 2012

Centre for Longitudinal Studies
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The 1970 British Cohort Study 2004 data on the assessment of symptoms associated with dyslexia

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1 Introduction

The age 34 survey of the 1970 British Cohort Study (BCS70) assessed symptoms associated with dyslexia. Though the precise origins and meaning of the syndrome has attracted controversy (Rice and Brooks, 2004), it is generally believed that dyslexia arises from a variation in the brain area that processes language-based information and affects the underlying skills that are needed for learning to read, write and spell. These symptoms are found in people from all socio-economic and education groups, from those who cannot read to those with higher education awards. Estimates of dyslexia, primarily from school populations, suggest that about four per cent of the population are severely dyslexic, with a further six per cent having mild to moderate problems[1].

BCS70 cohort members were previously assessed for symptoms of dyslexia when they were 10-years-old. Three short individual measures from the Bangor Dyslexia Test (Miles, 1982/1997)[2] were administered, in conjunction with other cognitive assessments, to more than 12,000 cohort members. Analysis of the data has estimated that between 2 and 4 per cent of cohort members were dyslexics to some degree (Miles and Haslum, 1986). By re-assessing the cohort members at age 34, another uniquely rich data resource is obtained that provides researchers with the opportunity to:

- obtain a true estimate of the distribution of dyslexic symptoms in a representative adult population of 34-year-olds
- see what, if any, symptoms are lost, persist or emerge between ages 10 and 34
- analyse the relationship between dyslexia, adult literacy and numeracy scores, and a wide range of socio-economic, educational and well-being outcomes.

The Dyslexia Adult Screening Test (DAST) (Fawcett & Nicolson, 1998) was chosen as the preferred instrument for use in the 2004 survey. The DAST does not measure identical symptoms of dyslexia as the Bangor Dyslexia Test, but its use was strongly supported by Professor Tim Miles (who devised the Bangor test) as offering good continuity with the earlier assessment[3]. In consultation with the test developer, four of the 11 tasks that make

[1] This information is taken from the websites detailed. For further information refer to the British Dyslexia Association (www.bda-dyslexia.org.uk), the Bangor Dyslexia Unit (www.dyslexia.bangor.ac.uk) and the Dyslexia Institute (www.dyslexiainst.org.uk).

[2] The Bangor Dyslexia Test contains ten items. The three selected measures were the Left-Right Test (involving naming body parts), and the Months Forward and Months Reversed tests (sequential recall of months of the year). See BCS70 age 10 survey documentation for further details www.cls.ioe.ac.uk/page.aspx?&sitesectionid=818&sitesectiontitle=Guide+to+Dataset

[3] At the 6th BDA International Conference, Allyson G. Harrison and Eva Nichols presented *A Validation Of The Dyslexia Adult Screening Test (DAST) In A Post Secondary Population in Canada.* The DAST was administered to 116 students with Specific Learning Disabilities (SLD) and 122 volunteer control subjects. The DAST correctly identified 74% of the students with a SLD at risk for dyslexia. However, the DAST misidentified 26% of SLD students as not being at risk for dyslexia, and 16% of the control group as being at risk for dyslexia, even though almost all control group students reported no history of any learning or reading problems. Despite this, the DAST does have a higher than acceptable false positive rate. Suggestions were offered for recalculation of the data and a clustering of the subtests to maximize differentiation between subject groups.

up the DAST were selected and then adapted for use in a survey setting[4]. The four selected exercises were felt to be the best combination of exercises, given the time restriction of just ten minutes of survey time. The four exercises were:

- 1-minute Reading
- 2-minute Spelling (revised to 1-minute)
- Spoonerisms
- Nonsense Passage Reading.

Reading and Spelling were particularly strong candidates for selection, given their obvious relationship with basic literacy skills, which was also assessed in the age 34 survey[5]. Spoonerisms provided a relatively complex measure of phonemic segmentation (the ability to split words into their constituent parts), was quick to administer, and was enjoyed by the great majority of respondents who took part in the pilot studies for the 2004 survey. The Nonsense Passage Reading exercise, although demanding, was included as it seemed particularly good at identifying difficulties among adults who had performed well on the other DAST exercises. The four exercises are detailed below, together with some findings based on initial analysis of BCS70 cohort members' performance.

1.1 The DAST exercises included in the 2004 survey

The DAST dataset contains all the responses from cohort members for the four DAST exercises included in the 2004 survey: 1-minute Reading, 1-minute Spelling (revised), Spoonerisms and Nonsense Passage Reading. All four of these exercises were completed by 8,804 BCS70 cohort members. The number of cohort members completing each of the four exercises is detailed below.

1.1.1 DAST 1-minute Reading exercise

An adult experiencing some of the symptoms associated with dyslexia, who may be regarded as successful, can still have greater problems when reading under time constraints. The exercise comprised a list of 120 words, graded in difficulty, which the respondent had to read aloud as fast and as accurately as they could in one minute.

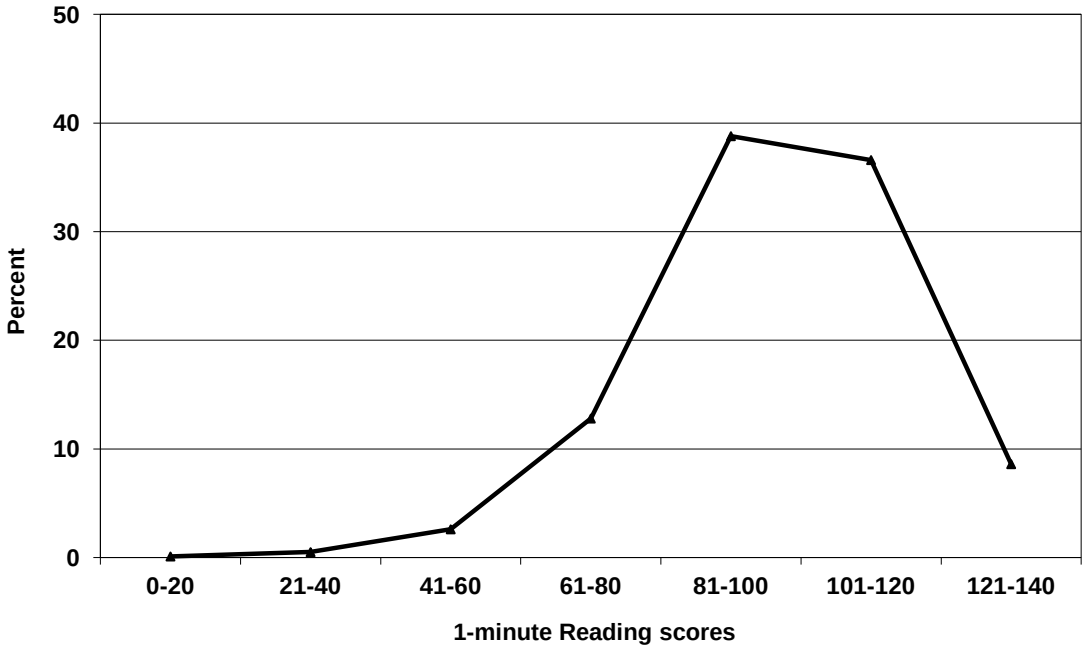
Each of the 120 words could be read 'correctly', 'incorrectly' or 'passed' (either the respondent did not attempt to read the word and said 'pass', or they inadvertently missed it). One point was awarded for each word read correctly. If all the words were read aloud in less than one minute (even if a respondent had passed on one or two words), an additional point was awarded for each second left on the timer. For example, if a respondent finished in 57 seconds, three points would be awarded.

[4] The development work behind the final selection of the four tasks is included in Parsons and Bynner, 2005. The document can be can be downloaded at http://www.nrdc.org.uk/publications_details.asp?ID=17

[5] See Parsons, S. (2012) BCS70 user guide: 2004 adult literacy and numeracy data. London, Centre for Longitudinal Studies. To download the PDF version, visit www.cls.ioe.ac.uk/bcs70_userguide_literacynumeracy.

Figure 1 shows the distribution of cohort members by their score in the 1-minute Reading exercise (n=9,364). We can see that the exercise distinguished between those who completed the exercise without difficulty and the substantial minority who struggled. These are shown on the graph by the 'tail' towards the low scores in the distribution.

Figure 1: Distribution of scores in the 1-minute Reading exercise



1.1.2 DAST (revised) 1-minute Spelling exercise

Time pressures can increase spelling errors for us all, but this is particularly so for adults experiencing dyslexic symptoms. Dyslexic adults often have poor spelling, with their grasp of spelling usually worse than their reading skills. The original exercise consisted of 32 words, increasing in difficulty. If a respondent spelt two of the first four words incorrectly, the interviewer read out eight additional easier words, making a total of 40 words. Time restrictions led to the exercise being reduced to one minute and comprising 16 words, with four additional easier words making a total of 20 words.

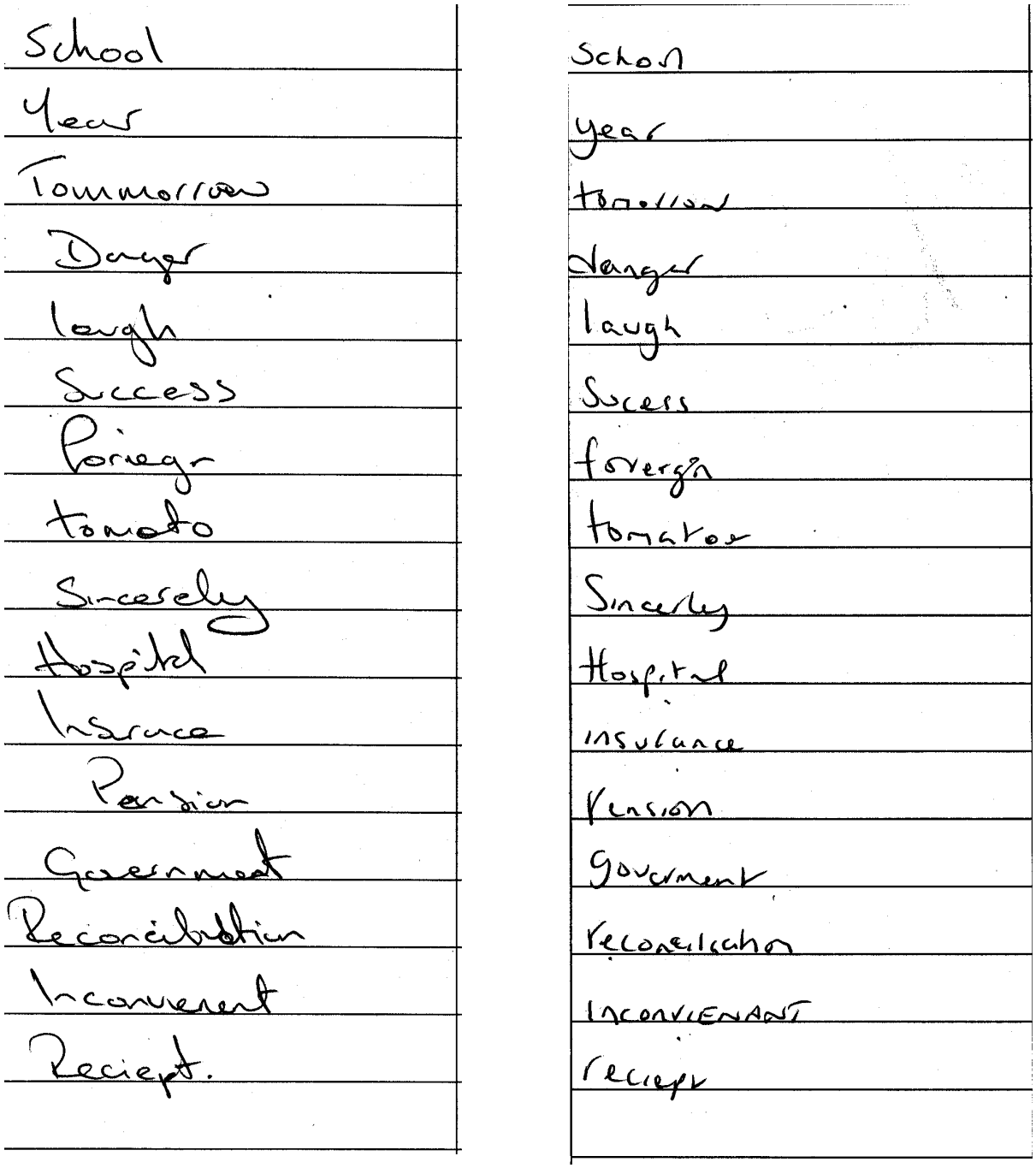
Words could be spelt correctly, spelt incorrectly, or passed (the respondent does not attempt to spell the word and says 'pass'). One point was awarded for each correct spelling. Four points were added to the final score if the respondent had not made early errors and had not moved on to try the additional easier spellings.

Interviewers read out one word at a time, starting to dictate the next word when the respondent had finished writing the previous word. At the end of the exercise, the interviewer recorded which hand the respondent wrote with[6] and checked that they could read what the respondent had written down. If not, they asked the respondent how they had spelt a

[6] Developmental disorders of reading and spelling have been associated with increased left- and mixed-handedness, although the evidence base is inconclusive. For a recent review see Annett, M. (2011) Dyslexia and handedness: developmental phonological and surface dyslexias are associated with different biases for handedness. *Perceptual and Motor Skills* 112(2): 417-25.

particular word, and wrote this down next to the word in question. This was very important. If the interviewer was not clear how a word was spelt, a coder entering the information into a dataset at a later date would probably not know either, and the information would be lost[7]. Some examples of the completed spelling exercise are given in Figure 2.

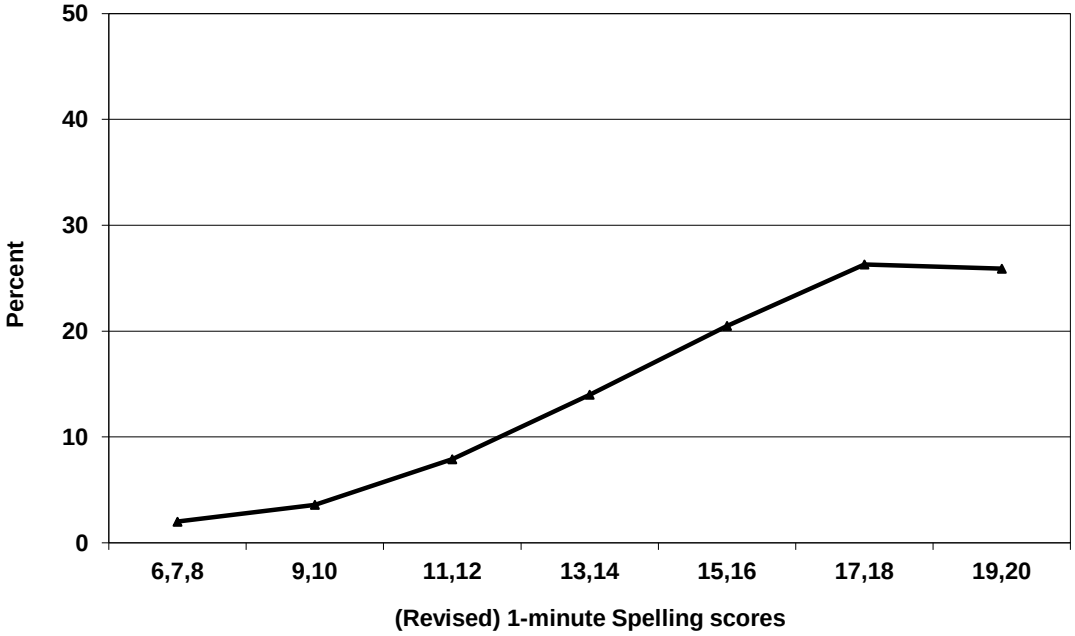
Figure 2: Examples of the completed Spelling exercise



[7] Interviewers raised initial concerns about doing this, but once they were reminded of the old adage of never being able to read a doctor's handwriting, they were comfortable with this procedure. Importantly, after the basic skills pilot study, they did not feed back any difficulties in doing this.

Figure 3 shows the distribution of cohort members by their score in the (revised) 1-minute Spelling exercise (n=9,233). As with the Reading exercise, this exercise distinguished between those who completed it without difficulty and the minority who struggled. These are shown on the graph by the 'tail' towards the low scores in the distribution.

Figure 3: Distribution of scores in the (revised) 1-minute Spelling exercise



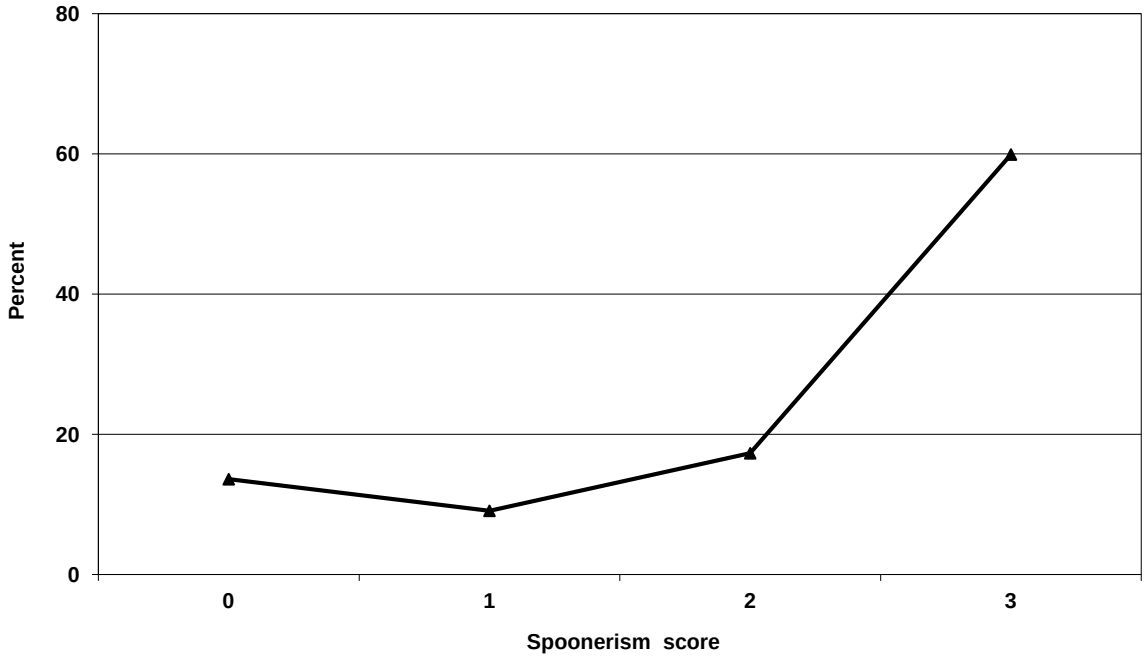
1.1.3 DAST Spoonerisms exercise

There is solid evidence that children with dyslexic symptoms are developmentally slow to detect rhymes, and that this is one of the reasons behind their struggles when learning to read. This type of phonological difficulty may persist into adulthood, and 'phonemic segmentation' – the ability to split words into their constituent sounds – is a sensitive index of these skills. Spoonerisms are a relatively complex measure of segmentation ability.

Interviewers explained to respondents that this was an exercise to play around with the sounds of words. Essentially, the interviewer read out two words and the respondents had to swap round the sounds at the beginning of each word: *'…….. so if I say 'Car Park' you would say 'Par Cark', and so on…….'.* The spoonerisms used in the exercise were the names of three famous people. Cohort members completed two further practice examples with famous names being attempting the Spoonerism exercise. The practice names were Michael Jackson (*Jichael Mackson*) and John Lennon (*Lon Jennon*).

Responses were given '1' point for a correct answer, and '0' points for an incorrect response or a pass. The Spoonerisms exercise was not timed. In Figure 4 we can see that approximately three fifths of BCS70 cohort members completing this exercise (n=9,351) could resolve all three Spoonerisms without difficulty but, again, the exercise identified a substantial minority who struggled with the task.

Figure 4: Distribution of Spoonerism scores



1.1.4 DAST Nonsense Passage Reading exercise

Adults with symptoms of dyslexia find it especially difficult to read words that they have never seen before. This can be readily explored by creating a passage of text containing 'made up' or 'nonsense' words. A well-known example of such is 'Jabberwocky' from *Through the Looking Glass*.

As for the Spoonerisms exercise, the short practice for this exercise was retained. Respondents were encouraged to try each word, but could 'pass' if they felt unable to attempt one of the words. The practice exercise was ***"Good lub", said the dix, "My name is Norgin".*** After the practice, any mistakes were highlighted and correct answers were given. Respondents then moved to the main exercise. The timer was set to three minutes for completion of the task. Although some respondents were awarded extra points for a quick time, the time limit was more a strategy for bringing the exercise to a close for the respondents who were really struggling but would not admit defeat.

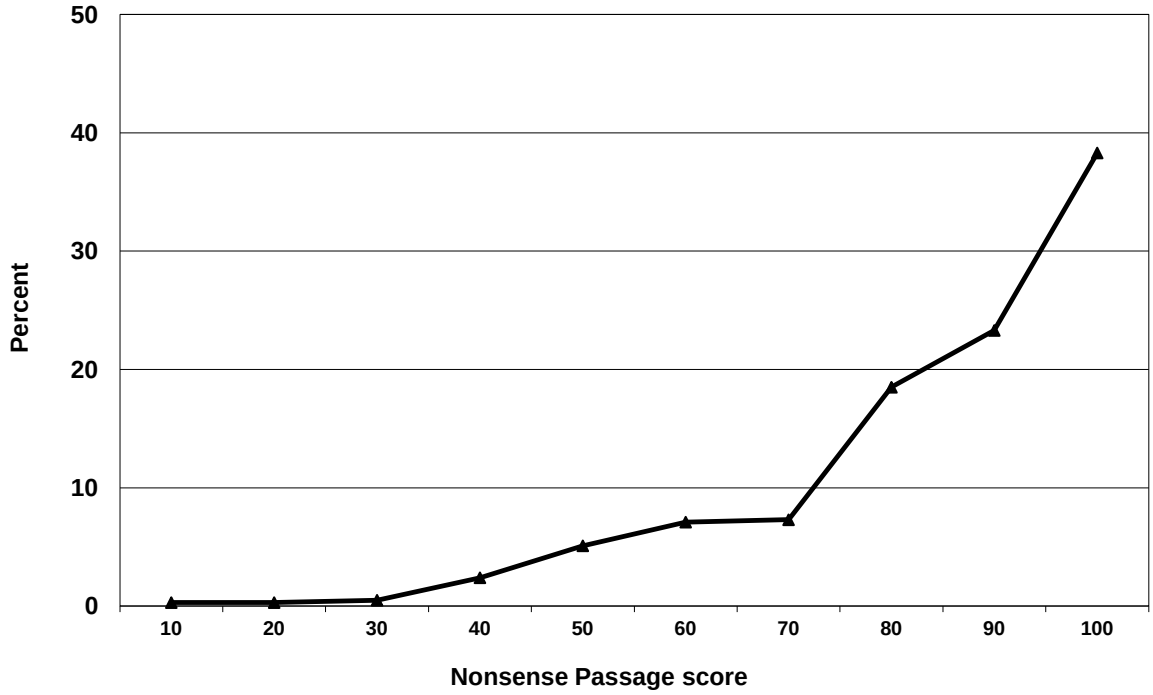
As in the practice exercise, respondents could 'pass' on a word, but were discouraged from not even trying to read the nonsense words. The exercise was stopped if the respondent made five consecutive mistakes, gave up, or was still going after three minutes. Scoring was more complex than for the other exercises. The number of words read and whether or not they were nonsense words were both taken into account, together with how long the respondent took. In summary, '1' point was given for each of the 59 normal words read correctly; '2' points were given for a correct (plausible) reading of each of the 15 'nonsense' words; and '1' point for a 'close try'. After the difficulties encountered in the pilot study, a 'close try' was defined as a pronunciation that had one sound or syllable different, one sound or syllable omitted, or one sound or syllable added.

For example:

- **'rinsomely'** is correctly broken down to have three syllables: **'rin-some-ly'**
- a close try would **be 'rinG-some-ly'** or **'rEn-some-ly'**
- an incorrect attempt would be **'rinG-ER-some-ly'** or **'rinG-ER-some-ER-ly.**

The maximum score for a perfect reading of all 'normal' and 'nonsense' words was 89, so we can see in Figure 5 that points for completing the task in a fast time were awarded to many of the cohort members completing this exercise (n=9,358), extending the score range up to 99. Once again the 'tail' of the distribution towards the low scores indicates the exercise was successful at identifying cohort members who struggled with the task.

Figure 5: Distribution of scores for the Nonsense Passage Reading exercise



1.1.5 DAST 'at risk' indicators

The purpose of the DAST is to screen for risk of dyslexia and other reading difficulties. Five categories of risk based on percentile scores of the original DAST sample population were defined (as in the DAST manual). 'Norms' were developed for each exercise for adults of all ages so that performance in any of the exercises can easily be allocated a standardised score[8]. A composite 'at risk' score can be determined by combining the 'at risk' scores for

[8] It was necessary to establish norms for performance on each of the tests, so that each subject's performance could be compared with that expected of a subject of that age. Norms were derived for each test for each age, so that any specific score could be assigned to a percentile point on the performance distribution. This means that one can establish, for instance, that an adult's performance in the Reading exercise fell on the 61st percentile for that age (that is, the adult did better on that test than 60 adults out of 100). To determine the norms for the general population, a standardised sample was derived equivalent to that for the Wechsler Adult Intelligence Scale (Revised) WAIS-R, with 600 adults in total: with 32 per cent in the age range 18 to 24, 44 per cent 25 to 54, and 24 per cent 55 to 74, and approximately 50 per cent male and 50 per cent female.

the individual exercises. In DAST this is achieved by taking a weighted mean of the individual 'at risk' scores, ignoring those scores that did not indicate risk. This was done by scoring '3' for very high risk scores, '2' for high risk scores, '1' for risk scores and '0' for all other scores, as follows.

% range	Risk of dyslexia	Risk score
1-4%:	Very high risk	3
5-11%:	High risk	2
12-22%:	Risk	1
23-77%:	Normal	0
78-100%:	Above average performance	0

All these 'at risk' scores for the individual exercises were then added together and divided by the total number of exercises administered to obtain a mean 'at risk' score or 'at risk quotient' (ARQ).

1.2 Calculating the DAST 'at risk quotient' score (ARQ) for BCS70

An 'at risk quotient' score (ARQ) for the BCS70 cohort was derived from performance in the four DAST exercises. Cohort members were assigned a score of 0, 1, 2 or 3 for their performance in each exercise. For example a cohort member who scored '0' in the Spoonerism exercise had a 'very high risk' of being dyslexic and was accordingly awarded three points; a cohort member who scored between 77 and 83 in the 1-minute Reading exercise was 'at risk' of being dyslexic and awarded one point[9]. The total score for the four DAST exercises was then divided by four to obtain an average score for performance in the four exercises – the 'at risk quotient' (ARQ) score.

Cohort members were then grouped into four 'risk' groups depending on their ARQ score: 'no risk' (0), 'low risk' (>0 and <1), 'high risk' (≥1 and <2), 'very high risk' (≥2). Table 1 gives the distribution of the 8,899 men and women who completed the four DAST exercises across these four 'risk' groups. We can see that five per cent of men and three per cent of women had a very high risk of being dyslexic. This is in line with population estimates that four per cent of any population are severely dyslexic and that more boys/men than girls/women are identified as being dyslexic. This is confirmed by the percentages of men and women in the different risk groups, and the small tendency for more men to be in the 'high risk' and 'very high risk' groups. It also supports earlier analysis of the BCS70 cohort with the data from when they were age 10 (Miles et al, 1998). However, Badian (1984)

[9] In comparison with the DAST 'norms' for 25- to 34-year-olds, BCS70 cohort members had lower average scores in the 1-minute Reading and the Nonsense Passage Reading exercises. Accordingly, if we had used the DAST scoring ranges for computing the ARQ, far more of the BCS70 cohort would have been identified by the individual exercises as being 'at risk' of dyslexia. As such, the percentile range was adopted, not the score range of that which identifies the DAST risk groups. Ongoing research will determine more sensitive ways of defining cohort members by their level of risk.

suggests that dyslexia is four times more common among males in the Western world than females, although more recent research has suggested that the gender split is more even (Everatt and Zabell, 2000).

Table 1: Distribution of BCS70 cohort members by ARQ groups

	Men %	Women %	All %
No risk	42	46	44
Low risk	39	41	40
High risk	14	10	12
Very high risk	**5**	**3**	**4**
N=	*4206*	*4693*	*8899*

For an early examination of the age 34 dyslexia data, which includes the relationship between dyslexia and cohort members' literacy and numeracy scores, see Bynner and Parsons (2006). Note the number and distribution of cohort members included in the DAST assessments differs slightly in this early report on the assessment data.

Appendix

List of variables in BCS70_2004_DyslexiaAssessmentScores.sav

Variable Name	Variable Label
BCSID	Research case identifier
DASTread	BCS70 2004 Survey: DAST Reading score
DASTspll	BCS70 2004 Survey: DAST Spelling score
DASTspon	BCS70 2004 Survey: DAST Spoonerisms score
DASTnonr	BCS70 2004 Survey: DAST Nonsense Passage Reading score
DASTrg	BCS70 2004 Survey: DAST Reading Score - grouped risk scores
DASTsplg	BCS70 2004 Survey: DAST Spelling Score - grouped risk scores
DASTspg	BCS70 2004 Survey: DAST Spoonerisms Score - grouped risk scores
DASTng	BCS70 2004 Survey: DAST Nonsense Passage Score - grouped risk scores
DASTarq	BCS70 2004 Survey: DAST Risk Score from Reading Spelling Nonsense and Spoonerisms exercises
DASTarqg	BCS70 2004 Survey: DAST ARQ Score from Reading Spelling Nonsense and Spoonerisms exercises

Syntax to derive DAST 'at risk' scores

****DAST Reading Score.**
freq dastread.
recode dastread (0 thru 63 = 3) (64 thru 76 = 2) (77 thru 83=1) (84 thru highest = 0) into DASTrg.
variable labels DASTrg 'BCS70 2004 Survey: DAST Reading Score - grouped as per DAST at risk groups'.
value labels DASTrg 3'very high risk' 2'high risk' 1'at risk' 0'normal to above average'.

freq DASTrg.

****DAST Spelling Score.**
freq DAStspll.

recode dastspll (0 thru 9 = 3) (10 thru 11 = 2) (12 thru 13 = 1) (14 thru highest = 0) into DASTsplg.

variable labels DASTsplg 'BCS70 2004 Survey: DAST Spelling Score - grouped as per DAST at risk groups'.
value labels DASTsplg 3'very high risk' 2'high risk' 1'at risk' 0'normal to above average'.

freq DASTsplg.

****DAST Spoonerisms Score.**
freq dastspon.
recode dastspon (0=3) (1=2) (2=1) (3=0) into DASTspg.
variable labels DASTspg 'BCS70 2004 Survey: DAST Spoonerisms Score - grouped as per DAST at risk groups'.
value labels DASTspg 3'very high risk' 2'high risk' 1'at risk' 0'normal to above average'.

freq DASTspg.

****DAST Nonsense Passage Score.**
freq dastnonr
recode DASTnonr (0 thru 42 = 3) (43 thru 58 = 2) (59 thru 72 = 1) (73 thru highest = 0) into DASTng.
variable labels DASTng 'BCS70 2004 Survey: DAST Nonsense Passage Score - grouped as per DAST at risk groups'.
value labels DASTng 3'very high risk' 2'high risk' 1'at risk' 0'normal to above average'.

freq DASTng.

****Overall DAST at risk score.**

compute DASTarq = (DASTrg + DASTsplg + DASTng + DASTspg) / 4.
variable labels DASTarq 'BCS70 2004 Survey: DAST at risk Score from Reading Spelling Nonsense and Spoonerisms exercises'.

freq DASTarq.

recode DASTarq (0 = 0) (0.1 thru 0.99 = 1) (1 thru 1.99 = 2) (2 thru 3 = 3) into DASTarqg.
variable labels DASTarqg 'BCS70 2004 Survey: DAST ARQ Score from Reading Spelling Nonsense and Spoonerisms exercises'.
value labels DASTarqg 0'no risk' 1'ARQ > 0' 2'ARQ 1+' 3'ARQ 2+'.

freq DASTarqg.

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