

Persistence of literacy problems: spelling in adolescence and at mid-life

B. Maughan,¹ J. Messer,¹ S. Collishaw,¹ A. Pickles,² M. Snowling,³
W. Yule,⁴ and M. Rutter¹

¹MRC Social, Genetic & Developmental Psychiatry Centre, King's College London Institute of Psychiatry, UK;

²University of Manchester, UK; ³University of York, UK; ⁴King's College London Institute of Psychiatry, UK

Background: Developmental reading problems show strong persistence across the school years; less is known about poor readers' later progress in literacy skills. **Method:** Poor ($n = 42$) and normally developing readers ($n = 86$) tested in adolescence (ages 14/15 years) in the Isle of Wight epidemiological studies were re-contacted at mid-life (ages 44/45 years). Participants completed a spelling test, and reported on educational qualifications, perceived adult spelling competence, and problems in day-to-day literacy tasks. **Results:** Individual differences in spelling were highly persistent across this 30-year follow-up, with correlations between spelling at ages 14 and 44 years of $r = .91$ ($p < .001$) for poor readers and $r = .89$ ($p < .001$) for normally developing readers. Poor readers' spelling remained markedly impaired at mid-life, with some evidence that they had fallen further behind over the follow-up period. Taking account of adolescent spelling levels, continued exposure to reading and literacy demands in adolescence and early adulthood was independently predictive of adult spelling in both samples; family social background added further to prediction among normally developing readers only. **Conclusions:** By adolescence, individual differences in spelling and its related sub-skills are highly stable. Encouraging young people with reading disabilities to maintain their exposure to reading and writing may be advantageous in the longer term. **Keywords:** Developmental reading problems, follow-up, spelling, epidemiology, continuity, reading disorder.

In most societies literacy skills are the key to educational success (Whitehurst & Lonigan, 1998); as a result, children who are slow to acquire reading and spelling skills may be an especially vulnerable group, at high risk of underachievement through the school years and beyond (Garnier, Stein, & Jacobs, 1997; Snowling, Adams, Bishop, & Stothard, 2001). Indeed, early schooling has been likened to a 'critical period' in establishing achievement trajectories (Entwisle & Alexander, 1989), with factors as varied as institutional structures, parent and teacher expectations, self-perceptions and inherited vulnerabilities all combining to constrain subsequent development.

We focus here on outcomes for one particular group of children at risk in this way: those with severe developmental reading problems. Difficulties of this kind affect some 5–10% of children; they are more common in boys than girls, show strong genetic influence, and often arise from phonological difficulties that affect children's capacity to decode words (Snowling & Hulme, 2008a). Follow-up studies have shown that the cognitive problems that contribute to reading difficulties persist at least throughout the years of schooling (see, e.g., Snowling, Muter, & Carroll, 2007), and that childhood poor readers show continuing impairments in both reading and spelling skills, with little evidence of 'catch up' (Maughan, Hagell, Rutter, & Yule, 1994; Shaywitz et al., 1999). Importantly, a slow start

in reading is also highly predictive of the *propensity* to read (exposure to print), which in turn is a strong contributor to later progress in reading (Cunningham & Stanovich, 1997).

Perhaps surprisingly, relatively little is known about the development of literacy skills beyond the end of formal schooling. In one of the few studies of representative samples, Rodgers (1986) found continuing improvement in reading comprehension between the ages of 15 and 26 years. Prior reading levels were the main predictors of later comprehension, but continued exposure to literacy demands in the workplace also showed some effects. Follow-ups of referred groups (Bruck, 1990, 1992) have also documented some resolution of reading difficulties with age, along with effects of continued involvement in education; problems with spelling and phoneme awareness were more persistent.

We provide further evidence on the long-term course of literacy problems here, based on findings from a mid-life follow-up of poor and normally developing readers first identified in the Isle of Wight epidemiological studies of the 1960s (Rutter, Tizard, & Whitmore, 1970). We were unable to test phonological skills in the context of a broad-range follow-up; instead, we assessed study members' spelling as one key marker of literacy skills. The aims of our study were three-fold: first, to assess continuities in spelling skills and spelling difficulties among poor and normally developing readers; second, to test for evidence of developmental catch-up among poor readers in adult life; and third, to explore influences

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on adult spelling. In addition to prior spelling levels, we focused on indicators in four other domains: (i) general cognitive abilities (as indexed by IQ); (ii) family social background, reported as influencing occupational attainments in some prior follow-ups of disabled readers (Maughan, 1995); (iii) exposure to print/literacy demands in adolescence and early adulthood, recently shown to have independent associations with adult spelling in a student sample (Burt, 2006); and (iv) behavioural difficulties (in particular hyperactivity/inattentiveness), widely established as correlated with, and probably influencing, reading progress in childhood (Willcutt & Pennington, 2000).

Method

Overview

The Isle of Wight studies were among the first systematic epidemiological studies of the prevalence and correlates of learning difficulties and psychiatric disorders in children and adolescents. Full details of the original studies are given in Rutter et al. (1970) and Rutter, Tizard, Yule, Graham, and Whitmore (1976). The studies used a two-phase design, with multiple screening of all children born between 1 September 1953 and 31 August 1955 with home addresses on the Island (including children placed in specialist medical and educational facilities elsewhere), followed by intensive psychological and psychiatric assessments of screen-positive children and randomly selected sub-samples of the full screen population. Eligible children were identified from local education and health authority records; the only exclusions were the small group of children (estimated at under 6% of the child population) attending private schools. The full programme of screening and intensive investigations was undertaken twice: Wave 1 (screen population $n = 2334$) took place in 1964, when the study children were aged 9/10 years, and Wave 2 (screen population $n = 2303$) took place in 1968/9, when they were aged 14/15 years. In 1999–2000, when study members were aged 44/45 years, individuals studied intensively in adolescence were re-contacted for a mid-life follow-up. Ethical approval for the follow-up was given by the Research Ethics Committee of the Institute of Psychiatry and South London and Maudsley NHS Trust; written informed consent was obtained from all participants.

Measures

Childhood and adolescent studies. (i) *Screening:* At Waves 1 and 2 the full study cohort was screened with reading, verbal and non-verbal IQ tests developed by the National Foundation for Educational Research (see Rutter et al., 1970 for details). All children scoring more than two standard deviations

below the mean for their age-group on any test were selected for intensive study, along with a randomly selected comparison group. In addition, teachers completed behaviour ratings (Rutter B scales; Rutter et al., 1970), which provide total problem scores (0–52), along with sub-scales tapping specific problem areas; we focus here on the hyperactivity/inattentiveness sub-scale (range 0–6).

(ii) *Intensive studies:* Children and adolescents selected for intensive study were individually administered 4 sub-tests of the Wechsler Intelligence Scale for Children (WISC; Wechsler, 1949), the Neale Analysis of Reading Ability (Neale, 1958) and the Schonell Graded Word Spelling Test (Schonell & Schonell, 1950). Family social class (Registrar General's classification) was determined from parental interviews at Wave 2. Interviews with the adolescents included questioning on out-of-school reading habits/print exposure: the number of books read outside school in the past month (coded as: none; one; two–three; four or more), and whether the young person read a daily newspaper (coded as: none; popular; broadsheet).

Adult follow-up. The follow-up interviews included additional indicators of exposure to literacy demands in adolescence/early adulthood: (i) age at completion of education or training, coded as ≤ 15 years (the age of compulsory school leaving for this cohort), 16–17 years, and ≥ 18 years; (ii) highest level of educational qualifications achieved (none; O/A levels and City and Guilds [the formal schooling-leaving and basic vocational qualifications awarded at the time]; higher technical diplomas; degree and professional qualifications); and (iii) literacy demands of first job. Two independent coders rated the extent to which the first full-time job that each participant described required the use of literacy skills (coded as: little/none; some; extensive; kappa = .70). We used scores on these three measures, along with the two indicators of out-of-school reading in adolescence (reading books and newspapers), to create a composite scale of adolescent/early adult exposure to print ($\alpha = .75$).

The follow-up interviews also included questioning on reading habits and perceived spelling competence at mid-life, and participants completed the Wide Range Achievement Spelling Test (WRAT3; Wilkinson, 1993). The WRAT3 was designed for use with individuals aged 5–75 years, and requires participants to write down the spelling of up to 40 words from dictation; administration continues until the participant makes ten consecutive errors or completes the test. The test was normed on a large sample of US children and adults, and reliability is reported to be high (Wilkinson, 1993).

All interviews were undertaken blind to participants' adolescent study status, and were conducted by psychologists, social workers and related

professionals who received extensive training in the interview protocol and administration of the spelling test.

Samples

(i) *Poor readers*: Children were classified as poor readers at ages 9/10 years if their scores on the individually administered reading accuracy or comprehension tests at Wave 1 fell 28 months or more below prediction on the basis of age ($n = 79$); age and short WISC IQ ($n = 76$); or IQ only ($n = 10$) (see Rutter et al., 1970 for full details). Excluding six children whose IQs fell below 70, 99 of these children were still on the Isle of Wight at ages 14/15, and were selected for inclusion in the intensive studies at Wave 2.

(ii) *Normally developing readers*: The normal reading comparison group studied at Wave 1 was not systematically followed at Wave 2. As a result, a new comparison group was drawn from children who were selected for intensive study at Wave 2 as part of the randomly selected comparison group. To ensure that these young people had no history of, or current major difficulties with, reading, we excluded any individuals who had (a) been identified as at risk of educational difficulties on any of the 'educational' screen tests administered at either Wave 1 or Wave 2; (b) specifically in relation to reading, scored at or below the 10th percentile on the screen reading tests at either Wave 1 or Wave 2 ($n = 129$).

(iii) *Randomly selected adolescent sub-sample*: for some analyses we also draw on data for the full randomly selected comparison group at Wave 2 ($n = 192$).

Adult follow-up: response rates

Two poor readers and one member of the normal reading comparison group were known to have died by the time of the adult follow-up; 99% of the remaining survivors were successfully retraced. Just under three quarters of traced comparison group members (93/127, 73.2%) and 55.2% of traced poor readers (53/96) agreed to participate in the follow-up interviews. In addition, 11 poor readers (20.8%) and seven members of the comparison group (7.5%) either declined to complete the adult spelling test or could not be tested for other reasons. As a result, adult spelling test data were available for 42 poor readers and 86 members of the comparison group. Despite the higher attrition rate among poor readers, the follow-up sample seemed satisfactorily representative of the full sample of poor readers in most respects. Poor readers with and without adult spelling data did not differ in adolescent reading comprehension (mean scores of 116.8 and 114.1 respectively, $t = -.64$, $p = .52$) or spelling (99.7 and 96.6 respectively, $t = -.84$, $p = .40$), but adolescent IQ scores were somewhat higher among those

with adult spelling data (96.5 and 91.6 respectively, $t = -1.71$, $p = .09$). There were no significant between-group differences in sex ratio, childhood SES, family size, or in rates of adolescent hyperactivity/inattentiveness. Parallel tests within the normal reading comparison group identified only one marginally significant difference: more women (74%) than men (59%) had adult spelling test data ($\chi^2[1] = 3.49$, $p = .062$).

Analyses

The analyses were undertaken in STATA 8.2 (Stata-Corp, 2003). T-tests were used to test group differences in continuous scores, and chi squared tests to evaluate differences in categorical variables. Predictors of adult spelling levels were tested using ordinary least squares regression.

Results

Sample characteristics

As expected, there were proportionately more men in the poor reader sample (73.8%) than in the comparison group of normally developing readers (45.4%). Table 1 shows other adolescent and early adult characteristics of the samples with adult spelling test data. Poor readers had significantly lower IQ, reading and spelling scores than comparison group members in adolescence. Using scores for the full randomly selected adolescent comparison group as a reference point, age 14 IQ scores among poor readers were .85 standard deviation (sd) units below the mean for this population; reading comprehension, by contrast, was 1.87 sds below expectation, and spelling 1.81 sds below. Teacher ratings underscored the high levels of general behaviour problems shown by poor readers in adolescence; as Table 1 shows, levels of hyperactivity/inattentiveness also remained elevated among poor readers in the teens. Family SES did not differ significantly between poor readers and comparison group members, but poor readers were less likely to report involvement in out-of-school literacy-related activities in their teens, left school/completed education/training earlier than their peers, and were markedly less likely to have achieved formal qualifications by the time of the adult follow-up. At the time they entered the labour market, childhood poor readers were also much more likely to have obtained jobs with limited literacy demands. As a result, scores on the composite scale of adolescent/early adult print exposure differed strongly between the two groups ($t = -7.99$, $p < .001$).

Adult spelling

Poor readers scored markedly less well than normally developing readers on the spelling tests

Table 1 Adolescent and early adult characteristics: poor and competent readers with adult spelling test data

	Comparison (<i>n</i> = 86)		Poor readers (<i>n</i> = 42)		test	<i>p</i>
	mean	(sd)	mean	(sd)		
<i>Age 14 ability and attainment scores</i>						
IQ	111.33	(12.59)	96.45	(14.37)	<i>t</i> = -5.96	< .001
Reading comprehension (months)	146.85	(6.55)	116.81	(21.65)	<i>t</i> = -11.73	< .001
Spelling (months)	153.51	(17.04)	99.69	(19.74)	<i>t</i> = -15.84	< .001
<i>Age 14 Teacher behaviour ratings</i>						
Total problem score	1.92	(3.08)	5.38	(5.96)	<i>t</i> = 4.34	< .001
Hyperactivity/inattention	.36	(.97)	1.05	(1.68)	<i>t</i> = 2.93	.004
<i>Age 14 Family social class</i>						
% Professional/managerial	25.3		12.2		χ^2 (2) 3.58	.17
% Skilled manual	39.8		39.0			
% Semi/unskilled	34.9		48.8			
<i>Age 14 Books read - last month</i>						
% 0	26.8		57.1		χ^2 (3) 16.05	.001
% 1	14.6		19.1			
% 2-3	30.5		19.1			
% > = 4	28.1		4.8			
<i>Age 14 Daily newspaper reading</i>						
% None	17.1		48.8		χ^2 (2) 16.25	<.001
% Popular	71.9		51.2			
% Broadsheet	11.0		0			
<i>Age completed education/training</i>						
% < = 15 years	20.9		66.7		χ^2 (2) 27.33	<.001
% 16-17 years	17.4		14.3			
% > = 18 years	61.6		19.1			
<i>Highest qualification achieved</i>						
% None	36.1		81.0		χ^2 (3) 27.84	<.001
% O, A level; City & Guilds	25.6		19.0			
% Higher technical	14.0		0			
% Degree, professional	24.4		0			
<i>Literacy demands of 1st job</i>						
% Little/none	24.7		72.6		χ^2 (2) 32.55	<.001
% Some	28.1		17.7			
% Extensive	47.2		9.80			

administered in adulthood (poor readers: $X = 61.38$, $sd = 11.97$; comparison group: $X = 98.36$, $sd = 14.42$, $t = 14.37$, $p < .001$). Again using data for the full randomly selected comparison group as a reference point, average spelling levels among poor readers fell 1.76 sds below expectation for this sample at mid-life. All poor readers scored below the mean for the randomly selected comparison group: 14.3% ($n = 6$) scored within one standard deviation of the mean, 50.0% ($n = 21$) between 1 and 2 sds below the mean, and the remaining 35.7% ($n = 15$) two or more sds below the mean. In terms of categories derived from the standardisation population for the WRAT3, only one poor reader (2.4%) was classified as average speller, three (7.1%) as low average and a further five (11.9%) as borderline; the great majority (78.6%, $n = 33$), however, scored in the 'deficient' range.

Figure 1a shows a scatterplot of age 14/15 and age 44/45 spelling scores for the two groups. As it shows, individual differences in spelling remained highly stable in both groups across this 30-year follow-up period. Correlations between adolescent and adult spelling were $r = .91$ ($p < .001$) for poor readers and $r = .89$ ($p < .001$) for members of the comparison

group. Tested in a multiple regression analysis there was no significant effect of childhood reading group on adult spelling once adolescent spelling had been taken into account ($beta = -.011$, $t = -.25$, ns). To assess relative 'progress' in the two groups, we also tested for an interaction between reading group status and adolescent spelling. This was significant ($beta = -.202$, $t = -3.24$, $p = .002$), the negative sign suggesting that poor readers' spelling had fallen further behind that of normally developing readers over the course of the follow-up period. Figure 1b shows fitted regression lines and 95% confidence intervals derived from these analyses for the two reading groups; as it suggests, although group differences were statistically reliable, they were also relatively modest. Wald-test comparisons of the regression lines at an adolescent spelling score of 101 (the lowest age 14 score represented in the comparison group) showed the difference of 3.55 not to be significant ($t = 1.50$, $p = .137$). However, at an adolescent score of 149, the highest score achieved by members of the poor reader sample, the poor reader regression line was estimated as 6.16 ($t = -2.32$, $p = .022$) below that of the comparison group ($b = 3.55$, $t = 1.50$, $p = .137$), ($b = -6.16$, $t = -2.32$, $p = .022$).

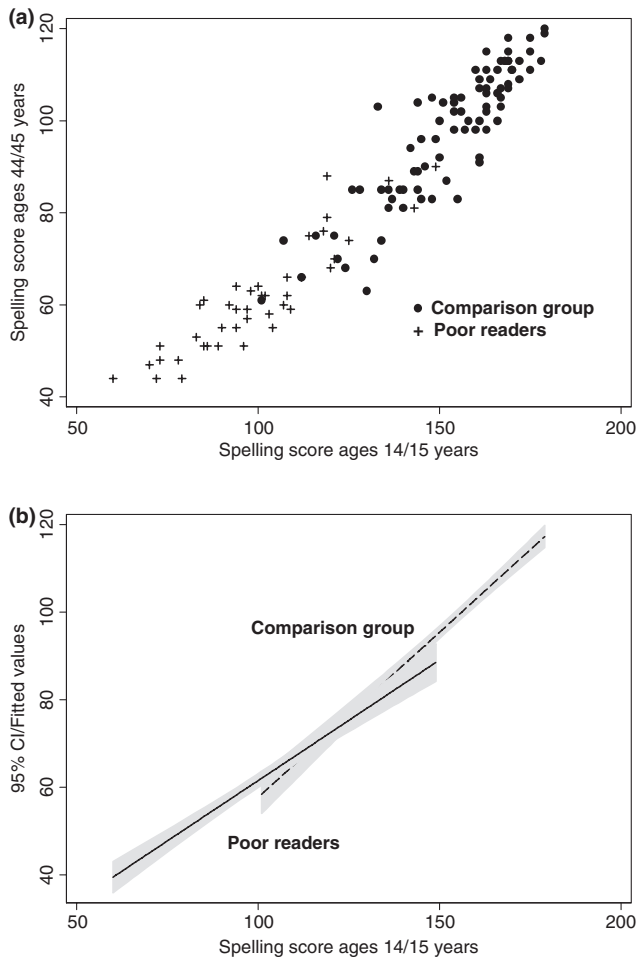


Figure 1 (a) Scatter plots of spelling scores at ages 14/15 and 44/45 years, (b) Fitted regression lines and 95% confidence intervals

Predictors of adult spelling

Finally, we undertook a series of regression analyses to examine predictors of adult spelling in each sample. Given the powerful effects of adolescent spelling on later spelling performance, adolescent spelling was controlled throughout. Table 2 shows the results for comparison group members and poor readers respectively. For each sample the left-hand block of columns shows effects of age 14 spelling, then gives results from bivariate tests of other potential predictors controlled for age 14 spelling. The right-hand block of columns shows results from multivariate analyses including all significant bivariate effects.

Within the comparison group of normally developing readers adult spelling did not vary by sex, and showed no additional effects of age 14 reading comprehension or accuracy, nor of adolescent behaviour problems, once adolescent spelling levels had been taken into account. Both adolescent IQ and family social class did, however, add to prediction, as did the combined scale of adolescent/early adult exposure to print. Tests of the individual items that made up the print exposure scale suggested that this effect was primarily attributable to variations in the length of formal education/training and in the level of educational qualifications that study members had achieved. In multivariate analyses adolescent spelling and adolescent/early adult print exposure continued to show clear effects; IQ was no longer a significant predictor in this multivariate context, but family social class in adolescence remained of borderline significance.

Table 2 Predictors of adult spelling

	Comparison group						Poor readers					
	Bivariate associations			Multivariate associations			Bivariate associations			Multivariate associations		
	Beta	<i>t</i>	<i>p</i>	Beta	<i>t</i>	<i>p</i>	Beta	<i>t</i>	<i>p</i>	Beta	<i>t</i>	<i>p</i>
Age 14 spelling	.891	17.81	<.001	.856	17.23	<.001	.908	13.71	<.001	.886	13.88	<.001
<i>Controlled for age 14 spelling</i>												
Sex	-.005	-.11	ns				.034	.050	ns			
Reading comprehension	-.029	-.57	ns				.109	1.04	ns			
Reading accuracy	.018	.19	ns				.298	1.88	.067			
IQ ¹	.134	2.40	.019				.094	1.44	ns			
<i>Teacher behaviour ratings</i>												
Total problem score	.024	.47	ns				.037	.55	ns			
Hyperactivity/inattention	.029	.56	ns				.033	.49	ns			
Family social class	-.124	-2.45	.016	-.091	-1.80	.076	.048	.73	ns			
<i>Print exposure</i>												
Print exposure (combined scale)	.159	3.27	.002	.136	2.65	.020	.145	2.27	.029	.145	2.27	.029
Age 14: books read last month	.030	.59	ns				.011	.16	ns			
Age 14: daily newspaper reading	.050	.98	ns				.129	1.94	.059			
Age completed education/training	.164	3.42	.001				.159	2.55	.015			
Highest qualification achieved	.190	4.09	<.001				.151	2.40	.021			
Literacy demands of 1st job	.081	1.57	ns				.111	1.70	.097			

¹Findings were similar for Total (shown here) and performance IQ sub-scales.

Among poor readers adult spelling was also unrelated to sex, and showed no effects of age 14 reading comprehension or behaviour problems once individual differences in adolescent spelling had been taken into account. By contrast with normally developing readers, prior reading accuracy showed a marginally significant additional influence on adult spelling, but IQ and family social background did not. As for normally developing readers, the scale of adolescent/early adult print exposure clearly added to prediction; while years in formal education/training and resulting qualifications were again the most powerful contributors to this effect, out-of-school reading in adolescence and literacy demands in the workplace also showed some associations with later spelling skills. In the multivariate analysis only adolescent spelling and the composite measure of print exposure showed independent significant effects.

These analyses suggested that family social background had a more important influence on later literacy skills among normally developing than among poor readers. We undertook additional analyses to assess whether this difference constituted a statistically significant interaction – a more powerful test of the extent to which social background effects did indeed vary between the two groups. Controlled for adolescent spelling and the reading group \times adolescent spelling interaction identified above, the interaction was significant ($\beta = .188$, $t = 1.90$, $p = .050$). In the comparison group, adult spelling scores showed a consistent gradient across family social background (professional/managerial: mean = 101.3 [$n = 21$]; skilled manual: mean = 99.4 [$n = 33$]; semi/unskilled: mean = 95.5 [$n = 29$]). Among poor readers, by contrast, adult spelling scores differed little in the small group of participants from professional/managerial backgrounds (mean = 58.8, $n = 5$), from scores for participants from skilled manual (mean = 63.2, $n = 16$) or semi/unskilled backgrounds (mean = 61.1, $n = 20$).

Self-perceptions of adult spelling skills

The follow-up interviews also included a series of questions on study members' own perceptions of their literacy skills in adulthood, and the extent to which any continuing difficulties contributed to functional impairments in day-to-day life. Eighty per cent of the poor readers considered their spelling below average, by contrast with 13% of comparison group members. Tested spelling skills were consistent with these reports: in the comparison group, mean spelling scores were 100.9 and 79.7 for those who considered themselves average and below average spellers respectively, while comparable figures among the poor readers were 73.0 and 57.8. We also asked if study members had problems in writing a 'decent' letter, or in filling in forms. Eighty per cent of the poor readers (by contrast with 17% of

comparison group members) reported difficulty in writing letters, with 77% typically needing help; 73% (versus 6% in the comparison group) reported difficulty with filling in forms, with 67% typically reliant on help.

Discussion

Past studies have demonstrated the persistence of developmental reading problems across childhood and adolescence (Snowling et al., 2007) and into early adult life (Shaywitz et al., 1999). Our findings extend that picture to middle adulthood. Tested at an average age of 44 years, individuals identified as poor readers almost three decades earlier continued to show major deficits in literacy skills. Using other Isle of Wight study members as a reference group, average spelling levels among poor readers lagged 1.75 standard deviations below expectation in adolescence, and 1.67 standard deviations below expectation at mid-life. Using a large US standardisation sample as the reference group, over three-quarters of childhood poor readers were classified as showing 'deficient' spelling skills in adulthood – a category found in under 3% of the US standardisation population. Not surprisingly, these continuing difficulties were associated with high levels of impairment in day-to-day literacy-related tasks.

Though our prime focus was on the persistence of literacy problems among poor readers, the analyses also highlighted strikingly stable individual differences in spelling among normally developing readers. Correlations in tested spelling levels approached $r = .9$ in the non-reading disabled comparison group across this 30-year follow-up period, suggesting that by adolescence, variations in spelling index highly stable individual differences among more and less skilled readers alike. The marked differences in average spelling levels between poor and competent readers in adulthood were very largely attributable to pre-existing differences in spelling in adolescence. Tests for an interaction between reading group status and prior spelling levels, however, suggested that poor readers had fallen somewhat further behind their peers over the course of the follow-up period. As the figures suggest, these differences were relatively modest, and were primarily evident at the top of the range of adolescent spelling skills represented in the poor reader sample. These findings provide further support for the view that the difficulties facing children with severe reading problems are likely to reflect deficits in underlying cognitive processes, rather than simply developmental delay.

Despite the powerful influence of individual differences in adolescent spelling, the analyses also highlighted other contributors to adult spelling. For normally developing readers these included IQ, family social background and continuing exposure to literacy demands – which, for these competent

readers, were primarily indexed by length of education/training and qualifications. Among poor readers, only more extensive exposure to reading/literacy demands showed significant effects once prior spelling had been taken into account. To an extent, the lack of social background effects among poor readers may reflect variations in statistical power, as our sample of poor readers with adult spelling test data was only modest in size. More detailed analyses, however, suggested that this may not have been the only explanation. Adult spelling levels showed a clear gradient across family socio-economic background categories among normally developing readers, with study members from professional and managerial backgrounds having the most superior skills. Among poor readers no effect of this kind was apparent, though the numbers from professional or managerial backgrounds were small. Early literacy development is known to be socially patterned (Hecht, Burgess, Torgesen, Wagner, & Rashotte, 2000), and past studies have noted positive effects of more advantaged social backgrounds on occupational outcomes in reading disabled samples (Maughan, 1995). Our findings suggest that effects of this kind may be less evident in relation to later progress in literacy-related skills, where the severity of poor readers' underlying deficits may override effects of other potentially ameliorating factors.

Indicators of more extensive involvement in reading-related activities were, however, significant predictors of mid-life spelling in both samples. Exposure to print has been identified as a key predictor of early reading progress (Cunningham & Stanovich, 1997), and longer-term follow-ups of reading disabled samples have noted that continued exposure to educational experience (Bruck, 1990, 1992), or to literacy demands in the workplace (Rodgers, 1986), are associated with continued progress in reading comprehension. In addition, recent cross-sectional evidence suggests that even young adults with superior phonological sensitivity may fail to achieve high levels of spelling competence if they read only rarely (Burt, 2006). For poor readers, however, exposure to print is often severely limited by a preference for non-literary pastimes (Snowling et al., 2007) and avoidance of formal settings likely to involve major literacy-related demands.

We tested effects of a variety of indicators of reading experience/print exposure here, including study members' own contemporaneous reports of out-of-school reading in adolescence; their length of education/training and final qualification levels; and assessments of the likely literacy demands of their first full-time jobs. At a simple descriptive level, the findings underscored the poor readers' low levels of exposure to reading-related activities of all these kinds: less than half reported reading for pleasure in the teens, two-thirds left formal education at the earliest opportunity, and approaching three-quarters took first jobs where reading or writing demands

could be expected to be at a minimum. While these choices are understandable, our findings are consistent with prior reports in suggesting that selection processes of this kind are only likely to compound poor readers' difficulties. In childhood, exposure to print is predominantly environmentally influenced, with genetic factors showing only a quite modest role (Harlaar, Dale, & Plomin, 2007). With age, person-environment or gene-environment correlations may become more marked, such that individuals' existing literacy levels play an increasingly important part in determining their reading exposure. Our results – highlighting the beneficial effects of continued reading experience for individuals at all levels of reading skill – suggest that efforts to encourage children and adolescents with reading difficulties to remain engaged with reading can only be advantageous.

So far as we are aware, our study represents the longest-term follow-up of literacy skills in non-referred samples of poor readers undertaken to date. The representative nature of our sample supports the likely generalisability of the findings, but the results must also be seen against the background of some limitations. First, though we were able to relocate the vast majority of surviving study members in adulthood, non-participation rates among poor readers were high. Attrition constitutes a major challenge in all long-term longitudinal research (Wadsworth et al., 2003), increasing risks of bias if responders differ from non-responders in key ways. In general, checks on the representativeness of the samples studied here were reassuring. Among poor readers, adolescent reading and spelling levels in the sub-sample with adult spelling data were closely comparable with those in the full original sample, as were indicators of socio-demographic background and behavioural difficulties. The only factor to suggest any noticeable variation was IQ, where the sub-sample with adult test data had slightly superior test scores at age 14. Within the comparison group, study member sex was the only factor differentiating responders and non-responders. As we have seen, neither sex nor IQ level emerged as predictors of adult spelling in the multivariate analyses. As a result, although sample attrition undoubtedly affected the statistical power of our comparisons, we have no reason to believe that it should have given rise to any serious bias in the pattern of the findings.

The second main limitation to the generalisability of our findings to more recent samples stems from their historical context. Isle of Wight study members attended school some four decades ago, and experienced both the strengths and the limitations of the educational provision of their time. More recently, educational policy has focused heavily on literacy development in the early school years, there are now a range of evidenced-based interventions known to be effective in ameliorating reading problems (Torgesen, 2005; Snowling & Hulme, 2008b), and the

widespread use of computers and spell-checkers may mitigate many of the day-to-day impairments that can flow from reading difficulties. We must await follow-ups of more recent samples to assess how far these developments have indeed resulted in improvements for poor readers today.

Taken together, our findings suggest that by adolescence, individual differences in spelling and its related sub-skills are highly stable. For young people with severe literacy problems this means that spelling levels are likely to continue to be compromised, with inevitable implications for functioning in day-to-day tasks. From a practice perspective, these findings only underline the need for early identification of specific learning difficulties so that appropriate interventions can be put in place before a downward spiral of poor reading and lack of motivation to read becomes established. More generally, there remains work to be done to ensure that the expectations of teachers and parents are realistic (and certainly not too low) for children with specific learning difficulties. With the availability of good support, including the use of information technology, children should feel positive that even though they find aspects of literacy difficult, this need not be an obstacle to success in other aspects of the curriculum - or indeed in their later lives.

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Correspondence to

Barbara Maughan, MRC Social, Genetic and Developmental Psychiatry Centre, P046, King's College London Institute of Psychiatry, De Crespigny Park, London SE5 8AF, UK; Tel: +44 (0)20 7848 0470; Fax: +44 (0)20 8748 0866; Email: b.maughan@iop.kcl.ac.uk

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