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■ A Thirteen-year Follow-up Study of Young Norwegian Adults with Dyslexia in Childhood: Reading Development and Educational Levels

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As part of a larger follow-up study, 75 students were diagnosed with dyslexia at 10 years of age. At the end of secondary school, grades for the whole cohort of 16-year olds were examined. At age 23 the whole study group responded to a questionnaire and the subgroup with dyslexia who responded to this questionnaire were invited to come for testing and interviews. The persistence of dyslexia into young adulthood and educational levels were examined. The results showed that almost all students still suffered dyslexia and showed lower decoding ability. However, they only showed slightly lower educational attainment levels compared with a representative sample of half the cohort ($n = 530$) they were part of. Copyright © 2009 John Wiley & Sons, Ltd.

Keywords: longitudinal; dyslexia; education

INTRODUCTION

In the ICD-10 and DSM-IV classification systems dyslexia is grouped among the specific developmental and learning disorders, affecting 2–10% of school children (Beitchman & Young, 1997; Shastry, 2007; Snowling, 2000). These definitions are based on exclusion of factors like insufficient education, brain damage or mental retardation as causes for reading problems. The ICD-10 Diagnostic Criteria for Research suggest that a cut-off of two standard deviations below expected level of reading achievement should be used.

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Dyslexia in childhood are much discussed in the literature (Astrom, Wadsworth, & DeFries, 2007; Beitchman & Young, 1997; Bishop, 2006; Goulandris & Defty, 1996; Grigorenko, 2001; Lundberg & Høien, 1990; Maugan, 1995; Pennington, 1999; Shaywitz, Lyon, & Shaywitz, 2006; Snowling, Shaywitz, & Shaywitz, 2005; Stanovich, 1986). Existing evidence shows that reading and spelling problems can persist into adolescence (Elbro, Møller, & Munk Nielsen, 1995; Fergusson, Horwood, Caspi, Moffitt, & Silva, 1996; Frisk, 1990; Greenberg, Ehri, & Perin, 1997; LaBuda & De Fries, 1998; Snowling, Muter, & Carroll, 2007; Svensson & Jacobson, 2006; Young *et al.*, 2002). Estimates of the stability of developmental reading problems have varied between 0.23 and 0.96 for a 1–8 year period (Astrom *et al.*, 2007; Harlaar, Dale, & Plomin, 2007; Shastry, 2007). There is, however, less evidence available documenting continuing problems into young adulthood.

Most studies focus on the development of language problems in terms of reading difficulties. European research has often taken spelling problems into consideration. For example, Ehri (1997) examining relationships between reading and spelling, has argued that measures assessing these areas may be looked upon as two ways of describing the same problem, because they depend upon the same information sources in memory. Thus, research supports the linkage between reading and spelling problems.

Since reading and writing skills correlate positively with general ability, most researchers have considered it important to disentangle the strong influence of the latter in studies of dyslexia and general school achievement. The discrepancy approach to the definition of dyslexia is a way to reduce the effects of general ability. Rutter and Yule (1975) made a distinction between reading 'backwardness' and reading retardation, the latter being described as a specific disability in reading not explicable in terms of the child's general intelligence. However, the role of intelligence in diagnosing dyslexia is still under debate (Siegel & Smythe, 2005; Stanovich, 1999; Tiu, Thompson, & Lewis, 2003).

Grundin's study of reading and spelling abilities among 25- and 35-year olds (1977) showed more problems among the older individuals, suggesting that adults with reading and writing problems might lose such skills when they do not use them. As most 23-year olds still are in the educational system or have recently been students at secondary schools, they should represent peak performance in terms of reading and writing skills, relative to younger and older subjects.

The aims of this longitudinal study were to examine the persistence of dyslexia among respondents diagnosed with dyslexia at 10 years of age into young adulthood, and to examine their educational levels at age 23. The hypotheses were that dyslexia would persist, and that individuals originally diagnosed with dyslexia by a discrepancy approach would have lower educational attainment levels than the age-cohort to which they belong, despite the fact that they as a group have about average general ability compared to their cohort.

METHOD

Due to lack of norms for young adults, the performances of our 23-year olds are compared to norms for 12–14-year olds, any score lower than the mean for this norm group is considered to indicate a reading and spelling problem.

Normative Group

The study is part of a larger longitudinal study of 530 young Norwegian adults in the city of Trondheim. These individuals represent half the cohort of 10-year olds in Trondheim. They completed Reading, Spelling and Ability tests at the age of 10, in 1983. In 1995 they completed a follow-up questionnaire about education, school experience and family matters. (The 530 will serve as a norm group in further analyses.)

Sample

Initially, a subgroup of 75 students (about 7.7%) was diagnosed with dyslexia at 10 years of age on the basis of regression-based discrepancy, either between reading achievement and general ability, or between spelling achievement and general ability. At the end of lower secondary school (age 16) school records were available for the total cohort of students. Of the 75 students with dyslexia, 68 were found among the graduating class of 1989, while 7 had moved out of the city of Trondheim. Of these 68 students, 36 (53%) responded to the follow-up questionnaire for the whole group ($n = 530$) in 1995, when they were 23 years of age. Twelve men and nine women then accepted an invitation to be tested and interviewed in the late fall of 1995 and spring of 1996.

Measurement of 10-Year Olds

Reading Comprehension: Eighteen short stories, each followed by four multiple-choice questions were read silently.

Speed-reading: A word is presented, followed by four figure drawings; one of each is to be selected.

Spelling: Written spelling of 50 single words that were read aloud in the context of a sentence.

General ability/fluid intelligence: Sum of z scores from three tests designed for the study, Matrices, Picture Analogies and Numbers Series. [Readers are referred to [Salvesen and Undheim \(1994\)](#) for a presentation of these measures, which have been used in several Norwegian studies.]

Measurement of 16-Year Olds

Records of school grades in Norwegian, English and Mathematics at the age 16 for the whole cohort in the city of Trondheim were available for measurement of school achievement (see Table 3).

Measurement of 23 Year of Age

The total group ($n = 530$): Answered a questionnaire.

The dyslexic group ($n = 21$): Answered the same questionnaire, came for testing and interview. The same reading and spelling measures as used at the age of 10 years (see above) were repeated at age 23. In addition, sub-tests from the KOAS battery ([Høien & Lundberg, 1989](#)) were used. KOAS is a battery of computerized Reading tests, which is routinely used to assess reading impairment in Norwegian schoolchildren. Its standardization is based on a large normative sample for different age groups.

Measures

Reading

Reading Comprehension Test: 18 short stories, each followed by four multiple-choice questions, were used to test comprehension. The score is the number of correct content markings within a given time period. The test is a longer version of the Reading Comprehension Test used at age 10 (see Salvesen & Undheim, 1994). The oldest age group with comparable normative data is the age group of 12–13 years ($n = 563$, see Thygesen, 1992, p. 84) showing a mean of 46.6, SD of 11.4 and a split-half reliability of 0.76.

Reading Speed Test A: OS 400 Test (Høien & Trana, 1978), testing speed in reading 400 single words. A word was presented, followed by four figure drawings, one of which was to be selected. The score is the number of correct choices within time limit. The test is a longer version of the Reading Speed test used for children aged 10 years (see also Salvesen & Undheim, 1994). Norms for 12–13-year olds ($n = 563$, see Thygesen, 1992) showed mean of 249.42, SD of 56.63 and split-half reliability of 0.81.

Reading Speed Test B1 and B2: Sub-test 2.1 of KOAS. Seventy-two words were briefly exposed on the screen (100 ms) to students who were asked to read aloud as quickly as possible, while the computer registered response time. The B1 measure represents the percentage of correct read words, while B2 refers to response time used for reading the same words. The test consisted of three, five and seven letter words, some of infrequent, others of frequent use; both concrete and abstract words were included. Norms were available from a representative sample of 14-year olds ($n = 100$, see Høien & Lundberg, 1991), and showed a mean of 98.3, SD of 3.0 for percentage of correct read words (B1), and response time mean of 570 ms, with an SD of 250 (B2).

Decoding of Non-words

KOAS, sub-test 3.1 (A and B); 36 non-words were exposed on a computer screen for a maximum of 5 s for the student to read aloud as quickly as possible. Three, five and seven letter words were represented. Available norms from a representative sample of 14-year olds ($n = 100$) showed percentage of correct read words (A) with mean of 95.8, and SD of 4.6, and mean of 1640 ms and SD of 390 for response time (B) (Høien & Lundberg, 1991).

Spelling

Spelling Test A: A test called Aston Index, containing 20 single words to be spelled in writing (Sivertsen, 1984). Sentences containing each word were read aloud, the word was then repeated twice. The number of words misspelled was scored. Norms were available from a representative sample of 12–14-year-olds ($n = 586$) in the city of Trondheim (Finbak, 1999), showing a mean of 6.7 and SD of 4.5.

Spelling Test B: Dictation of whole sentences (Dale & Carlsten, 1981) read aloud twice by the instructor, one sentence at a time. Students wrote five sentences. The number of misspellings was counted. Available norms (Finbak, 1999) showed a mean of 3.2 and SD of 3.4.

Evaluation of Reading and Spelling

In evaluating reading and spelling abilities at the age of 23, our group of 21 subjects were compared to a representative sample of Norwegian young people aged 12–14 years. This was due to the fact that normative data for persons older than 14 years were not available. Reading, spelling and decoding scores lower than the mean for 12–14-year olds were considered to indicate dyslexia. These criteria were also used in an earlier study of Norwegian adults with dyslexia (Skaalvik, 1994).

Questionnaire

Subjects were asked to fill out a questionnaire consisting of 48 closed questions concerning school and work history, leisure activity and family life, as well as current life situation and further educational plans.

Procedures

Dyslexia Diagnosis at Age 10

The dyslexia diagnosis used regression-based discrepancies between a reading score (sum of standard scores for Reading Comprehension and Reading Speed) and general ability (sum of standard scores for ability measures) or between the spelling score and general ability. The children were tested on two separate occasions. Diagnosis was based on having large discrepancy scores at both occasions and if only on one occasion, on independent teacher referral as well.

Self-selection of Our 21 Subjects at Age 23

Table 1 (below) compares the original group of students with dyslexia with the sample in terms of reading, spelling and general ability as measured at 10 years of age. At this age, the original group of students with dyslexia ($n = 75$) had average scores more than 1 SD below their classmates in both reading and spelling (see Table 1). General ability, however, was measured to be about .3 SD below average. The sample ($n = 21$) showed higher mean scores in general ability and in reading than the 75, but showed the same mean on spelling scores. Thus, there was a significant positive self-selection among those who came for testing. However, both high and low scores on reading and general ability were represented in the study group. Since the original group of 75 had about 70% men, more women than men agreed to participate in this follow-up.

Statistics

To obtain a composite score of readings, the average individual standard scores (z scores) for the three reading tests, Reading Comprehension, Reading Speed A

Table 1. Means of standard z scores for reading, spelling and general ability among children aged 10 years of age in the original dyslexic group and the sample

Variables	Original group $n = 75$	Sample $n = 21$
Reading	-1.16	-0.76
Spelling	-1.46	-1.41
General ability	-0.28	-0.15

and Reading Speed B2 were used. Spelling was likewise the average standard score for the two spelling measures.

Decoding of non-words as measured by KOAS 3.1, and non-word reading, were analysed separately. The score for decoding of non-words was average standard score for correctly read words and response time, KOAS 3.1 A and KOAS 3.1 B. One person did not complete this test. For three subjects, the reading score was based on only two tests, since Reading Speed B2 was missing for technical reasons because of computer failure.

In line with Skaalvik (1994), there was obtained composite score from the KOAS 3.1 A and B.

Differences between group means were analysed by means of one-sample *t*-tests.

RESULTS

16 Years

Table 2 presents the school achievement scores at the age of 16 for the 68 students with dyslexia (of the original group of 75), who still resided in the city of Trondheim, and for the sample. There was a self-selection in terms of later development.

At the age of 16 years, the sample did better in Mathematics and English than the original group of 68 students, who still lived in the city of Trondheim. There was no difference in Norwegian (mother tongue).

While the main focus will be on the status of subjects when being 23 years of age, it should be noted that both the original group of students with dyslexia, and the sample, who were followed until the age of 23 years, did less well in school at the age of 16, the last year of compulsory schooling. Table 3 presents school grades for the cohort of 16-year olds in Trondheim that year and for the sample. Noteworthy here is that only the language-related (not Math or General Achievement Index) scores were lower than for those in the control group.

The students with dyslexia were almost 1 SD behind in English (as a foreign language), about 0.6 behind in Norwegian and in General Achievement, and were about 0.4 SD behind the cohort in Math achievement. The differences were

Table 2. Mean and SD on school achievement among children aged 16 years in the original dyslexic group and in the sample

Variables	Original group <i>n</i> = 68		Sample <i>n</i> = 21	
	Mean	SD	Mean	SD
Norwegian	2.81	0.65	2.81	0.51
English	2.50	1.09	2.81	0.68
Math	2.79	0.80	3.10	0.62
Achievement index ^a	19.60	5.50	21.62	4.17

Note: School grades were converted to numbers on a 5-point scale, higher scores representing better results.

^aThe achievement index is the sum of grade numbers for seven academic school subjects.

Table 3. School grades at the age of 16 years (junior high school diploma)

Variables	Cohort <i>n</i> = 1857		Sample <i>n</i> = 21	
	Mean	SD	Mean	SD
Norwegian	3.32	0.80	2.81*	0.51
English	3.27	0.93	2.81*	0.68
Mathematics	3.16	0.94	3.10	0.62
Achievement index	23.23	5.43	21.62	4.17

*Significant at $p < 0.05$. Sample compared to the whole cohort of Trondheim.

Table 4. Reading, spelling and decoding of non-words results of the sample ($n = 21$) at age 23

Variables	Mean	SD	Min.	Max.
Reading	-0.23	0.68	-2.18	1.42
Spelling	-0.27	0.86	-2.72	1.23
Decoding non-words	-1.01	1.40	-5.17	0.75

Note: Scores are standardized relative to available normative data for 12–14-year olds, Reading is average standard score for three tests on Reading Comprehension and Reading Speed A and Reading Speed B2. Spelling is likewise the average standard score for the two spelling measures. Decoding of non-words is the average standard score for response time and correctly read words.

reduced by about 0.2 SD, if the effects of General Ability were controlled for. The sample did much better, but was still significantly behind the cohort mean in the languages tested.

23 Years

The results, showing negative mean scores, indicated that most of our students still had dyslexia at 23 years of age (see Table 4).

Only one student had scores above the mean for 12–14-year olds on all three measures. Of the two other students with above mean scores on the reading and spelling measures, one did not get a result on the Reading Speed B measure for technical breakdown (see statistics). The third student had a negative score on the Non-word Decoding Test.

For reading, the distribution showed 14 individuals below mean and 3 above (0.06). One student, however, read more than 1 SD above mean, although his spelling was below the mean. Individual scores on spelling showed 13 subjects below mean at 23 years of age.

Three students showed above means on both measures in reading and spelling at 23 years of age. Taking decoding of non-words into consideration eliminates one of these. A second person, however, was missing this specific test because of computer breakdown.

Students originally assigned to this study because of spelling problems, still exhibited such problems. Only two of the students with a spelling problem at age 11 had current scores above the mean for the norm group. Of respondents originally assigned for reading problems, only one had a reading score above mean at 23 years of age.

Three students scored below $-1.5z$ in reading, seven students scored below $-1.5z$ in spelling and five students scored below $-1.5z$ on both reading and spelling. Students, who had both reading and spelling problems at the age of 10, still exhibited these at the time of testing.

The distribution of scores on Reading Speed B, (KOAS 2.1 number of correctly read words), showed very little variation and was strongly negatively skewed (Table 5).

The self-evaluations in reading and spelling for the sample ($n = 21$) compared to the total group ($n = 530$) showed significant differences ($p < 0.05$) both in reading and spelling. While most of the subjects with dyslexia seemed to have accepted themselves as having such problems and in the questionnaire rated themselves below average in reading and spelling, some still reported themselves to be average or above. The three students with above mean scores in both reading and spelling rated themselves below average on self-evaluations in reading, two of them also in spelling.

Decoding of non-words turned out to be a difficult task, with a mean of -1.01 ; correctly read words and response time both indicated problems and the estimated composite scores (KOAS 3.1 A and B) showed all but three of the students with dyslexia scoring below the mean of 14-year olds, some also considerably lower. The respondents in the tested sample showed problems in reading unknown words as well as in reading non-words. In addition, the reading of briefly exposed words was difficult for them.

The sample showed also lower levels of completed education compared to their cohort at age 23, but no significant differences were found (see Table 6). Fifteen persons had finished 3 years of high school, four persons had finished 2 years, one person had finished 1 year and one person did not start high school. Interview data at age 23 published elsewhere completes this picture, reporting 23% respondents as unemployed, 23% in unskilled work, 23% in skilled work and 29% still in college/universities or vocational schools (Undheim, 2003).

DISCUSSION

Results support our hypothesis that dyslexia in childhood persisted throughout adolescence and into young adulthood for all but two of the respondents. At age 23 they all showed lower decoding abilities. They rated themselves lower in

Table 5. Self-evaluation in reading and spelling for sample compared to total group

	Norm group $n = 541$		Sample $n = 21$	
	Mean	SD	Mean	SD
Reading	2.06	0.7	3.00*	0.9
Spelling	2.01	0.8	3.1*	0.8

Note: Rated on a 5-point scale from 'better than most' to 'having big problems'. A score of 2 refers to 'about average', while a score of 3 refers to 'somewhat less than average'.

*Significant at $p < 0.05$.

Table 6. Educational levels at age 23 for the sample compared to the norm group

	Norm group (N = 530)		Sample (N = 21)	
	Mean	SD	Mean	SD
Educational level ^a	4.17	1.28	3.85	1.27

No significant difference.

^aThe score is the estimated number of years of schooling after completed compulsory schooling at age 16. The score is based on a number of questions about education completed.

reading and writing skills than their cohort, and they also showed lower achievement in these areas. However, as young adults they had reached an educational level not much lower than their cohort.

Even if the sample showed slightly higher ability levels than the original group, they still showed dyslexic problems. The fact that such problems were found in a positive self-selected group of children with dyslexia among average general abilities indicates findings generalizable to a wider dyslexic population.

Discrepancy-selected students with dyslexia represent a higher ability group than backward readers (Rutter & Yule, 1975) because the discrepancies will be of little importance for students with low ability, and few will meet these criteria. The results in the present study are expected to be somewhat better than for children with dyslexia when selected on the basis of a given cut-off level on reading and spelling measures. In addition, discrepancy diagnosed students might find it easier to work with their difficulties and thereby improve their skills, as some of the respondents in this study also had done. In spite of slightly higher ability levels than the original sample of 68 students with dyslexia and the efforts made to compensate for their difficulties, the sample except two students still showed dyslexia at the age of 23.

In particular, decoding of non-words was found to cause severe difficulties. Even if the non-words were read correctly, the response time was much higher than for the 14-year-old norm group, suggesting that their reading technique was insufficient to the task. This is consistent with interview information from the same students where they described their constant feelings of lacking skills for reading unfamiliar words properly (Undheim, 2003).

Students with dyslexia tend to be underachievers. To compensate for reading problems they usually take on a heavy workload, resulting in longer workdays and more stress than for others. Thus, the end of compulsory schooling might be a relief. Further educational choices are likely to be affected by help and support provided to deal with the academic stress during previous school years. For some, further schooling may be a too heavy burden, constantly fighting their own and others expectations concerning achievement levels. Interview information from the present sample, published elsewhere (Undheim, 2003) revealed a lack of teacher support as an overall feeling, and half the students reported little special help in school. They argued that heterogeneous small groups including slow learners, as was the way such support was offered, did not suit their needs so they got out of these groups and stayed in regular classrooms without any attention to their dyslexic problems.

Grundin (1977) has argued that adults with dyslexia gradually might lose their reading and writing competence because they do not use or develop the skills on a daily basis. While most subjects in the sample seemed to have accepted the fact that they had dyslexia, some still rated themselves as average or above in reading and writing. For some there were little or no relationships between their self-evaluations in reading and spelling and their measured performance. Students still in school seemed to have a more realistic view, while individuals not attending schools any longer tended to think dyslexia had diminished, as they did not meet daily reading or writing requirements or received teacher feedback regularly.

Avoiding the problem by decreasing the use of reading and writing skills might be a self-protective pattern, as negative feedback thereby will also decrease. This is consistent with findings discussed by Elbro *et al.* (1995) and Maugan (1995).

Even if educational attainment was lower among students with dyslexia at age 16, compared to their cohort population, the sample had done surprisingly well in terms of completed education, and no significant difference was evident at age 23. This could be due to the significant positive selection among those who came for testing. However, the present group of 23-year olds is possibly too young to represent its final educational levels. Some students with dyslexia may need more time to reach the same educational levels as the normative group. On the other hand, the gap between groups might also be larger in the future if students without dyslexia continue higher education after 23 years of age more often than students suffering dyslexia, which might be expected. Only further testing might show.

The results of the present study showing the persistence of dyslexia into young adulthood and consequences for life and educational levels are in line with those reported by Maugan (1995) and Young *et al.* (2002). Students need support in school because dyslexia causes a stressful school situation. They also have to face dyslexia as a life-long problem. Even if intensive training may improve their reading and writing skills, this study shows that the majority of individuals with dyslexia in childhood will be slow in reading and struggle with frequent spelling errors for the rest of their lives.

The impact of reading problems might differ across countries. The writing system of the Norwegian language is substantially more transparent than that of par example the English. The challenges associated with reading problems might therefore be even harder in English speaking environments.

The strength of this study is a 13-year follow-up of a representative sample of students thoroughly diagnosed by a research group in early childhood (10 years of age). As school records were available at age 16 for the whole age-cohort, the present study examines reading and writing issues from 10 years through 16 years and into young adulthood, which is seldom found in other studies. However, larger samples are needed in future studies.

Overall few longitudinal studies of children diagnosed with dyslexia are followed into adulthood. Several longitudinal studies have followed dyslexic subjects for a few years in childhood, and adult studies tend to include heterogeneous samples often representing a wide age range.

The weakness of this study is the small sample size and the lack of control group for the reading and writing measures at age 23; however, the results were compared to a younger normative group.

Using 12–14-year olds as norm group for young adults with dyslexia may have disadvantages. It is difficult to detect how students really develop their skills in their upper teens. However, further schooling and more exposure to language is considered important (Grundin, 1977), and 23-year olds, therefore, are expected to be more mature in their reading and writing skills than those in the norm groups.

Attrition was relatively high from the original representative sample. However, this study includes a 13-year-period follow-up, and many of the respondents had moved out of the city and were therefore difficult to trace for testing. Follow-ups over longer periods of time including testing procedures are likely to show higher attrition rates. Low reading test scores in childhood were found to be among the most consistent predictors of non-response in later contacts with members of a national birth cohort (Maugan, 1995). From many studies on adults Maugan (1995) stated that people with literacy problems can be reluctant to talk about them, and may avoid studies focusing on these problems.

In the future, research should examine development of dyslexia in the adult age groups, for people with different reading and writing requirements in their daily life situations and larger samples are needed.

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