



# Self-reported reading problems in parents of twins with reading difficulties

Chayna J Davis, Valerie S Knopik, Sally J Wadsworth and John C DeFries

Institute for Behavioral Genetics, University of Colorado, Boulder, CO, USA

Parents of 323 twin pairs with reading disability (RD) reported significantly more problems learning to read (16% of mothers and 33% of fathers) than parents of 309 twin pairs without reading difficulties (6% of mothers and 9% of fathers). These rates of self-reported reading problems in parents of twins are highly similar to those previously obtained in parents of non-twin children with RD and controls, suggesting that the etiology of reading deficits in twin and non-twin children may also be highly similar. Moreover, within both the RD and control samples, twins whose parents self-reported a positive history of reading problems had lower reading performance test scores, on average, than those whose parents reported no reading problems. Therefore, results of the present twin study support those of previous studies with non-twin children in which parental self-reports have been found to provide a valid index of family history status for reading difficulties. *Twin Research* (2000) 3, 88–91.

Keywords: reading disability, family history, genetics, twin studies

## Introduction

Results obtained from family studies have provided compelling evidence for the familial nature of reading disability.<sup>1–8</sup> Although the etiology of reading disability is almost certainly heterogeneous,<sup>9</sup> children with a family history of reading difficulties are at greater risk for developing reading problems than children with no family history of reading difficulties.<sup>4,10</sup> This increased relative risk for children with a positive family history of reading problems may be sufficiently high to warrant the use of such information in a multifactorial assessment battery.<sup>11</sup> Although risk assessment in children could be accomplished by collecting objective test data from their parents, administration of psychometric tests to parents may not always be feasible. Further, if parents with reading difficulties received intervention as children, their psychometric test scores as adults may have been influenced by compensation. In contrast, parental self-report of early reading difficulty can be obtained with relative ease and should be less confounded by remediation efforts. However, the validity of parental self-report should be established prior to advocating its use for risk or diagnostic assessment.

In order to assess the validity of parental self-reported reading difficulties, Decker et al<sup>11</sup> analyzed both questionnaire and composite reading perform-

ance data obtained from parents of children referred for reading problems and from parents of matched control children. Of the 123 mothers of reading-disabled children for whom self-report data were available, 19% reported encountering serious problems learning to read. In contrast, of the 124 mothers of control children, only 5% reported difficulty learning to read ( $P \leq 0.01$ ). Of 119 fathers of children with reading disabilities, 30% reported a history of reading problems vs only 6% of 124 fathers of control children ( $P \leq 0.0001$ ). In addition, parents who reported serious problems learning to read had significantly lower scores on tests of reading performance than did those parents who reported no problems learning to read, providing support for the validity of parental self-reported reading difficulties. Subsequently, Gilger<sup>12</sup> assessed the validity of self-report data by correlating questionnaire responses and performance on the Iowa Test of Basic Skills obtained from 365 female and 331 male adult relatives of RD children ascertained through the University of Iowa Pediatric Psychology Clinic. Results of this study indicated that self-reported historical information on school achievement was adequately valid, although the accuracy of the report varied with the subjects' gender, age, and school achievement.

Because reading disability is familial,<sup>9</sup> children whose parents had problems learning to read are at higher risk for reading difficulties than those with no family history of reading problems. Therefore, a comparison of the reading performance of children with and without a family history of reading problems can also be used to assess the validity of

Correspondence: Chayna J Davis, Institute for Behavioral Genetics, University of Colorado, Boulder, CO 80309-0447, USA.

Tel: +1 303 492 2817; Fax: +1 303 492 8063;

E-mail: davisc@colorado.edu

Received 23 August 1999; accepted 27 November 1999

parental self-reported reading difficulties. In the present study, data from twin pairs tested in the Colorado Twin Study of Reading Disability<sup>13</sup> were analyzed to perform this alternative test. In addition to assessing the validity of parental self-reported reading difficulties, this analysis also facilitated a comparison of the frequency of reading problems self-reported by parents of twins with reading disability to those of non-twin children tested in the Colorado Family Reading Study.<sup>11</sup> If reading difficulties in twin and non-twin samples are due to the same genetic and environmental etiologies, the rates of self-reported reading problems in parents of twins with reading disabilities should be similar to those of parents of non-twin children with reading problems. For example, Bishop, North and Donlan<sup>14</sup> previously reported comparable rates of speech, language and learning disorders among first-degree relatives of affected twins and singletons, and concluded that although twinning is a known risk factor for delay in language skills, it does not appear to cause deficits which persist into and beyond school age.

In the present study, we compared the frequency of self-reported reading problems in parents of twins to those observed in a previous family study,<sup>11</sup> and further validated parental self-report by comparing the average reading performance of twin pairs whose parents self-reported problems learning to read with those with no family history of reading difficulties.

## Methods

### Sample and measures

The sample consisted of 323 same-sex twin pairs in which at least one member of each pair was diagnosed with a reading disability and a comparison sample of 309 control twin pairs ascertained from 27 cooperating public school districts in the State of Colorado. In order to reduce the possibility of ascertainment bias, school administrators identified all twin pairs within a school, and parental permission was then sought to examine the twins' school records for evidence of reading problems (eg low reading achievement test scores, referral to a reading therapist, reports by classroom teachers or school psychologists, etc.). Twin pairs in which at least one member demonstrated evidence of reading problems, as well as potential matched control pairs, were invited to the University of Colorado to complete an extensive battery of psychometric tests that included the Wechsler Intelligence Scale for Children – Revised (WISC-R)<sup>15</sup> or the Wechsler Adult Intelligence Scale – Revised (WAIS-R),<sup>16</sup> and the Peabody Individual Achievement Test (PIAT).<sup>17</sup> A discriminant function score (DISCR) was then

computed for each individual using data from the Reading Recognition, Reading Comprehension, and Spelling subtests of the PIAT, based on weights obtained from a discriminant analysis of an independent sample of 140 reading-disabled and 140 control non-twin children.<sup>18</sup> In addition to the psychometric tests, information concerning the parents' education, income, occupation, reading habits, television viewing habits, and the occurrence of reading difficulties in their families was obtained via a self-report questionnaire. One item asked each parent if she or he had encountered any difficulty learning how to read, and this single item was used in the present study as an index of self-reported parental reading problems.

Twin pairs were included in the proband (RD) sample if at least one member of the pair exhibited a positive school history of reading problems, and also met the following criteria: a negative discriminant function score; an IQ score of at least 90 on the Verbal or Performance scale of the WISC-R<sup>15</sup> or the WAIS-R;<sup>16</sup> no evidence of serious neurological, emotional, or behavioral problems; and no uncorrected visual or auditory acuity problems. Where possible, control twin pairs were matched to the RD sample on the basis of age, gender, and zygosity. Twin pairs included in these analyses were reared in predominantly middle-class, English-speaking families. At the time of testing, the sample ranged in age from 8 to 20 years with a mean age of 11.66 years.

### Analyses

All measures were age-adjusted, and because of the non-independence of twin data, an average DISCR score was created for each twin pair. Those average twin scores were then subjected to a three-way analysis of variance in order to assess the significance of the main effects of gender of the twin pair, parental self-reported reading status, group (proband vs control), and their interactions.

## Results

The numbers of twin pairs in which a parent self-reported a problem learning to read are presented by gender of the twin pair and group in Table 1. From this table it can be seen that the prevalence of self-reported reading problems is very similar in parents of male and female twin pairs in both the proband and control samples (mothers of probands, 16% vs 15%; mothers of controls, 4% vs 7%; fathers of probands, 36% vs 31%; and fathers of controls, 10% vs 9%). In contrast, parents of twins in the proband sample self-reported substantially more reading problems than parents of control twins. For example,

---

### Twin Research

Table 1 Number of twin pairs by gender and parental self-reported reading status

Parental history	Proband				Control			
	Male		Female		Male		Female	
	Mother	Father	Mother	Father	Mother	Father	Mother	Father
Positive	27	60	23	48	6	14	12	15
Negative	141	108	132	107	141	133	150	147
% Positive	16	36	15	31	4	10	7	9

of the 323 mothers of RD twin pairs for whom self-reported reading status data were available, 50 (16%) reported difficulties learning to read. In contrast, only 18 (6%) of 309 mothers of control twin pairs reported reading difficulties ( $\chi^2_1 = 15.34, P \leq 0.0001$ ). Furthermore, of the 323 fathers of RD twin pairs for whom self-reported reading status data had been obtained, 108 (33%) reported having difficulty learning to read. In contrast, only 29 (9%) of 309 fathers of control twin pairs reported reading difficulties ( $\chi^2_1 = 53.80, P \leq 2.2 \times 10^{-13}$ ). It is especially interesting to note that these rates of self-reported reading problems in parents of twins with reading difficulties (16% of mothers and 33% of fathers) and controls (6% of mothers and 9% of fathers) are highly similar to those in parents of non-twin children with RD (19% of mothers and 30% of fathers) and controls (5% of mothers and 6% of fathers) previously reported by Decker et al.<sup>11</sup> Because the DISCR scores of twin pairs did not differ significantly as a function of maternal versus paternal self-reported reading status (ie mother positive vs father positive) in either the proband ( $t = -0.97, P \leq 0.33$ ) or control ( $t = 0.61, P \leq 0.55$ ) samples, maternal and paternal self-report data were combined to yield two parental self-reported reading status classes (viz. positive vs negative history). Resulting mean DISCR scores for RD and control twins as a function of parental self-reported reading status are presented in Table 2. Of particular interest for the present analysis is the comparison between average scores of twin pairs whose parents self-reported problems learning to read (positive history) and those who did not (negative history). From Table 2 it may be seen that for each comparison, twin pairs whose parents self-reported reading difficulties had lower average DISCR scores than those twin pairs whose parents did not report difficulties learning to read.

Results obtained from three-way analysis of variance, which analyzed DISCR score data from the reading-disabled and control twin pairs simultaneously, indicated significant main effects for both group membership (RD vs control) [ $F(1,624) = 696.39, P \leq 0.001$ ] and parental self-reported reading status [ $F(1,624) = 9.50, P \leq 0.002$ ]. As expected, the average reading performance score of the RD group (-0.78) is substantially less than that of the control group (1.28), a difference of over 2.5 standard deviations. The corresponding difference between the average DISCR scores of twin pairs with a positive vs a negative family history for RD (0.13 vs 0.37, respectively) is 0.30 of a standard deviation. Also as expected, this difference between the average reading performance of twin pairs with a positive versus negative family history for reading problems is about half that observed by Decker et al.<sup>11</sup> for the reading performance test scores of parents who self-reported problems learning to read vs those who reported no reading problems. Although the main effect of gender in the present study is not significant, [ $F(1,624) = 0.04, P \leq 0.85$ ], the interaction between gender and group membership is highly significant [ $F(1,624) = 8.67, P \leq 0.003$ ]. From Table 2 it may be seen that male twin pairs in the proband group obtain lower average reading performance scores than female twin pairs, whereas male twins in the control sample obtain higher average scores than females.

### Discussion

Results obtained from the present study clearly show that parents of twins with reading difficulties self-report more reading problems than parents of control twin pairs. Moreover, the prevalence of self-reported reading problems in parents of RD (16% of mothers and 33% of fathers) and control (6% of mothers and

Table 2 Mean DISCR scores of twin pairs in the proband and control groups as a function of parental self-reported reading status

Parental history	Proband				Control			
	Male		Female		Male		Female	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Positive	-1.08	0.97	-0.76	0.75	1.32	0.72	1.05	0.90
Negative	-0.71	0.89	-0.55	0.66	1.46	0.79	1.29	0.68

### Twin Research

9% of fathers) twin pairs in the present study is highly similar to that previously reported by Decker *et al*<sup>11</sup> for parents of RD and control non-twin children. Thus, the genetic and environmental etiologies of reading deficits may be highly similar in twins and non-twin children.<sup>14</sup>

Results of the present study also indicate that twin pairs whose parents self-reported difficulties learning to read obtain significantly lower average reading scores than twin pairs whose parents did not report encountering such difficulties. These results obtained from families of twin pairs support the previous findings of Decker *et al*<sup>11</sup> and Gilger<sup>12</sup> who obtained evidence that parental self-report provides a valid index of reading status in families with non-twin children. Although parents of twins with reading difficulties might self-report reading problems more frequently than parents of controls due to a heightened awareness of the problems of reading disability, the observed difference in average reading performance between twin pairs whose parents self-report problems learning to read versus those whose parents do not report such problems in both the proband and control groups (0.35 and 0.25 standard deviations, respectively) provides additional evidence for the validity of parental self-reports.

Finally, results obtained from previous studies<sup>4,10</sup> have demonstrated that the risk of reading disability for a child is increased substantially if either parent encountered difficulty learning to read. Early identification of children at risk, and subsequent early intervention, could possibly reduce the incidence of reading disability in such children, as well as the negative consequences that this disability can have on other areas of academic achievement.<sup>19</sup> Therefore, because parental self-report is easily obtained and provides a valid index of risk, family history data should routinely be collected in clinical practice. This information might be especially valuable for use in the assessment and diagnosis of very young children for whom other reliable indicators of potential reading problems may not be available.

## Acknowledgements

This work was supported in part by program project and center grants from the National Institute of Child Health and Human Development (HD-11681 and HD-27802) to JC DeFries. This report was prepared while CJ Davis was supported by NIMH training grant MH-16880 and VS Knopik was supported by NICHD training grant HD-07289. The invaluable contributions of staff members of the many Colorado school districts from which our sample of twins was

ascertained, and of the families who participated in this study, are gratefully acknowledged.

## References

- Hallgren B: Specific dyslexia: A clinical and genetic study. *Acta Psychiatr Neurol Scand* 1950; 65 (Suppl.): 1–287.
- Finucci JM: Genetic considerations in dyslexia. In: Myklebust HR (ed.). *Progress in Learning Disabilities* vol IV, Grune and Stratton: New York, 1978; pp 41–63.
- DeFries JC, Decker SN: Genetic aspects of reading disability: A family study. In: Malatesha RN, Aaron PG (eds). *Neuropsychology of Developmental Dyslexia and Acquired Alexia: Varieties and Treatments*. Academic Press: New York, 1982, pp 255–279.
- Gilger JW, Pennington BF, DeFries JC: Risk of reading disability as a function of parental history in three family studies. *Reading and Writing* 1991; 3: 205–217.
- Pennington BF, Gilger JW, Pauls D, Smith SA, Smith SD, DeFries JC: Evidence for major gene transmission of developmental dyslexia. *J Am Med Assoc* 1991; 266: 1527–1534.
- Scarborough HS: Antecedents to reading disability: Preschool language development and literacy experiences of children from dyslexic families. *Reading and Writing* 1991; 3: 219–233.
- Wolff PH, Melngailis I: Family patterns of developmental dyslexia: Clinical findings. *Am J Med Genet (Neuropsychiatr Genet)* 1994; 54: 122–131.
- Borstrom I, Elbro C: Prevention of dyslexia in kindergarten: Effects of phoneme awareness training with children of dyslexic parents. In: Hulme C, Snowling M (eds). *Dyslexia: Biology, Cognition and Intervention*, Whurr Publishers: London, 1997, pp 235–253.
- DeFries JC, Alarcón M: Genetics of specific reading disability. *Mental Retardation and Developmental Disabilities Research Reviews* 1996; 2: 39–47.
- Vogler GP, DeFries JC, Decker SN: Family history as an indicator of risk for reading disability. *J Learning Disabil* 1985; 18: 419–421.
- Decker SN, Vogler GP, DeFries JC: Validity of self-reported reading disability by parents of reading-disabled and control children. *Reading and Writing* 1989; 1: 327–331.
- Gilger JW: Using self-report and parental-report survey data to assess past and present academic achievement of adults and children. *J Appl Devel Psychol* 1992; 13: 235–256.
- DeFries JC, Knopik VS, Wadsworth S: Colorado twin study of reading disability. In: DD Duane (ed.). *Reading and Attention Disorder: Neurobiological Sources of Comorbidity*. York Press: Baltimore MD, 1999, pp 17–41.
- Bishop DVM, North T, Donlan C: Genetic basis of specific language impairment: Evidence from a twin study. *Devel Med Child Neurol* 1995; 37: 56–71.
- Wechsler D: *Examiner's Manual: Wechsler Intelligence Scale for Children – Revised*. The Psychological Corporation: New York, 1974.
- Wechsler D: *Examiner's Manual: Wechsler Adult Intelligence Scale – Revised*. The Psychological Corporation: New York, 1981.
- Dunn LM, Markwardt FC: *Examiner's Manual: Peabody Individual Achievement Test*. American Guidance Service: Circle Pines, Minnesota, 1970.
- DeFries JC, Olson RK, Pennington BF, Smith SD: Colorado reading project: Past, present, and future. *Learning Disabilities: A Multidisciplinary Journal* 1991; 2: 37–46.
- Badian NA: The prediction of good and poor reading before kindergarten entry: A nine-year follow-up. *J Learning Disabil* 1988; 21: 98–123.