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Frequency of reading, math, and writing disabilities in children with clinical disorders

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Abstract

Learning disabilities (LD) are common in clinical disorders, but no study has compared the relative prevalence in referred children with different diagnoses. Our sample comprised 949 children (6 to 16 years). LD percentages were highest for bipolar disorder (79%), ADHD combined type (71%), autism (67%), ADHD inattentive type (66%), and spina bifida (60%). Children with oppositional-defiant disorder, adjustment disorder, anxiety, and depression had relatively low LD percentages (18–19%). LD in written expression was twice as common as LD in reading or math. Findings indicate that children with neurogenetic disorders should be assessed for possible LD because of the high potential yield and the need to intervene educationally if learning problems exist.

Keywords: Learning disability; ADHD; Autism; Mood and behavior disorders

No study to date has compared the relative prevalence of learning disabilities (LD) in children with different clinical disorders. Children with psychiatric and behavior disorders often have LD (Cantwell & Baker, 1991; Fessler, Rosenberg, & Rosenberg, 1991; Frisk, 1999; Glassbreg, Hooper, & Mattison, 1999; Greenblatt, Mattis, & Trad, 1990; Mattison, 2001; Osman, 2000; Prior, Smart, Sanson, & Oberklaid, 1999). A high LD frequency is most often reported for children who have attention deficit hyperactivity disorder or ADHD (August & Garfinkel, 1990; Barkley, 1990; Biederman, Newcorn, &

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Sprich, 1991; Brock & Knapp, 1996; Cantwell & Baker, 1991; Fletcher, Shaywitz, & Shaywitz, 1999; Hall, Halperin, Schwartz, & Newcorn, 1997; Livingston, Dykman, & Ackerman, 1990; Mayes, Calhoun, & Crowell, 2000; Plizka, 1998; Rapport, Scanlon, & Denney, 1999; Semrud-Clikeman et al., 1992; Shaywitz et al., 1995; Swanson et al., 2000; Tannock & Brown, 2000). LD frequencies for children with ADHD in these studies ranged from 15% to 44% in reading and 31% to 60% in math. Only two of the ADHD studies (Mayes et al., 2000; Schuerholz et al., 1995) assessed written expression and found LD frequencies of 65% and 60%, respectively. Research also indicates high LD frequencies for children with autism (Mayes & Calhoun, 2003a,b) and neurogenetic disorders, such as neurofibromatosis and Tourette's syndrome (Schuerholz et al., 1995).

Most LD research with clinical children combines children with different disorders into one group, such as those with emotional and behavioral disturbances (Fessler et al., 1991; Handwerk & Marshall, 1998; Mattison, 2001) or children receiving psychiatric care (Frisk, 1999; Greenblatt et al., 1990; Javorsky, 1995), or studies focus on a single group (e.g., ADHD or autism). Given the high comorbidity of emotional, behavioral, and learning disorders, it is not possible to study a single disorder without taking into account comorbid problems (Kavale & Forness, 1998). Information on co-existing mental health and learning disorders is scarce (Rock, Fessler, & Church, 1997), though this information is essential for diagnosis, treatment, and research (Jensen, Martin, & Cantwell, 1997). For example, children with conduct problems have a high incidence of LD; however research indicates that the academic problems are due to comorbid ADHD and not the behavior problems (Fergusson & Horwood, 1995; Rapport et al., 1999). Therefore, knowledge regarding comorbid diagnoses and associated learning problems is critical to understand the true relationship between learning disabilities and clinical disorders.

Written expression is a neglected area in LD research (Hooper, Swartz, Wakely, de Kruif, & Montgomery, 2002). Most published LD studies assess only reading, math, and sometimes spelling, without providing an evaluation of compositional writing skills or written expression (Aylward, Verhulst, & Bell, 1990; Barkley, 1990; Casey, Rourke, & Del Dotto, 1996; Greenblatt et al., 1990; Gresham, MacMillan, & Bocian, 1996; Janzen, Boersma, Fisk, & Chapman, 1983; Korkman & Pesonen, 1994; McKinney, 1989; Minshew, Goldstein, Muenz, & Payton, 1992; Minshew, Goldstein, Taylor, & Siegel, 1994; Samuels & Miller, 1985; Semrud-Clikeman et al., 1992; Swanson et al., 2000; Szatmari, Tuff, Finlayson, & Bartolucci, 1990; Tarnowski, Prinz, & Nay, 1986). This omission is unfortunate as studies comparing reading, math, and writing disabilities indicate that a learning disability in written expression is more common than LD in reading or math in clinical children (Mayes & Calhoun, 2003a,b; Mayes et al., 2000; Schuerholz et al., 1995), as well as in normal children. In large school-based epidemiologic studies, the percentage of children with a significant weakness in written expression (Hooper et al., 1993) is far greater than in reading (Shaywitz, Shaywitz, Fletcher, & Escobar, 1990). Because written expression is often overlooked in research, review articles erroneously report that the most common LD is a reading disability (Aaron, 1997; American Psychiatric Association, 1994; Fletcher et al., 1999; Lerner, 1989; Osman, 2000; Sattler, 2002; Shaywitz, Pugh, Fletcher, & Shaywitz, 2000).

Another limitation of LD research is inconsistent and idiosyncratic LD definitions, which can vary considerably from study to study (August & Garfinkel, 1990; Handwerk and Marshall, 1998; Livingston et al., 1990; Semrud-Clikeman et al., 1992). Some LD samples consist of children who have simply been identified as having a learning disability by their schools (Anderson, Kutash, & Duchnowski, 2001; Dumont & Willis, 1995; Grobecker & De Lisi, 2000; McKinney, 1989; Prifitera & Dersh, 1993; Richards, Samuels, Turnure, & Ysseldyke, 1990). Historically, LD was conceptualized as difficulty

learning in spite of normal or above normal intelligence (Shaywitz & Shaywitz, 1993). Currently, the most common and conventional definition of LD is the IQ-achievement discrepancy definition (American Psychiatric Association, 1994; Fessler et al., 1991; Fletcher et al., 1999; Frankenberger & Fronzaglio, 1991; Glassberg et al., 1999; Gresham et al., 1996; Hoskyn & Swanson, 2000; Kavale, Fuchs, & Scruggs, 1994; Sattler, 2002; Schuerholz et al., 1995; Shaywitz et al., 1990; Tannock & Brown, 2000; Ward, Ward, Glutting, & Hatt, 1999). This is also the definition used in the current Individuals with Disabilities Education Act or IDEA (Federal Register, 1999). According to IDEA, the criteria for a learning disability are "the child does not achieve commensurate with his or her age and ability levels" and "the child has a severe discrepancy between achievement and intellectual ability." In other words, the student has difficulty learning in spite of normal or above normal intelligence. However, not all LD studies use this definition.

Another problem in LD research is the multitude of different tests used to assess IQ and achievement and the fact that many are normed on different samples at different times. The Wechsler Intelligence Scale for Children-III (WISC-III) and Wechsler Individual Achievement Test (WIAT) have a particular advantage over other tests because of their linking sample, allowing for direct comparisons of scores on the two tests. Further, the WISC-III and WIAT regression equation controls for measurement error, the correlation between tests, and regression to the mean (Glutting, McDermott, Prifitera, & McGrath, 1994). The predicted achievement (vs. simple discrepancy) method is recommended to diagnose LD so that children with high IQs are not over-identified and children with low IQs are not under-identified with LD (Psychological Corporation, 1992).

The purpose of our study is to determine the relative frequency and severity of specific learning disabilities in reading decoding, reading comprehension, math, spelling, and written expression in referred children who have mental health and neurological disorders. Our study has many strengths including: (1) large sample size ($N=949$), (2) inclusion of all major child mental health diagnoses representing a typical referred population, (3) 100% agreement on DSM-IV diagnoses between the psychologist and child psychiatrist, (4) administration of WISC-III and WIAT, (5) comprehensive assessment of academic areas including reading decoding, reading comprehension, math, spelling, and written expression, and (6) conventional and objective LD definition consistent with federal law.

1. Method

1.1. Sample and procedures

The sample comprised 949 children evaluated in our outpatient diagnostic clinic or on our child psychiatry unit. Most children were referred for learning, attention, and/or behavior problems. Only children with DSM-IV diagnoses agreed upon by both a licensed psychologist and child psychiatrist were included in the sample. Therefore, there was 100% diagnostic agreement between the psychologist and child psychiatrist. The psychological evaluation included (1) administration of the WISC-III, WIAT, a continuous performance test, and additional neuropsychological tests, (2) analyses of parent and teacher rating scale scores and questionnaires, (3) child and parent interview, (4) clinical observations of the child, and (5) review of previous evaluations and school records from kindergarten to the present. The psychiatric evaluation entailed a semistructured interview with the parents and child, review of

records, clinical observations, and analysis of the questionnaire and rating scale data obtained from the parents and teachers. Clinical diagnoses are presented in Table 1.

Children in the sample had a mean age of 9.1 years (SD=2.5, range of 6–16). The mean IQ was 97.4 (SD=18.5), with a range of 48 to 150. Seventy-three percent of the children were male, 91% were White, and 9% were Black, Hispanic, or Asian. For 37% of the children, one or both parents had a professional or managerial occupation.

Children were divided into those with low IQs (<80) and those with high IQs (≥80). An IQ cutpoint of 80 was chosen because the WISC-III manual defines normal to above normal intelligence as an IQ of 80 or above (Wechsler, 1991) and because this is the cutoff used in most LD research studies (Anderson et al., 2001; Casey, Rourke, & Del Dotto, 1996; Fletcher et al., 1998; Graham, 1990; Hall et al., 1997; Jimenez et al., 2003; Kershner, 1990; Kupietz, 1990; Mayes, Calhoun, & Crowell, 1998, 2000; Shaywitz et al., 1990). Children with IQs of 80 or higher were categorized as having or not having a specific learning disability in reading (either reading decoding or reading comprehension), math, and written expression. A learning disability was defined as a WIAT Basic Reading, Reading Comprehension, Numerical Operations, or Written Expression subtest score significantly lower ($p<.05$) than predicted based on the child's WISC-III Full Scale IQ using the predicted achievement method specified in the WIAT manual. Written expression analyses were limited to children 8 years and older because this WIAT subtest cannot be administered to younger children. Mean interscorer reliability among three school psychologists on the Written Expression subtest was .96.

1.2. Data analyses

Descriptive statistics were used to summarize IQ scores and the frequency and types of learning disabilities found in children with various clinical disorders. To determine the significance of differences in LD frequencies between diagnostic groups, χ^2 was calculated. ANOVA followed by Bonferroni *t*-tests

Table 1
Sample diagnoses (N=949)

N	Diagnosis
199	ADHD alone (ADHD combined type)
276	ADHD plus a comorbid diagnosis
107	ADD alone (ADHD predominantly inattentive type)
35	ADD plus a comorbid diagnosis
124	Autism
79	Bipolar disorder[a]
50	Brain injury (e.g., closed head injury or anoxic brain injury)
27	Anxiety/depression (generalized anxiety disorder, social phobia, separation anxiety disorder, obsessive–compulsive disorder, dysthymic disorder, or major depression)
23	Spina bifida
21	Behavior disorder (oppositional defiant disorder with or without anxiety or depression or adjustment disorder with mixed disturbance of emotions and conduct)
8	Psychotic disorder[b]

[a]Children in this group had bipolar disorder (acute episodic mania) or bipolar disorder-NOS (rapid cycling or chronic mania) using NIMH (2001) criteria. [b]Children with psychotic disorder were eliminated from the data analyses because of the small sample size.

(to correct for the number of comparisons made) were used to investigate the degree of difference in IQ and IQ-achievement discrepancy scores between diagnostic groups. To determine the clinical significance of differences, the effect size statistic, Cohen's *d* (Cohen, 1988) was calculated. All statistical analyses are two-tailed.

2. Results

2.1. IQ

Children with ADHD, ADD, and Anxiety/Depression had similar IQs (Bonferroni $p > .05$) that were significantly greater than IQs for children with Brain Injury, Autism, Bipolar Disorder, and Spina Bifida ($F = 10.9$, $p < .0001$, Bonferroni $p < .05$), with medium to large effect sizes ($d = 0.5$–1.3) (Table 2). IQ differences among the latter groups (Brain Injury, Autism, Bipolar Disorder, and Spina Bifida) were nonsignificant (Bonferroni $p > .05$). Children with Behavior Disorders did not differ significantly in IQ from children in any of the other diagnostic groups (Bonferroni $p > .05$).

2.2. LD frequencies

The percentages of children with normal intelligence and LD in reading, math, and written expression using the predicted achievement discrepancy definition are presented in Table 3. All children classified as LD had one or more WIAT standard score below age level (<100), as well as having a significant discrepancy between IQ and achievement. The percentage of children whose WIAT Spelling score was significantly less than predicted based on IQ is also reported for comparative purposes, though this was not technically considered an LD in our study.

The frequencies of children with one or more LD (in reading, math, or written expression) versus no LD were compared for the clinical groups. Children with Bipolar Disorder, ADHD, Autism, and ADD had similar LD frequencies ($\chi^2 = 0.0$–1.4, $p > .10$) that were significantly greater ($\chi^2 = 6.8$–17.7, $p < .004$) than the LD frequencies for children with Anxiety/Depression and Behavior Disorder. Differences in LD frequencies for children with Anxiety/Depression versus Behavior Disorder were nonsignificant ($\chi^2 = 0.2$, $p = .95$). The relatively low LD percentage for children with Brain Injury (42%)

Table 2
IQ data for children with clinical disorders

	% IQ<80	Mean IQ[a]	SD
Brain injury	44	83	17
Autism	30	92	22
Bipolar	22	93	17
Spina bifida	17	89	14
Behavior disorder	14	95	17
ADHD	11	102	17
ADD	11	103	18
Anxiety/depression	4	106	19

[a] ADHD, ADD, and anxiety/depression significantly higher IQs than brain injury, autism, bipolar, and spina bifida.

Table 3
LD percentages for children with clinical disorders and normal intelligence

	Reading, math or written expression[a]	Reading	Math	Spelling	Written expression
Bipolar	79	28	32	24	74
ADHD	71	33	26	25	63
Autism	67	6	23	9	60
ADD	66	31	21	22	59
Spina bifida	60	7	33	0	40
Brain injury	42	12	19	11	42
Anxiety/depression	19	9	8	0	14
Behavior disorder	18	7	11	0	18

[a] Bipolar, ADHD, autism, and ADD significantly higher overall LD frequency than anxiety/depression and behavior disorder.

was offset by their high percentage of mental retardation (44%). As shown in Table 3, children with Autism and Spina Bifida had relatively high percentages of LD in written expression (60% and 40%, respectively), but low percentages in reading and spelling (0%–9%) that were not significantly different from the 0% to 9% percentages for children with Anxiety/Depression and Behavior Disorder ($\chi^2 = 0.0$–1.3, $p > .10$).

Fig. 1 presents the severity of learning disabilities or the magnitude of the IQ-achievement discrepancy in Basic Reading, Reading Comprehension, Numerical Operations, Spelling, and Written Expression for each clinical group. For children with ADHD, ADD, Bipolar Disorder, and Autism, mean

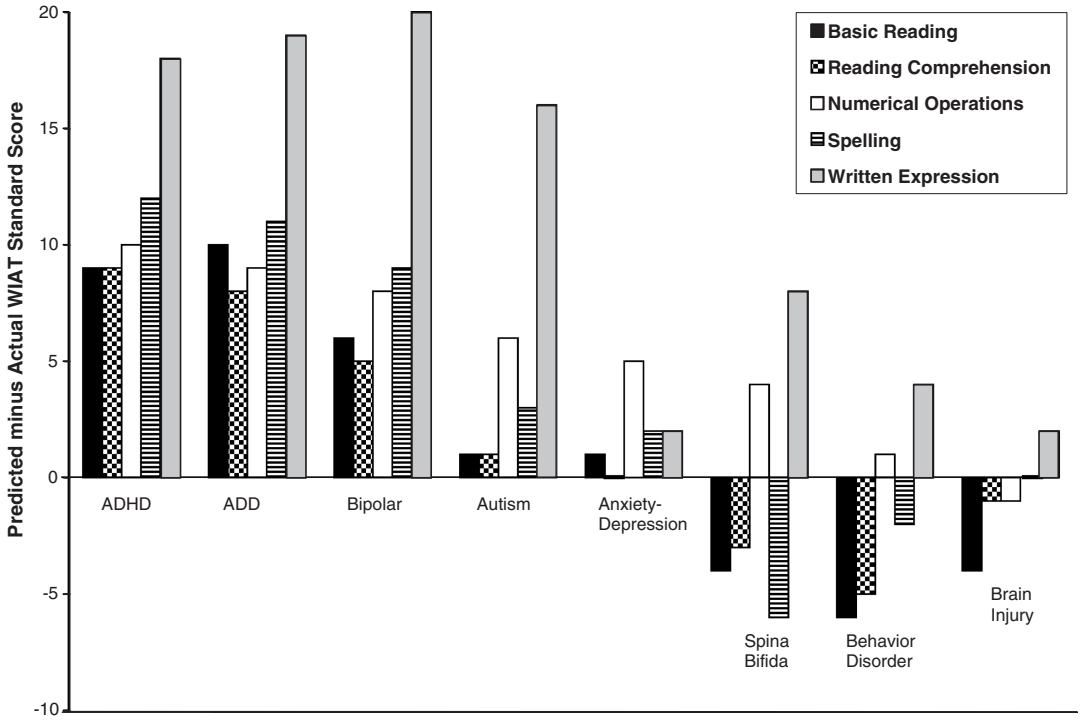

Fig. 1. IQ-achievement discrepancy (predicted minus actual WIAT standard score).

Table 4
Mean WIAT standard scores for children with normal intelligence

	Basic reading	Reading comprehension	Numerical operations	Spelling	Written expression
	M (SD)				
Bipolar	93 (15)	95 (13)	92 (17)	90 (16)	82 (12)
ADHD	96 (14)	97 (14)	95 (13)	94 (13)	86 (12)
Autism	103 (17)	103 (16)	97 (17)	100 (18)	87 (13)
ADD	97 (12)	100 (15)	98 (14)	96 (13)	89 (13)
Spina bifida	97 (12)	98 (13)	88 (16)	99 (12)	79 (6)
Brain injury	99 (16)	97 (15)	96 (15)	95 (13)	90 (18)
Anxiety/depression	106 (15)	104 (16)	102 (14)	104 (15)	103 (14)
Behavior disorder	106 (14)	103 (12)	99 (18)	102 (19)	94 (17)

achievement scores in each area were lower than predicted based on the mean IQ. This was not the case for children with Anxiety/Depression, Spina Bifida, Brain Injury, and Behavior Disorder. Mean standard scores for each WIAT subtest are reported in Table 4.

2.3. Comorbid diagnoses and LD

The presence of comorbid Anxiety/Depression or Behavior Disorder did not increase the risk of LD in children with ADHD. LD in reading, math, or written expression was present in 71% of children who had ADHD alone. The LD rate was 73% for children with ADHD plus Anxiety/Depression, 75% for ADHD plus Oppositional-Defiant Disorder, and 72% for ADHD plus any comorbid diagnosis. χ^2 comparisons between LD frequencies for the group with ADHD alone and the groups with ADHD plus comorbid diagnoses were nonsignificant ($\chi^2 = 0.0–0.1$, $p > .60$). LD percentages for children with ADD alone (66%) versus ADD plus a comorbid diagnosis (54%) were also similar ($\chi^2 = 0.6$, $p = .31$).

3. Discussion

Referred children with Brain Injury, Autism, Bipolar Disorder, and Spina Bifida had higher percentages of mental retardation (17– 44%) and lower IQs than children with ADHD, ADD, and Anxiety/Depression. Among children with normal intelligence (IQ > 80), the majority of children with Bipolar Disorder, ADHD, ADD, Autism, and Spina Bifida had a learning disability (60–79%). Referred children with Anxiety Disorders, Depression, Oppositional-Defiant Disorder, and Adjustment Disorder with mixed disturbance of emotions and conduct had relatively low LD percentages (18–19%). For all groups, LD in written expression was two or more times as common as LD in reading or math. These high LD frequencies indicate that it is critical to assess possible LD in children with neurobiological disorders because of the high incidence and the need for educational intervention if learning problems are identified.

Assessment of written expression (compositional writing skills) is especially important because it is the most common type of LD in clinical children (Mayes & Calhoun, 2003a,b; Mayes et al., 2000; Schuerholz et al., 1995) and because writing problems are more common in general population studies

of school students (Hooper et al., 1993) than are reading problems (Shaywitz et al., 1990). An evaluation of spelling or the production of single words and single sentences alone (as on the Woodcock–Johnson Tests of Achievement Written Language subtests) is not sufficient because such tests may miss children who have significant problems with compositional writing skills (Mayes, Calhoun, & Lane, 2005). For all clinical groups in the present study, the LD percentages for spelling (0–25%, $M=11\%$) were far below those for written expression (14–74%, $M=46\%$). For students who have a LD in written expression, many effective accommodations and interventions are available to assist with the writing disability. These include using a keyboard, word processor, and other assistive technology for written work; reducing writing requirements; modifying tests and assignments (e.g., giving multiple choice and true/false questions instead of essay questions); providing class notes and outlines so the students do not need to rely solely on their own note taking; allowing dictated performance and testing; and teaching structured writing strategies, such as organizing, planning, and proofing (Danoff, Harris & Graham, 1993; Glazer & Curry, 1988; Graham, 1990; Graham, Harris, & Larsen, 2001; Keefe & Candler, 1989; Kerchner & Kistinger, 1984; Lane & Lewandowski, 1994; MacArthur, 1996, 2000; MacArthur & Graham, 1987; McNaughton, Hughes, & Ofiesh, 1997; Sawyer, Graham, & Harris, 1992; Vaughn, Gersten, & Chard, 2000).

Children with neurobiological disorders (Bipolar Disorder, ADHD, ADD, Autism, and Spina Bifida) had similarly high overall LD percentages (60–79%), with written expression the most common LD type. These groups also had math LD percentages that were similar to each other (21–33%). However, reading and spelling results differed significantly. For children with Bipolar Disorder, ADHD, and ADD, LD percentages for reading and spelling were similar to math and ranged from 22% to 33%. In contrast, children with Autism and Spina Bifida had relatively low percentages of LD in reading and spelling (0–9%), which did not differ from the low percentages for children with Anxiety/Depression and Behavior Disorder (0–9%). These scores reflect a relative strength in rote learning for children with Autism and Spina Bifida, which has been reported in other studies as well (Allen, Lincoln, & Kaufman, 1991; Friedrich, Lovejoy, Shaffer, Shurtleff, & Beilke, 1991; Mayes & Calhoun, 1999, 2003a,b; Rumsey, 1992; Rumsey & Hamburger, 1990; Wills, Holmbeck, Dillon, & McLone, 1990; Yirmiya & Sigman, 1991).

LD percentages for referred children with Anxiety/Depression (18%) and Behavior Disorder (19%) were relatively low. When ADHD was added to these diagnoses, LD percentages skyrocketed to 73% and 75%, respectively. The LD percentage for ADHD alone (71%) was similar. When Anxiety/Depression or Oppositional-Defiant Disorder was added to ADHD, the percentages remained the same. These results suggest that LD (significant discrepancy between IQ and achievement) is associated with ADHD and not anxiety, depression, or behavior problems. Other studies have found similar results and report that ADHD, not behavior problems, is related to low achievement (Fergusson & Horwood, 1995; Rapport et al., 1999). Low achievement in children with behavior disorders is explained by the high prevalence of ADHD in these children. In our study, 93% of children with Oppositional-Defiant Disorder also had ADHD, which is consistent with the 93% rate reported by Turgay et al. (2003). Both ADHD and LD have a neurogenetic basis (Fiedorowicz et al., 2001; Hooper & Tramontana, 1997; Learning Disabilities Roundtable, 2002; Raskind, 2001; Seidman et al., 1995; Tramontana, Hooper, Curley, & Nardolillo, 1990), and a genetic link has been established between ADHD and LD (Light, Pennington, Gilger, & DeFries, 1995; Stevenson, Pennington, Gilger, DeFries, & Gillis, 1993). All of these findings support the position that LD (IQ-achievement discrepancy) is primarily a neurogenetic disorder and not caused by behavior or emotional problems.

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