

Intellectual, Academic, and Adaptive Functioning of Tourette Syndrome Children With and Without Attention Deficit Disorder

Elisabeth Dykens,¹ James Leckman,^{1,2} Mark Riddle,¹ Maureen Hardin,¹ Sheri Schwartz,¹ and Donald Cohen¹

The intellectual, academic, and adaptive strengths and weaknesses of 30, medication-free children (M = 10.5 years) with Tourette syndrome (TS) were assessed with a battery of standardized psychoeducational measures and the Vineland Adaptive Behavior Scales. Results indicated significant relative weaknesses in mental and written arithmetic, and relative strengths in reading achievement and abstract, logical thinking. Socialization skills emerged as a significant weakness in adaptive functioning. Comparisons between TS children with attention deficit disorder with hyperactivity (ADD-H) (n = 19) and without ADD-H (n = 11) pointed to similar profiles of strength and weakness in both groups in all areas assessed, but significantly lower performance IQs in TS subjects with ADD-H. These findings are discussed in relation to future research with TS children.

Gilles de la Tourette's syndrome (TS) is a chronic movement disorder of childhood onset that is characterized by multiform motor and vocal tics that wax and wane in severity. Recent biomedical research has largely focused on efforts to identify etiological factors and pathophysiological mechanisms active in TS and to develop safe and effective psychopharmacological interventions (Leckman, Walkup, Riddle, Towbin, & Cohen, 1987). Despite re-

The authors wish to thank Robert Hodapp, Ph.D., for his reading of an earlier draft of this manuscript. Sharon Ort, R.N., M.P.H., and Kenneth Towbin, M.D., assisted in the collection of the clinical data. This research was supported, in part, by Boehringer Ingelheim, Ltd., the John Merck Fund, and NIMH grants MH18268 and MH30929.

¹Child Study Center, Yale University School of Medicine, New Haven, Connecticut 06510.

²Requests for reprints should be sent to James F. Leckman, Yale Child Study Center, 230 South Frontage Road, P. O. Box 3333, New Haven, Connecticut 06510.

cent advances, there is a clear need for data that can guide the daily management and educational programs of these children (Bauer & Shea, 1984). A necessary step in developing appropriate educational and management strategies with TS children is the identification of their intellectual, academic, and adaptive strengths and weaknesses.

Previous research has been inconclusive regarding the intellectual and academic profiles of children with TS. Some researchers investigating their intellectual functioning have reported difficulties in tasks that require visual-motor coordination, perceptual organization, short-term memory, and numerical reasoning (Ferrari, Mathews, & Barbas, 1984; Golden, 1984; Incagnoli & Kane, 1982; Shapiro, Shapiro, Brunn, & Sweet, 1978). Other researchers, however, have indicated no consistent areas of difficulty on standardized psychological tests (e.g., Bornstein, King, & Carroll, 1983). A lack of consensus has also been noted in the academic achievement of TS children. Difficulties in math, reading, and writing language have all been observed (e.g., Bornstein et al., 1983; Comings & Comings, 1987; Incagnoli & Kane, 1982), yet academic achievement at or above grade level has also been reported (Hagin, Beecher, Pagano, & Kreeger, 1982).

Some of the inconsistency in the intellectual and academic functioning of TS children may be due to the presence of attentional and hyperactivity problems in a substantial subgroup of TS patients seen in the clinical setting (Shapiro, Shapiro, Young, & Feinberg, 1988). Although attention deficits and problems with concentration and activity levels have been observed in many TS patients (Harcherick, Carbonari, Shaywitz, Shaywitz, & Cohen, 1982), the literature on cognitive and academic functioning has not yet made a distinction between TS children with and without diagnosable attentional problems. Thus, it may be that TS children with attention deficits manifest different intellectual, academic, and adaptive profiles than their counterparts without such difficulties.

In addition to a lack of research that distinguishes between TS children with and without attention deficit disorder (ADD-H), there are also no data in the literature regarding the adaptive behavior of TS youngsters, or their ability to perform "daily activities required for personal and social sufficiency" (Sparrow, Balla, & Cicchetti, 1984, p. 6).

This study examined the intellectual, academic, and adaptive functioning of 30 medication-free children with TS. In addition, TS subjects who met Diagnostic and Statistical Manual of Mental Disorders-III (DSM-III; American Psychiatric Association, 1980) criteria for ADD-H were compared to TS subjects who did not meet criteria.

METHOD

Subjects

Thirty children (23 males, 7 females) with TS, ranging in age from 7 to 14 years ($M = 10.5$), were assessed as part of an ongoing research program at the TS Clinic, Child Study Center, Yale University School of Medicine. All subjects were medication-free for a minimum of 2 months at the time of their initial psychoeducational evaluations. Nineteen children (15 boys, 4 girls) met DSM-III criteria for ADD-H ($M = 10.3$ years), and 11 subjects (8 boys, 3 girls) did not meet these criteria ($M = 10.6$ years). Diagnoses of TS and ADD-H were based upon DSM-III criteria, utilizing direct examinations and psychiatric interview of all subjects, parental and teacher reports, and a review of past medical records. By combining data from these sources, four clinicians from the TS team (JL, MR, MH, DC) were able reach consensus decisions as to TS and ADD-H status for all 30 subjects.

Tic symptomatology in this sample ranged from mild to severe as assessed by the Tourette Syndrome Clinician's Global Impression Scale (TS-CGI) (Leckman, Towbin, Ort, & Cohen, 1988) and the members of the TS team. The mean TS-CGI score was found to be "moderate" in this sample as a whole, i.e., "tic symptoms cause some problems in some areas of functioning and are noticeable to people who come into close contact with the patient some of the time" (Leckman *et al.*, 1988, p. 76). The TS and ADD-H TS groups were comparable with respect to mean TS-CGI scores (TS $M = 3.4$; TS ADD-H $M = 4.2$; $t(27) = 1.64$, n.s.).

Procedures and Measures

Psychoeducational Measures. The psychoeducational test battery was individually administered by a clinical psychologist during the child's initial visits to the Yale Child Study Center TS Clinic. The clinical psychologist was blind to the child's diagnosis of ADD-H. The battery consisted of the WISC-R, and the Reading, Arithmetic, and Written Language Clusters of the *Woodcock-Johnson Psychoeducational Battery: Part II, Tests of Achievement* (Woodcock & Johnson, 1977).

Adaptive Behavior Measure. The *Vineland Adaptive Behavior Scales-Interview Edition* (Sparrow *et al.*, 1984) were individually administered by a clinical psychologist to each subject's parent at the time of the initial evalu-

ation. The Vineland scales assess adaptive behavior in the areas of Communication (receptive, expressive, written), Daily Living Skills (personal, domestic, community), and Socialization (interpersonal relationships, use of play/leisure time, coping skills).

RESULTS

To examine strengths and weaknesses in the intellectual, academic, and adaptive functioning of the TS group as a whole, the domain effects of eight repeated-measures ANOVAs were examined. Given the number of ANOVAs performed, the $p < .01$ level of significance was adopted for all analyses.

Significant domain effects were further assessed by protected t tests (t') as *post hoc* comparisons. The t' is a means of identifying strengths and weaknesses by comparing mean subtest scores to the group mean (not to the other individual subtests); use of this procedure is recommended by Silverstein (1975) for *post hoc* comparisons of this type. Comparisons of intellectual, academic, and adaptive functioning between the TS and ADD-H TS groups were made by examining the group and interaction effects of the eight repeated-measures ANOVAs.

Intellectual Functioning

Overall IQ. A 2×2 (group by IQ) repeated-measures ANOVA utilizing Verbal and Performance IQ scores revealed a significant group effect, $F(1, 28) = 10.20$, $p < .01$, with the ADD-H TS group manifesting lower Performance IQs than their TS-only counterparts (see Table I).

Verbal Subtests. A 2×5 (group by subtests) repeated-measures ANOVA examining the five WISC-R Verbal subtests revealed a significant domain effect, $F(4, 28) = 5.94$, $p < .001$, pointing to a profile of strength and weakness in verbal skills for the TS sample as a whole (see Table I). *Post hoc* analyses indicated a significant strength in Similarities, $t' (29) = 4.77$, $p < .01$, and a significant weakness in Arithmetic, $t' (29) = -3.37$, $p < .01$.

Performance Subtests. The 2×5 (group by subtests) repeated-measures ANOVA assessing the five WISC-R Performance subtests indicated a significant group effect, $F(1, 28) = 12.28$, $p < .001$, with ADD-H TS subjects scoring lower on all five subtests than the TS-only group (see Table I).

Academic Functioning

A 2×3 (group by subtests) repeated-measures ANOVA utilizing the Reading, Arithmetic, and Written Language tests of the Woodcock-Johnson

Table 1. Means and Standard Deviations of Combined TS Group, and TS Subjects With and Without ADD-H, on Measures of Intellectual Functioning and Academic Achievement

	Combined TS ^{a,b} (n = 30)	TS only ^a (n = 11)	TS + ADD-H ^{a,c} (n = 19)
WISC-R IQ			
Verbal	102.6 (14.5)	108.6 (15.6)	96.6 (12.2)
Performance	104.6 (15.6)	113.4 (10.6)	95.9* (14.5)
Verbal subtests			
Information	10.3 (3.3)	11.3 (3.7)	9.4 (2.9)
Similarities	11.9 (S) (3.2)	12.2 (3.1)	11.7 3.3
Arithmetic	9.2 (W) (2.5)	10.0 (2.8)	8.5 (2.3)
Vocabulary	10.7 (3.2)	12.0 (3.5)	9.4 (2.6)
Comprehension	10.1 (2.5)	11.7 (1.5)	8.6 (2.3)
Performance subtests			
Picture Completion	10.4 (3.0)	11.6 (2.6)	9.3 (2.9)
Picture Arrangement	11.5 (3.0)	13.0 (2.4)	10.1 (2.8)
Block Design	10.3 (2.9)	11.1 (2.7)	9.5 (3.0)
Object Assembly	11.0 (3.6)	12.8 (3.0)	9.3 (3.6)
Coding	9.7 (3.1)	11.1 (3.2)	8.3 (2.5)
Woodcock-Johnson			
Reading	103.2 (S) (12.4)	106.4 15.7)	100.1 (9.9)
Arithmetic	95.5 (W) (13.9)	99.3 (13.8)	91.7 (13.5)
Written Language	97.6 (13.2)	100.7 (15.6)	94.6 (11.1)

^aValues in parentheses are standard deviations.

^b(S) depicts an area of significant strength and (W) an area of significant weakness.

^c* indicates a significant difference at $p < .001$.

Achievement Battery revealed a significant domain effect, $F(2, 28) = 6.61$, $p < .01$ (see Table I). *Post hoc* analyses indicated that the TS group as a whole displayed a significant strength in Reading, $t'(29) = 3.89$, $p < .01$, and a significant weakness in Arithmetic, $t'(29) = -2.73$, $p < .01$.

Adaptive Functioning

Vineland Domains. The 2×3 (group by domains) repeated-measures ANOVA assessing the Communication, Daily Living Skills, and Socializa-

Table II. Mean Age-Equivalent Scores and Standard Deviations of Combined TS Group, and TS Subjects With and Without ADD-H, on the Vineland Adaptive Behavior Scale

	Combined TS ^{a,b} (<i>n</i> = 30)	TS only (<i>n</i> = 11)	TS + ADDH (<i>n</i> = 19)
Vineland domains			
Communication	8.8 (2.1)	9.3 (2.2)	8.3 (2.1)
Daily Living Skills	8.3 (2.3)	8.7 (2.2)	7.9 (2.3)
Socialization	7.6 (W) (3.3)	8.1 (3.2)	7.1 (3.4)
Vineland subdomains			
Communication:			
Receptive ^c	—	—	—
Expressive	8.2 (2.7)	8.6 (2.2)	7.9 (3.2)
Written	9.2	9.6	8.8
Daily Living Skills:			
Personal	9.2 (S)	8.6	8.8
	3.4	(3.4)	(3.5)
Domestic	7.3 (W) (2.6)	7.6 (2.0)	7.1 (2.9)
Community	8.8 (2.4)	9.5 (2.7)	8.2 (2.2)
Socialization:			
Interpersonal Relationships	6.9 (3.3)	7.6 (4.0)	6.3 (2.6)
Play/leisure	7.4 (2.6)	7.6 (2.7)	7.2 (2.5)
Coping skills	7.8 (3.2)	9.0 (3.4)	6.7 (2.8)

^aValues in parentheses are standard deviations.

^b(W) depicts an area of relative weakness and (S) an area of relative strength.

^cNot included, as it had an artificial ceiling.

tion domains of the Vineland revealed a significant domain effect, $F(2, 28) = 4.64$, $p < .01$ (see Table II), with socialization skills emerging as a significant weakness, $t'(29) = -3.05$, $p < .01$.

Vineland Subdomains. The domain effect from the 2×3 (group by subdomains) ANOVA assessing the Vineland's Daily Living Skills' personal, domestic, and community subdomains proved significant, $F(2, 28) = 10.49$, $p < .001$, revealing a pattern of strength and weakness in Daily Living Skills for the group as a whole. *Post hoc* comparisons indicated a significant strength in personal skills, $t'(29) = 3.32$, $p < .01$, and a significant weakness in domestic skills, $t'(29) = -3.78$, $p < .01$.

DISCUSSION

This study identified intellectual, academic, and adaptive strengths and weaknesses in a medication-free sample of children with TS. Although the ADD-H and non-ADD-H TS groups did not display any academic or adaptive behavior differences, the two groups did significantly differ in their Performance IQs.

In terms of intellectual performance, TS subjects manifested a relative strength in the ability to think conceptually in an abstract, logical manner, and a relative weakness in mental, numerical reasoning. These results from the WISC-R Verbal subtests are consistent with previous literature that point up difficulties with the WISC-R Arithmetic subtest in TS children, yet also offer additional data regarding an area of relative strength for these youngsters.

Although several reports suggest that TS youngsters manifest difficulties in WISC-R Performance tasks that require visual-motor integration and perceptual organization, this has not been a universal finding. Indeed, in this study, no profile of strength or weakness in WISC-R Performance subtests was found for the group as a whole. ADD-H TS subjects did, however, manifest significantly lower Performance IQ's than the TS-only group. Thus, although neither group evidenced a distinctive profile in performance subtests, it may be that TS children with ADD-H experience more difficulty completing tasks requiring perceptual organization and visual-motor integration than their non-ADD-H TS counterparts. This finding is consistent with the observation that ADD-H children in general tend to score lower on tasks of perceptual-motor skills than children without this disorder (Sattler, 1988).

Results pertaining to academic achievement indicated a relative strength in reading, and a relative weakness in arithmetic. This profile is consistent with the finding that 53% of the sample had arithmetic as their lowest achievement test score, and only 7% of subjects had reading as their lowest score. It may be that arithmetic is a more frequent area of academic difficulty than reading among TS children. Additional data are needed to clarify this hypothesis, particularly as it relates to the prevalence of developmental reading disorder in children in general (Sparrow & Blachman, 1985).

Relative weaknesses in Socialization skills (i.e., interpersonal relationships, use of play and leisure time, coping skills) were applicable to both groups of subjects and pointed to a level of social functioning that fell considerably below chronological age expectations. Although these data do not establish whether or not this weakness in socialization is secondary to the stigmatizing effects of TS symptoms, they do suggest that many TS children show delay in social adaptation relative to other areas of adaptive functioning.

The TS group also evidenced a significant weakness in Domestic Daily Living Skills and a significant strength in Personal Daily Living Skills. As reported by the parents of these children in the Vineland interviews, this profile appears related to the child's lack of compliance with requests to complete domestic chores, and with parental difficulty in consistently handling the consequences of noncompliant behavior.

We found relative strengths and weaknesses in all areas assessed, including relative weaknesses in social adaptation and arithmetic, and relative strengths in reading and abstraction. These specific profiles of strength and weakness were applicable to both groups of TS youngsters, with Performance IQ emerging as the only area of difference. Further research with a non-TS ADD-H group is necessary to determine if low Performance IQs of TS ADD-H children are best attributed to the symptoms of ADD-H or the combined effects of ADD-H and TS symptomatology.

REFERENCES

- American Psychiatric Association (1980). *Diagnostic and statistical manual of mental disorders* (3rd ed.). Washington, DC: Author.
- Bauer, A. M., & Shea, T. M. (1984). Tourette syndrome: A review and educational implications. *Journal of Autism and Developmental Disorders, 14*, 69-80.
- Bornstein, R. A., King, G., & Carroll, A. (1983). Neuropsychological abnormalities in Gilles de la Tourette's syndrome. *Journal of Nervous and Mental Diseases, 171*, 497-502.
- Comings, D. E., & Comings, B. G. (1987). A controlled study of Tourette syndrome. *American Journal of Human Genetics, 41*, 1-22.
- Ferrari, M., Matthews, W., & Barbas, G. (1984). Children with Tourette syndrome: Results of psychological tests given prior to drug treatment. *Developmental and Behavioral Pediatrics, 5*, 116-119.
- Golden, G. S. (1984). Psychological and neuropsychologic aspects of Tourette's syndrome. *Neurologic Clinics, 2*, 91-101.
- Hagin, R. A., Beecher, R., Pagano, G., & Kreeger, H. (1982). Effects of Tourette syndrome on learning. In A. J. Friedhoff & T. N. Chase (Eds.), *Gilles de la Tourette syndrome* (pp. 323-329). New York: Raven Press.
- Harcherik, D. F., Carbobari, C. M., Shaywitz, S., Shaywitz, B. A., & Cohen, D. J. (1982). Attentional and perceptual disturbances in children with Tourette's syndrome, attention deficit disorder, and epilepsy. *Schizophrenia Bulletin, 8*, 356-359.
- Incagnoli, T., & Kane, R. (1982). Neuropsychological functioning in Tourette syndrome. In A. Friedhoff & T. Chase (Eds.), *Gilles de la Tourette syndrome* (pp. 305-310). New York: Raven Press.
- Leckman, J. F., Towbin, K. E., Ort, S., & Cohen, D. J. (1988). Clinical assessment of tic disorder severity. In D. J. Cohen, R. D. Bruun, & J. F. Leckman (Eds.), *Tourette's syndrome and tic disorders, clinical understanding and treatment* (pp. 55-78). New York: Wiley Interscience.
- Leckman, J. F., Walkup, J. T., Riddle, M. A., Towbin, K. E., & Cohen, D. J. (1987). Tic disorders. In H. Y. Meltzer (ed.), *Psychopharmacology, the third generation of progress* (pp. 1239-1246). New York: Raven Press.
- Sattler, J. M. (1988). *Assessment of children* (3rd ed.). San Diego: Author.
- Shapiro, A. K. Shapiro, E., Brunn, R. D., & Sweet, R. D. (1978). *Gilles de la Tourette syndrome*. New York: Raven Press.

- Shapiro, A. K., Shapiro, E., Young, G., & Feinberg, T. (1988). *Gilles de la Tourette syndrome* (2nd ed.). New York: Raven Press.
- Silverstein, A. B. (1975). Comparing all treatment means with the grand mean: III. An application to pattern analysis. *Psychological Reports*, *37*, 1093-1094.
- Sparrow, S. S., Balla, D. A., & Cicchetti, D. V. (1984). *The Vineland adaptive behavior scales-interview edition*. Circle Pines, MN: American Guidance Service.
- Sparrow, S. S., & Blachman, B. A. (1985). Developmental learning disorders. In R. Michels, J. O. Cavenar, H. K. Brodie, A. M. Cooper, S. B. Guze, L. L. Judd, G. L. Klerman, & A. J. Solnit (Eds.), *Psychiatry* (pp. 1-9). Philadelphia: Lippincott.
- Woodcock, R. W., & Johnson, M. (1977). *Woodcock-Johnson psychoeducational battery examiner's manual: Part II, Tests of Achievement*. Allen, TX: DLM Teaching Resources.