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Neuropsychological Correlates of Psychopathology in an Unselected Cohort of Young Adolescents

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Members of a birth cohort were assessed for psychopathology and neuropsychological dysfunction at age 13. Ss who met *DSM-III* criteria for a single disorder, multiple disorders, and no disorder were compared on 5 composite neuropsychological measures. The multiple disorders group performed significantly worse than did the nondisordered group on the Verbal, Visuospatial, Verbal Memory, and Visual–Motor Integration factors. They also showed the highest rate of neuropsychological impairment. The attention-deficit disorder group performed significantly worse than did the nondisordered group on the Verbal Memory and Visual–Motor Integration factors, and the anxiety disorder group performed significantly worse than did the nondisordered group on the Visual–Motor Integration factor. Results suggest that neuropsychological dysfunction is more often associated with multiple, rather than single, psychiatric disorders in adolescents. The problem of comorbidity in studies of neuropsychological function in childhood and adolescent psychopathology is highlighted.

This study investigated the neuropsychological correlates of four adolescent mental disorders—attention-deficit disorder (ADD), conduct disorder (CD), anxiety disorder, and depression. A very brief review of the literature on the cognitive deficits associated with each of these disorders follows. Readers are referred to Quay and Werry (1986) and Rutter (1983) for more detailed presentations.

Children with ADD have consistently been found to perform poorly on all aspects of IQ tests, as well as on tests of perception, motor coordination, abstraction, and complex problem solving (see Campbell & Werry, 1986, for a review). This picture of pervasive deficits in ADD is not unexpected, given that the effortful maintenance of attention is a prerequisite for adequate performance on all types of cognitive tests. Even so, Douglas (1983) has argued that the poor cognitive performance of children with ADD cannot be entirely explained by their off-task behaviors, but, rather, that more subtle deficits exist.

Studies of the neuropsychological test performance of children with CD are scarce. However, the large literature on juvenile delinquents (who frequently have CD) shows remarkable agreement that these subjects are deficient in verbal skills (see Moffitt & Silva, 1988, for a review). Other areas of neuropsychological function have been examined in delinquents, but with less consistent results. They have been found to be variously normal or impaired on visuospatial, motor, memory, and executive functions.

Nearly all of the neuropsychological studies of anxious children have been conducted with test-anxious children, who have been found to perform poorly on verbal measures (Nottelmann & Hill, 1977; Stevenson & Odom, 1965; Zatz & Chassin, 1983) and complex problem-solving tasks (Castaneda, 1961; Castaneda, Palermo, & McCandless, 1956; Palermo, Castaneda, & McCandless, 1956; Sarason, Davidson, Lighthall, Waite, & Ruebush, 1960). Task-debilitating cognitions (Zatz & Chassin, 1983) and high rates of off-task behaviors (Nottelmann & Hill, 1977) have been hypothesized to underlie test-anxious children's poor performance.

Depressed children have been found to show deficits in complex problem-solving skills (Kaslow, Rehm, & Siegel, 1984; Kaslow, Tanenbaum, Abramson, Peterson, & Seligman, 1983; Mullins, Siegel, & Hodges, 1984; Schwartz, Friedman, Lindsay, & Narrol, 1982) but not vocabulary (Kaslow et al., 1983, 1984), and their performance has been shown to improve on the Wechsler Intelligence Scale for Children–Revised (WISC–R; Wechsler, 1974) and a wide range of attention and visual perceptive measures after the administration of amitriptyline (Brumback, Staton, & Wilson, 1980). Recently, however, McGee, Anderson, Williams, and Silva (1986) demonstrated that depressed children's deficits may be an artifact of the high correlation between depression and inattention.

The present study assessed neuropsychological function and

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psychopathology in a large, unselected sample of young adolescents. Our goal was to find the neuropsychological correlates of each of the major childhood and adolescent disorders. This descriptive study differs from most previous studies in two important ways. First, it was not an investigation of a single disorder. Second, it did not use a selected group of subjects who had been referred for treatment or who had gotten into trouble with the law. Consequently, it was not a study of severe cases of disorder only, but rather, a more representative study of cases of disorder defined by the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-III;* American Psychiatric Association, 1980) in the general early adolescent population.

Method

Subjects

Subjects were the members of an unselected birth cohort that has been studied extensively as part of the Dunedin Multidisciplinary Health and Development Study. The history of the study and sample have been described in detail by McGee and Silva (1982). Briefly, the cohort consists of all children born at Queen Mary Hospital in Dunedin, New Zealand, between April 1, 1972, and March 31, 1973, who were still living in the province of Otago when the longitudinal study began in 1975. At that time, 1,139 of the 1,649 live births met that criterion and thus were eligible for inclusion; 1,037 participated. The sample has been reassessed with a diverse battery of psychological, medical, and sociological measures every 2 years since then. McGee (1985) compared the children who were lost to the study at each age with those who remained at age 11. He found no systematic differences between the groups in terms of social class, IQ, or a variety of behavioral variables.

Compared with the general population of New Zealand, the Dunedin sample is slightly socioeconomically advantaged. Also, Maoris and Polynesians are underrepresented: They are 10% of the general population, but only 2% of the sample. The predominantly European background of the sample suggests that it is comparable to those from other English-speaking Western cultures.

Eight hundred fifty subjects (435 male, 415 female) participated in the age 13 cohort assessment. However, only those subjects with complete data (n = 678) were included in the present study. One hundred and eight subjects lived too far away to participate in the laboratory portion of the assessment. An additional 64 subjects were able to come into the laboratory but had missing data for miscellaneous reasons. Of the 172 subjects who had incomplete data, 150 (87%) took the WISC–R, either in the laboratory or in their schools. They did not differ from the 678 subjects who had complete data on the WISC–R Full Scale IQ, $t(827) = 0.43$. Neither did the 678 subjects included in the present study differ from the other 359 subjects assessed at age 3 on a measure of family social class (Elley & Irving, 1972) taken at the time of the child's birth, $t(1,036) = 0.59$.

Measures

Diagnostic Interview Schedule for Children–Child Version. The Diagnostic Interview Schedule for Children–Child Version (DISC–C; Costello, Edelbrock, Kalas, Kessler, & Klaric, 1982) is a highly structured diagnostic interview for children that was developed under the auspices of the National Institute of Mental Health. It is based on *DSM-III* criteria for the various disorders of childhood and adolescence. All items refer to the child's functioning over the past year and are structured so as to elicit responses of *no* (0), *sometimes* (1), or *yes* (2). Although the full DISC–C was used for the age 11 assessment, an abbreviated version was developed for the age 13 assessment because of time constraints. This version contains 110 items, or approximately three fourths of the questions found in the original interview. The items that were omitted include six questions about the undersocialized/socialized distinction in CD (a distinction that has been omitted from the 1987 revised version of the *DSM-III*), five questions about separation anxiety that were deemed inappropriate for 13-year-olds, and approximately 20 questions that had low item–diagnosis correlations at the age 11 assessment. (Half of this last group were questions about ADD, for which diagnosis the age 13 DISC–C was not used. The remaining questions were spread across several diagnostic categories.) The DISC–C was administered as part of a broader interview that assesses career plans, self-esteem, attitudes toward school, and social attachments. (A copy of the modified DISC–C, as well as psychometric information about both the original and the modified version, may be obtained from the authors.)

Revised Behavior Problem Checklist. The Revised Behavior Problem Checklist (RBPC; Quay & Peterson, 1983) is a parent and teacher rating instrument for the major categories of childhood and adolescent psychopathology. Only the parents completed it in the present study. The major subscales of the RBPC are Conduct Disorder, Socialized Aggression, Anxiety–Withdrawal, and Attention Problems–Immaturity. They contain from 11 to 22 items, which are rated *does not apply* (0), *applies somewhat* (1), or *certainly applies* (2). The subscales have yielded coefficient alpha reliabilities ranging from .82 to .94 (Quay, 1983). The Attention Problems–Immaturity scale has been shown to be related to the diagnosis of ADD (Lahey, Schaughency, Frame, & Strauss, 1985; Quay, 1983).

Rutter Child Scale B. The Rutter Child Scale B (RCSB; Rutter, Tizard, & Whitmore, 1970) is a 26-item questionnaire designed to be filled out by classroom teachers. The items inquire about the major areas of a child's behavioral and emotional functioning during the past year and are rated *does not apply* (0), *applies somewhat* (1), or *certainly applies* (2). The RCSB was supplemented with 16 items concerning inattention, impulsivity, and hyperactivity (see McGee, Williams, & Silva, 1985). These additional items were derived from the *DSM-III* criteria for ADD.

Self-Report Early Delinquency inventory. The Self-Report Early Delinquency inventory (SRED; Moffitt & Silva, 1988) is a 58-item instrument that was developed for use in New Zealand. It contains both interview and card-sort questions that inquire about a variety of antisocial behaviors including theft, assault, vandalism, and substance abuse. The items are scored dichotomously (*subject has engaged in the behavior at least once* vs. *subject has never engaged in the behavior*) and each item is weighted for seriousness. The measure's internal consistency (Kuder-Richardson Formula 20) and 1-month test–retest reliability were evaluated and found to be adequate (.90 and .85, respectively). The concurrent and construct validity of the SRED have been reported by Moffitt and Silva (1988). The 27 items of the SRED that correspond directly to the *DSM-III* criteria for CD were used in the present study.

Wechsler Intelligence Scale for Children–Revised. The WISC–R (Wechsler, 1974) was administered according to standard protocol, with two exceptions: Two subtests (Comprehension and Picture Arrangement) were omitted because of time constraints, and six Information items were modified in order to achieve local relevance (e.g., "Who discovered America?" was changed to "Who discovered New Zealand?").

Neuropsychological test battery. The neuropsychological assessment battery included the Grooved Pegboard, the Mazes, the Rey Auditory Verbal Learning Test, the Rey-Osterreith Complex Figure Test, the Trail Making Test, the Controlled Word Association Test, and the Wisconsin Card Sort Test. (Readers should consult Lezak, 1983, for a detailed description of each measure.) The measures were chosen according to the following criteria: (a) The battery should tap as broad a range of cognitive functions as possible, given the limited amount of time available for the assessment (1 hr); (b) each test must be widely used and commonly known; (c) each test must have high reliability and validity; and (d) each

test must be brief and intrinsically interesting. All measures were administered according to standard procedures, with the exception that abbreviated versions of the Auditory Verbal Learning Test (four learning trials only), the Controlled Word Association Test (two trials only), and the Wisconsin Card Sort Test (three categories only) were used.

To increase the reliability of the dependent measures and achieve greater theoretical parsimony, the large number of cognitive variables was reduced statistically to a smaller set of composite scores, with each composite score representing a hypothetically distinct higher order function. This strategy seemed both reasonable and justifiable in light of Hogan and Quay's (1984) conclusion, after reviewing the relevant literature, that the factor structure of intelligence and cognitive function appears to be similar in heterogeneous groups of emotionally disturbed youths and normal youths. The data reduction analyses used in the present study have been described in detail elsewhere (Moffitt & Heimer, 1988). Briefly, the 13 neuropsychological test scores and the eight WISC–R subtest scores were entered into an exploratory principal-components analysis, with varimax rotation. The large sample allowed us to conduct the exploratory analysis on a random half of the sample and then test the principal-component solution on the remaining half, using maximum likelihood confirmatory factor analysis (Joreskog & Sorbom, 1986). Five components were extracted that together accounted for 62% of the total variance in test scores. The interpretive labels assigned to the components (and the scores loading on them) were Verbal (WISC–R Information, WISC–R Vocabulary, WISC–R Similarities, and WISC–R Arithmetic), Visuospatial (Rey-Osterreith Complex Figure delayed recall, Rey-Osterreith Complex Figure copy, WISC–R Object Assembly, and Mazes), Verbal Memory (Rey Auditory Verbal Learning delayed recall, last trial, and first trial), Visual–Motor Integration (Trail Making Part A time, WISC–R Coding, Trail Making Part B time, and Grooved Pegboard total time with both hands), and Mental Flexibility (Wisconsin Card Sort Test percentage of perseverative errors and Wisconsin Card Sort Test number of trials to first category). Three scores (WISC–R Picture Completion, Grooved Pegboard hand speed difference, and Trail Making Part B errors) were omitted during the course of the analysis because they did not load adequately on any component. WISC–R Block Design, which loaded complexly on several components, was analyzed separately. The confirmatory factor analysis showed the five-component model to be an adequate representation of the data, $L^2(101) = 200.94$. The standardized validity coefficients ranged from .50 to .84, indicating that the five components accounted for 25–70% of the variance in the 17 measures. This level of cross-sample validation lends confidence to the reliability of the solution.

Diagnoses

The *DSM-III* (American Psychiatric Association, 1980) diagnoses were made using the DISC–C (Costello et al., 1982), the RBPC (Quay & Peterson, 1983), the RCSB (Rutter et al., 1970), and the SRED (Moffitt & Silva, 1988). Strict and multiple diagnostic criteria were used to avoid the problems of under- and overreporting by a single source and to enhance diagnostic reliability.

Children were given a diagnosis of ADD if (a) they had been so diagnosed at age 11 (see Anderson, Williams, McGee, & Silva, 1987, for age 11 diagnostic criteria, which included the criterion of onset before age 7) and (b) either their parent rating on the Attention Problems–Immaturity scale of the RBPC or their teacher rating on the Inattention scale of the RCSB was still one or more standard deviations above the cohort mean at age 13. The ADD group had mean scores of 12.4 (SD = 7.4) and 9.6 (SD = 3.9) on the Attention Problems–Immaturity and Inattention scales, respectively. Analogous scores for the remaining subjects were 3.8 (SD = 4.6) and 3.0 (SD = 4.1).

Children were given a diagnosis of CD if (a) on the SRED, they reported having committed four or more of the antisocial behaviors included in the *DSM-III* criteria for CD and (b) either their parent rating on the Conduct Disorder scale of the RBPC or their teacher rating on the Antisocial scale of the RCSB was one or more standard deviations above the cohort mean. The CD group had mean scores of 6.9 (SD = 4.1), 14.9 (SD = 7.5), and 5.2 (SD = 4.5) on the SRED, Conduct Disorder scale, and Antisocial scale, respectively. Analogous scores for the remaining subjects were 0.8 (SD = 1.5), 4.7 (SD = 5.1), and 0.8 (SD = 1.5).

Children were given a diagnosis of anxiety disorder if (a) they met the criteria for one of the *DSM-III* childhood anxiety disorders (separation anxiety disorder, overanxious disorder, simple phobia, or social phobia), based on their DISC–C interview, and (b-1) either their parents or their teacher reported confirming symptoms and they obtained a total RBPC or RCSB score of at least 1.5 standard deviations above the cohort mean, or (b-2) they obtained a RBPC Anxiety–Withdrawal scale score or a RCSB Worried–Fearful scale score of at least 1.5 standard deviations above the cohort mean. The anxiety disorder group had mean scores of 7.5 (SD = 3.8) and 2.5 (SD = 2.1) on the Anxiety–Withdrawal and Worried–Fearful scales, respectively, compared with the remaining subjects' mean scores of 3.4 (SD = 3.3) and 1.1 (SD = 1.6).

Children were given a diagnosis of dysthymia/depression if (a) they met the *DSM-III* diagnostic criteria for either dysthymic disorder or major depression, on the basis of their DISC–C interview, and (b-1) either their parents or their teacher reported confirming symptoms and they obtained a total RBPC or RCSB score of at least 1.5 standard deviations above the cohort mean or (b-2) they obtained a RBPC Anxiety–Withdrawal scale score or a RCSB Worried–Fearful scale score of at least 1.5 standard deviations above the cohort mean. (Factor analytic studies [Hinshaw, Morrison, Carte, & Cornsweet, 1987; McGee et al., 1985; Quay, 1983] have shown that the RBPC and the RCSB each contain a single scale for internalizing disorder, called the Anxiety–Withdrawal scale in the former inventory and the Worried–Fearful scale in the latter. These scales were used in the present study to provide parent and teacher confirmation of both anxiety disorder and dysthymia/depression symptoms. The DISC–C items were used to make a differential diagnosis.) The dysthymia/depression group had mean scores of 6.2 (SD = 2.2) and 2.0 (SD = 1.9) on the anxiety–withdrawal and worried–fearful scales, respectively, compared with the remaining subjects' mean scores of 3.4 (SD = 3.3) and 1.1 (SD = 1.6), respectively.

Using these conservative diagnostic criteria, 13 (12 boys and 1 girl) children were diagnosed as having ADD only, 17 (10 boys and 7 girls) as having CD only, 14 (7 boys and 7 girls) as having anxiety disorders only, and 10 (8 boys and 2 girls) as having dysthymia/depression only. Hyperactivity was present in 4 of the 12 ADD-only boys. An additional 19 children (14 boys and 5 girls) who met the criteria for two or more of the above disorders, were labeled as having multiple disorders. Approximately one fourth of the disordered subjects thus exhibited multiple disorders. Fifteen subjects had two disorders (6 of these had ADD and CD), 2 subjects had three disorders (in both cases, ADD, CD, and anxiety disorder), and 2 subjects had all four disorders. The remaining 605 children (300 boys and 305 girls) were considered nondisordered. The prevalence of disorder in the cohort was thus 10.8%. The prevalence rates for the individual disorders (when both single disorder cases and multiple disorder cases are taken into account) were as follows: ADD, 3.7%; CD, 4.6%; anxiety disorder, 3.8%; dysthymia/depression, 2.2%. These cohort prevalence rates are similar to those reported for a large sample of 10-year-olds in the Isle of Wight study (Rutter et al., 1970). The overall sex ratio for the disordered subjects was 2.3:1, boys to girls. IQ and treatment history information for the cohort may be found in Tables 1 and 2, respectively.

Procedure

The subjects were seen within 1 month of their 13th birthdays for a full day of medical, psychological, sociological, and anthropometric

Table 1
Estimated WISC–R Verbal, Performance, and Full Scale IQ

Diagnostic group	*n*	Verbal	Performance	Full scale
Nondisordered	605			
M		105.14	112.33	109.32
SD		13.83	14.22	13.81
Attention-deficit disorder	13			
M		94.92	102.77	98.46
SD		12.20	16.01	14.47
Conduct disorder	17			
M		99.18	102.94	101.12
SD		14.60	14.24	14.98
Anxiety	14			
M		97.79	105.29	101.36
SD		12.00	13.41	11.73
Depression	10			
M		106.60	108.50	108.30
SD		15.73	8.15	12.92
Multiple disorders	19			
M		89.47	99.47	93.42
SD		15.96	15.72	13.91

Note. WISC–R = Wechsler Intelligence Scale for Children–Revised.

testing at the Multidisciplinary Research Unit. All of the measures used in the present study (which was only one of several studies being conducted) were administered in the morning, in four 50-min sessions that were counterbalanced in order and separated by 10-min breaks. The DISC–C was administered by R. M., the SRED was administered by T. M., and the neuropsychological test battery and WISC–R were administered by master's-level graduate students in clinical psychology and trained psychometrists. Each examiner was blind to the subjects' performance on the other measures. The parent and teacher measures were mailed out prior to the laboratory assessment.

Results

In order to test for group mean differences in performance on the neuropsychological measures, a multivariate analysis of variance (MANOVA) was performed. Diagnosis, gender, and their interaction term were entered as the independent variables; the five factor scores and block design, as the dependent variables. The results indicated a significant main effect for gender, $F(6, 660) = 3.48$, $p < .002$, which the univariate tests showed to be restricted to the Visuospatial factor, but no Gender × Diagnosis interaction, $F(30, 3292) = 1.37$. Consequently, it seemed justifiable to keep the boys and girls combined. Of greater interest was the significant main effect for Diagnosis, $F(30, 3292) = 2.88$, $p < .001$, and its accompanying univariate tests, which revealed significant ($p \leq .02$) group differences on the Verbal, Visuospatial, Verbal Memory, and Visual–Motor Integration factors, as well as on block design. Post hoc tests (Tukey's honestly significant difference [HSD]) indicated that the multiple disorders group performed significantly worse than did the nondisordered group on each of these four composite measures, worse than did the CD group on the Visual–Motor Integration factor, and worse than did the dysthymia/depression group on the Verbal factor. In addition, the ADD group performed significantly worse than did the nondisordered group on the Verbal Memory and Visual–Motor Integration factors, and the anxiety disorders group performed worse than did the nondisordered group on the Visual–Motor Integration factor. These results are illustrated in Figure 1.

In order to evaluate group differences in the rate of specific neuropsychological deficits, the percentage of subjects in each group who scored lower than one standard deviation below the cohort mean was determined for each factor. These rates are presented in Table 3. Chi-square tests on the corresponding raw frequency data yielded significant group differences on Verbal, $\chi^2(5, N = 678) = 41.81$, $p < .001$; Visuospatial, $\chi^2(5, N = 678) = 15.68$, $p < .01$; Verbal Memory, $\chi^2(5, N = 678) = 30.22$, $p < .001$; and Visual–Motor Integration, $\chi^2(5, N = 678) = 35.00$, $p < .001$. The multiple disorders group had the highest rate of specific deficit (as defined) on the Verbal, Visuospatial, and Visual–Motor Integration factors. The ADD group had the highest rate of deficit on the Verbal Memory factor.

In order to evaluate group differences in the rate of generalized neuropsychological deficit, the percentage of subjects in each group who scored lower than one standard deviation below the cohort mean on three or more factors was determined. These rates are presented in Table 4. A chi-square test on the corresponding raw frequency data was significant, $\chi^2(5, N = 678) = 41.57$, $p < .001$. The multiple disorders group showed the highest rate of generalized deficit (26%). For both the entire sample and the subsample of disordered subjects only, there was a significant association between generalized deficit and positive treatment history; for the entire sample, $\chi^2(1, N = 652) = 14.70$, $p < .001$; for the disordered subsample, $\chi^2(1, N = 69) = 5.55$, $p < .02$.

Discussion

This study of a large, unselected sample of young adolescents only partially met its goal of uncovering the neuropsychological correlates of each of the major forms of adolescent psychopathology, in that only two of the four pure diagnostic groups studied were distinguishable from nondisordered subjects on the basis of their neuropsychological test performance. The ADD-only subjects performed relatively worse on the verbal memory and visual–motor integration measures. They also showed the highest rate of deficit on the verbal memory measures. The anx-

Table 2
Percentage of Subjects Who Had Sought or Been Referred for Treatment During the Preceding 2 Years

Diagnostic group	*n*	%
Nondisordered	583	7.9
Attention-deficit disorder	11	27.3
Conduct disorder	15	26.7
Anxiety	14	21.4
Depression	10	50.0
Multiple disorders	19	57.9

Note. The nondisordered, attention-deficit disorder, and conduct disorder groups included subjects with missing data for this variable.

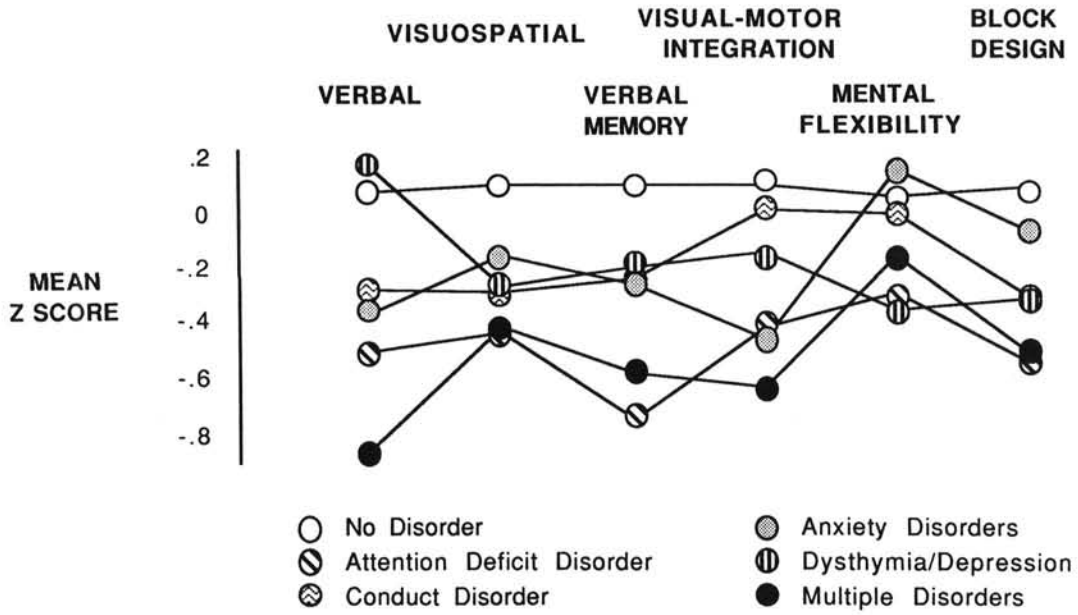

Figure 1. Neuropsychological test performance as a function of diagnosis. (For ease of illustration, the test scores that loaded on each component were standardized. Subjects' standardized scores on each group of tests were then averaged to yield a set of overall summary scores representing their performance on the five components. Block Design scores were also standardized. The units on the ordinate are, therefore, *z*-score units.)

iety disorder-only subjects performed relatively worse on the visual–motor integration measures. However, the CD and dysthymia/depression subjects did not perform differently from the nondisordered subjects. Overall, these findings are in moderate agreement with those of previous investigators. Our failure to find a verbal deficit in the CD group is probably the greatest inconsistency between our study and others.

Table 3
Percentage of Subjects Who Showed Specific Neuropsychological Deficits

Diagnostic group	*n*	Neuropsychological factor 1	2	3	4	5
Nondisordered	605	8.9	6.9	11.1	3.0	6.6
Attention-deficit disorder	13	23.1	23.1	46.2	15.4	15.4
Conduct disorder	17	5.9	11.8	0.0	0.0	5.9
Anxiety	14	21.4	7.1	35.7	14.3	7.1
Depression	10	20.0	20.0	10.0	10.0	20.0
Multiple disorders	19	52.6	26.3	31.6	26.3	15.8

Note. Specific deficit was defined as scoring lower than one standard deviation below the cohort mean for the factor. Chi-square tests on the raw frequency data corresponding to the above percentages were significant ($p < .01$) for Factors 1 (Verbal), 2 (Visuospatial), 3 (Verbal Memory), and 4 (Visual–Motor Integration). Factor 5 represents Mental Flexibility.

The most striking findings we obtained concern the multiple disorders subjects. They performed worse than did the nondisordered subjects on four of the five neurocognitive factors (Verbal, Visuospatial, Verbal Memory, and Visual–Motor Integration) and showed the highest rates of specific and generalized neuropsychological deficit. Significant and diverse neuropsychological dysfunction thus appears to be most strongly associated with multiple, rather than single, psychiatric disorders.

Two important methodological differences between our study and others may explain the differences in our findings. First, as has already been noted, most investigators of neuropsychological dysfunction in young psychopathological groups have used highly selected samples—subjects who have been referred for or are currently in treatment. Consequently, they have based

Table 4
Percentage of Subjects Who Showed a Generalized Neuropsychological Deficit

Diagnostic group	*n*	%
Nondisordered	605	2.3
Attention-deficit disorder	13	15.4
Conduct disorder	17	0.0
Anxiety	14	7.1
Depression	10	0.0
Multiple disorders	19	26.3

Note. Generalized deficit was defined as scoring lower than one standard deviation below the cohort mean on three or more of the neuropsychological factors. A chi-square test on the raw frequency data corresponding to the above percentages was significant ($p < .001$).

their conclusions on the performances of children whose disorders have gotten them into academic, interpersonal, or legal difficulties. Our use of an unselected sample, in contrast, means that our subjects included many who had not been referred for treatment, despite their meeting psychiatric diagnostic criteria. It may be that their disorders are less severe than those of their treated counterparts. Alternatively, they may have equally severe disorders, but also the advantage of compensatory personality, cognitive, or environmental factors.

A second critical difference between the present study and most previous work concerns the issue of comorbidity, or multiple disorders. The majority of previous studies, being studies of single disorders, have not assessed their subjects for psychopathologies other than the one under investigation. We, however, could not ignore the presence of multiple disorders. Not knowing how the disorders we found in our sample interact with one another, we grouped the multiple disorders subjects separately, and so preserved the homogeneity of the other diagnostic groups. In doing so, we probably reduced the mean severity level for the single disorder groups and thus made them less like the groups examined in single disorder studies. For example, the multiple disorders subjects with ADD had a higher incidence of hyperactivity than did the pure ADD subjects (50% vs. 31%). According to the *DSM-III,* children with ADD and hyperactivity exhibit more severe impairments than do children with ADD only. Additional evidence regarding differences between multiply and singly disordered children comes from Anderson et al.'s (1987) study of our cohort at age 11, in which they found that the multiply disordered children had both an earlier age of onset and a higher rate of treatment than did those with single disorders. As reported above, the finding for treatment has held up between ages 11 and 13. Hinshaw (1987) has also concluded, on the basis of his review of the distinction between the two major childhood externalizing disorders, that children with both attention deficits/hyperactivity and conduct problems/aggression exhibit more severe problems than do children with one or the other disorder only.

Had we not grouped the multiple disorders subjects separately, but instead included them in all groups for which they met criteria (in effect, had we done four single disorder studies), the sample sizes would have increased by the following percentages: ADD, 76%; CD, 70%; anxiety disorder, 73%; and dysthymia/depression, 60%. Comparisons of each of these four groups with the nondisordered group on each of the six dependent variables (the five factor scores and block design) yielded 14 significant ($p < .01$) t values out of the 24 tests computed. The CD subjects performed worse than did the nondisordered subjects on five of the six measures, the ADD subjects and the anxiety disorder subjects performed worse on four out of the six, and the dysthymia/depressed subjects performed worse on one out of the six. These results are clearly and more strongly in keeping with those of other investigators than are the results for the pure single disorder groups.

Our results highlight the need for careful consideration of the problem of comorbidity in the design, analysis, and interpretation of studies of neuropsychological function in psychiatrically disturbed children and adolescents. Anderson et al. (1987) have discussed the clinical and research implications of the relatively high incidence of multiple disorders in this population. We agree with their warning that "a degree of caution in looking for correlates of individual disorders as a guide to their etiology, without careful exclusion of the contribution to the correlation from co-existing other disorders, is warranted" (p. 81).

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