

## Factor Structure and Correlates of Ratings of Inattention, Hyperactivity, and Antisocial Behavior in a Large Sample of 9-Year-Old Children From the General Population

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Teacher ratings of inattentive, impulsive, hyperactive, aggressive, and anxious behaviors were obtained for a non-clinic-referred sample of 926 9-year-old children from Dunedin, New Zealand. Factor analysis of the ratings identified four factors of Inattention, Antisocial Behavior, Hyperactivity, and Worry-Fearful. Subscales based on these factors were only weakly related to parent ratings of the same behaviors. Canonical correlational analysis indicated that both cognitive (performance IQ, reading, and spelling) and motor (speech articulation and tapping speed) abilities best predicted the parent and teacher ratings of inattention. Family background measures, on the other hand, were associated primarily with the antisocial, hyperactive, and worry ratings. Overall, the results suggest that inattention represents the core dysfunction in hyperactivity. It is argued that inattention, hyperactivity, and antisocial behaviors should be regarded as at least partially independent dimensions.

The *Diagnostic and Statistical Manual of Mental Disorders* (DSM-III; American Psychiatric Association, 1980) has proposed an attention deficit disorder (ADD) to replace the concept of hyperactivity. ADD may or may not be accompanied by hyperactive behavior, but the focus of the disorder has become attentional dysfunction rather than excessive motor activity. The relations among attention deficit, hyperactive behavior, and conduct problems or aggressive-antisocial behavior, however, are yet to be clearly described. In Rutter's (1982) review of the concepts of minimal brain dysfunction and the hyperkinetic syndrome, he concluded that there is no good empirical support for a

broad concept of hyperactivity as a separate disorder. Furthermore, he argued that even though emphasis has shifted from activity to attention deficits, the problem of the validity of the disorder remains. For example, the features of one disorder may be present in others, such as inattentiveness associated with conduct disorder, depression, or anxiety. In addition, lack of agreement among measures may be just as much a problem for inattentiveness as it is for hyperactivity. If attention deficit, hyperactivity, and conduct problems represent meaningful clinical conditions, then the issue still remaining is whether they may be differentiated on the basis of variables other than the symptoms that define the disorders, for example, treatment or etiological variables (Achenbach, 1981; Loney, 1980; Rutter, 1982).

Evidence from factor analytic studies of behavioral descriptions has shown that inattention, hyperactivity in the sense of motor excess, and antisocial or aggressive behaviors often emerge as separate factors (Aman, Werry, Fitzpatrick, Lowe, & Waters, 1983; Conners, 1969; Lahey, Stempniak, Robinson, & Tyroler, 1978; Loney, Langhorne, & Pater-nite, 1978; O'Leary & Steen, 1982; Trites & Laprade, 1983; Werry & Hawthorne, 1976). However, behavioral measures based on these

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factors may be highly correlated. Unfortunately, there are relatively few studies examining the validity of these behavioral dimensions in terms of differential associations with other variables.

Lahey, Green, and Forehand (1980) examined the interrelations among hyperactivity, conduct disorder, and attention deficit using a combination of direct observation, teacher ratings, peer evaluation, and academic performance. They concluded that although inattentiveness and hyperactivity may be separate behavioral dimensions, conduct disorder and hyperactivity are not. Furthermore, they argued that the results do not confirm the existence of hyperactivity as a separate diagnostic category.

On the other hand, Loney et al. (1978) found differential associations between factor scores for aggressiveness and hyperactivity and a number of background variables. More recently, Milich, Loney, and Landau (1982) confirmed and extended these findings with a sample of 90 boys referred to a psychiatric outpatient service. Taken together, these two studies suggest the desirability of distinguishing between hyperactive and aggressive dimensions of behavior. These two studies, however, did not make a distinction between inattentive and hyperactive behaviors.

A slightly different approach to the problem of the distinctiveness of childhood disorders has been to use behavioral dimensions derived from factor analytic studies to identify various groups of children scoring at the extremes of the dimensions. In a descriptive sense, it is clearly possible to identify children with pure and mixed forms of disorder, such as conduct disorder with or without hyperactive behavior or pure hyperactivity without conduct disorder (August & Stewart, 1982; Lynn, Mirkin, Lanese, Schmidt, & Arnold, 1983; McGee, Williams, & Silva, 1984a; Stewart, Cummings, Singer, & deBlois, 1981; Trites & Laprade, 1983). The question of differential associations between these disorders and various background variables is more difficult to answer. There is some evidence to suggest that hyperactivity is associated with a more general cognitive impairment, whereas aggressive behavior is not (August & Stewart, 1982; McGee et al., 1984a). However, variables that might be considered to be of etiological significance,

for example, family background, do not appear to differentiate strongly among children with these disorders (McGee, Williams, & Silva, 1984b; Sandberg, Wieselberg, & Shaffer, 1980).

The present study examines further the issue of the independence of hyperactive and antisocial behavior in a large sample of 9-year-old New Zealand children. It reports the factor structure of inattentive, impulsive, hyperactive, and antisocial behavior ratings and examines the relations between the derived factors and other developmental and background variables. The developmental variables were chosen on the basis of the research literature, particularly their relation with hyperactive behavior, and included cognitive measures (Rosenthal & Allen, 1978), speech articulation measures (Thorley, 1984), and both fine and gross motor development (Denckla & Rudel, 1978). The background characteristics of the children included socioeconomic, maternal, and family variables.

## Method

### *Subjects*

The subjects were 926 non-clinic-referred children aged 9 from the Dunedin Multidisciplinary Child Development Study, which is a longitudinal investigation of their health, development, and behavior. The history of this study and characteristics of the sample have been described by McGee and Silva (1982). To summarize, the children were part of a cohort born at Dunedin's only obstetric hospital (Queen Mary Hospital), between April 1, 1972 and March 31, 1973. The sample was first traced at age 3, and 1,139 children were eligible for inclusion because they were living within the province of Otago, in which Dunedin is situated. Of these 1,139 children, 1,037 (91.0%) were assessed; the remaining children either were traced too late or the parents were unable to cooperate. Subsequently, the sample was assessed at age 5 ( $N = 991$ ), at age 7 ( $N = 954$ ), and at age 9 ( $N = 955$ ).

In terms of cross-cultural perspective, New Zealand enjoys an overall high standard of living, and when compared with other countries on various indexes of living standards, New Zealand ranks in the first 10 (New Zealand Department of Statistics, 1976). When compared with New Zealand as a whole on a measure of socioeconomic status (SES; Elley & Irving, 1972), the Dunedin sample tended to be socioeconomically advantaged, with overrepresentation in the two highest SES levels and underrepresentation in the two lowest levels. In addition, the sample was underrepresentative of Maori and Polynesian races, with about 2% being more than half Maori and Polynesian compared with about 10% for New Zealand (New Zealand Department of Statistics, 1976).

The predominant European background of the children suggests that the sample would be comparable to other English-speaking, Western cultures.

## Measures

**Teacher ratings.** The Rutter Scale B for teachers consists of 26 items covering a variety of behaviors to which the teacher responds *does not apply* (0), *applies somewhat* (1), and *certainly applies* (2). A factor analysis of the results of the 7-year-olds with this scale identified three factors: Aggressiveness, Hyperactivity, and Anxiety-Worry (McGee et al., in press). The questionnaire, however, has only three items relating to hyperactive behaviors: poor concentration, restless-hardly ever still, and squirmy-fidgety. Consequently, at the 9-year assessment the Rutter scale for teachers was administered again, but additional items to assess inattention, impulsivity, and hyperactivity in more detail were also given. These new items were taken from DSM-III criteria for ADD.<sup>1</sup> Three of these additional items related to lack of self-confidence, quick mood changes, and assertiveness mentioned in DSM-III as possible associated features of ADD. These three were included in the present study because they were found to be associated with hyperactive behavior in an analysis of the 7-year results from the Dunedin project (McGee et al., 1984a). The new items were rated in the same manner as the original scale items, and the full set of 31 behaviors selected for analysis is shown in Table 1.

There are three important points to note about the items chosen for analysis. In the first instance, about half of the items were constructed ad hoc, although based on behavioral descriptions from DSM-III. These items were piloted on a trial sample of children, and several teachers made suggestions regarding the appropriate wording of items. However, the new items are essentially unvalidated. Second, the items were chosen to give a broad range of behaviors thought to relate to ADD/hyperactivity/antisocial behavior and included some items that were not strictly part of DSM-III diagnostic criteria. Third, five items relating to anxiety-unhappiness were included in the factor analysis. In McGee et al.'s (in press) factor analysis of the Rutter teacher scale at age 7, they identified a factor made up of worries, fearful, miserable, fussy, and solitary, and these were included in the present study to see whether this factor would be replicated. Completed ratings were available for 926 children, representing a follow-up of 81.3% of the eligible sample at age 3. There were 480 boys and 446 girls.

**Parent ratings.** At the 9-year assessment, the parent completed the Rutter Child Scale A, a 31-item questionnaire covering the same range of behaviors as the teacher scale. In addition, the parents were given the extra questions relating to inattention, impulsivity, and hyperactivity except for Question 11, calling out in class. Consequently, it was possible to compare teacher and parent ratings of these behaviors.

**Background measures.** Three kinds of background variables were studied in relation to the behavioral ratings, namely, cognitive measures, speech-motor measures, and family background. These measures were restricted to the 7-year and 9-year assessments. Cognitive development was assessed by verbal and performance IQs (VIQ and

PIQ) obtained from the Wechsler Intelligence Scale for Children-Revised (WISC-R) administered when the children were aged 7 and 9 (Wechsler, 1974).<sup>2</sup> Reading at both ages was measured by the Burt Word Reading Test-1974 Revision (Scottish Council for Research in Education, 1976), and spelling ability was assessed at age 9 by a 25-item scale adapted from a test described by Smith and Pearce (1966). These tests were administered by trained psychometrists who did not have access to the results of the teacher and parent behavior ratings.

Speech articulation at both ages was measured by the Dunedin Articulation Check (DAC), a 20-item scale scored for the correct articulation of 6 phonemes and 14 groups of sounds (Justin, Lawn, & Silva, 1983). Motor ability at ages 7 and 9 was assessed by the nine subtests of the Arnheim and Sinclair (1974) Basic Motor Abilities Test. For the present study, the two subscales of Tapping Ability and Standing Long Jump were chosen for analysis. A factor analysis of the motor test (Wilson, Silva, & Williams, 1981) indicated that these two subscales had the highest loadings on a factor of Fine Motor Control (tapping ability) and a second factor of Large Muscle Control (long jump).

The family background measures included the following variables: (a) SES as indicated by the Elley and Irving (1976) index for New Zealand that ranks occupations from highest (Rank 1) to lowest (Rank 6); (b) whether the child came from a solo-parent family; (c) whether the child's natural parents had separated any time from birth to age 9; (d) mother's report of her mental health, using the Rutter, Tizard, and Whitmore (1970) Malaise Inventory, a 24-item symptom checklist administered at both ages; and (e) quality of family relationships when the child was 7 and 9, based on maternal report using the Cohesiveness, Expressiveness, and Conflict subscales of the Family Environment Scale (FES; Holahan & Moos, 1983).

## Procedure

A similar general procedure has been used at each assessment phase of the study. Prior to the child attending the unit, the parents received details concerning the nature of the assessments, and written consent was sought for the child's participation in the assessment program. Parents were also asked for permission to seek behavioral reports and details of progress from the child's school. Children enrolled in the study were assessed at the Dunedin unit within 1 month of their ninth birthday on a variety of measures regarding their health, cognitive, motor, and behavioral status. Children living in other parts of New Zealand who could not attend in Dunedin

<sup>1</sup> Unfortunately, the DSM-III item, "Always on the go. Acts as if driven by a motor," was not included. However, for the purposes of the present article (i.e., factor analysis), the ratings appeared to be sufficiently diverse to cover the problem areas of inattention, impulsivity, and hyperactivity.

<sup>2</sup> The WISC-R subscales of Comprehension from the Verbal scale and Picture Arrangement from the Performance scale were omitted at both ages because of time constraints on the testing schedule.

were assessed by the Psychological Service of the Department of Education. The child's parent, usually the mother, completed extensive questionnaires to gather background information, including the Rutter Scale A and other behavioral items. The child's teacher was also asked to complete the Rutter Scale B and additional questions relating to attentiveness and behavior during class.

## Results

The distribution of responses "applies somewhat" and "certainly applies" for the

31 items in the teacher questionnaire is presented in Table 1. Sex differences were examined using chi-square ( $2df$ ) tests, with the level of significance for each  $\chi^2$  being adjusted ( $p < .0016$  or  $.05/31$ ) using the Bonferroni inequality to control for inflation of the overall Type I error rate beyond  $p < .05$  (Grove & Andreasen, 1982). Twenty-two items had a significant sex difference in the distribution of ratings as shown in Table 1. On most items relating to inattention, impulsivity, hy-

**Table 1**  
*Distribution of Responses "Applies Somewhat" and "Certainly Applies" for the Teacher Ratings and Sorted Factor Loadings*

Item*	Applies somewhat	Certainly applies	Factor			
			I	II	III	IV
1. Fails to complete tasks	26.3	9.1*	<u>0.81</u>	0.20	0.08	0.12
2. Poor concentration	25.8	9.5*	<u>0.79</u>	0.23	0.23	0.14
3. Easily distracted	31.4	11.9*	<u>0.77</u>	0.23	0.27	0.10
4. Not listening to instructions	31.6	9.4*	<u>0.74</u>	0.25	0.19	0.17
5. Difficulty organizing work	29.3	7.1*	<u>0.71</u>	0.15	0.17	0.27
6. Needs help/attention	20.6	7.3*	<u>0.70</u>	0.25	0.12	0.25
7. Shifts activities	15.4	5.5*	<u>0.64</u>	0.29	0.36	0.06
8. Difficulty staying with play	13.6	2.2*	<u>0.60</u>	0.27	0.17	0.16
9. Acts before thinking	34.9	6.3*	<u>0.49</u>	0.23	0.25	0.12
10. Lacks self-confidence	33.3	5.1	<u>0.49</u>	0.00	-0.05	<u>0.58</u>
11. Frequently fights	14.6	2.8*	0.19	<u>0.76</u>	0.17	0.12
12. Bullies other children	9.2	2.7*	0.21	<u>0.73</u>	0.17	-0.01
13. Often tells lies	11.0	2.2*	0.29	<u>0.68</u>	0.03	0.03
14. Irritable	14.6	2.9*	0.09	<u>0.66</u>	0.38	0.23
15. Often disobedient	13.4	2.5*	0.31	<u>0.65</u>	0.39	-0.03
16. Quick changes in mood	11.9	3.2	0.11	<u>0.64</u>	0.28	0.24
17. Impatient waiting turns	15.7	3.2*	0.18	<u>0.62</u>	0.41	0.07
18. Destructive	5.2	0.6*	0.24	<u>0.61</u>	0.14	0.02
19. Not much liked	16.7	3.1	0.32	<u>0.55</u>	0.05	0.31
20. Assertive approach	17.0	3.2*	0.03	<u>0.49</u>	0.33	0.00
21. Stolen things	4.0	1.6	0.28	<u>0.48</u>	-0.01	0.00
22. Trouble sitting still	20.4	4.0*	0.44	0.27	<u>0.68</u>	-0.01
23. Very restless	19.4	3.7*	0.34	0.34	<u>0.67</u>	0.08
24. Squirmy, fidgety	19.5	4.5*	0.42	0.26	<u>0.63</u>	0.08
25. Calls out in class	13.7	4.5*	0.23	0.35	<u>0.55</u>	0.01
26. Often worried	31.7	5.6	0.08	0.04	0.10	<u>0.71</u>
27. Tends to be fearful	23.8	2.8	0.27	-0.03	-0.02	<u>0.68</u>
28. Often appears miserable	15.1	2.2	0.16	0.30	0.13	<u>0.53</u>
29. Rather solitary	29.3	4.9	0.23	0.19	-0.08	<u>0.47</u>
30. Fussy	13.2	1.0*	-0.02	-0.01	0.02	0.37
31. Truants from school	1.2	0.4	—	—	—	—

*Note.* Factor I = Inattention; Factor II = Antisocial Behavior; Factor III = Hyperactivity; and Factor IV = Worry-Fearful. Factor loadings above 0.45 are underscored. A loading of 0.45 indicates that the factor accounts for 20% of the variance on the item.

\* Items 2, 11 to 15, 18, 19, 21, 23, 24, and 26 to 31 are taken from the Rutter Child Scale B for teachers. A full description of the behavioral items is available from the authors.

\*  $p < .05$ ; indicates item showed significant sex difference in the distribution of ratings.

peractivity, and antisocial behavior, the boys were rated as showing the behavior more often than the girls. The only behavior shown more often by girls than by boys was being fussy or overparticular.

To examine the factor structure of the teacher ratings, factor analyses using principal factoring with iteration followed by varimax rotation (Nie, Hull, Jenkins, Steinbrenner, & Bent, 1975) were carried out separately for boys and girls. As there was little difference between these two analyses in terms of the relative sizes of factor loadings of the various items, the data were reanalyzed for the total sample, and those results are reported here. For this analysis, Item 31 (truants from school) was not included because of the low frequency of ratings 1 and 2 (1.6%). All other items had combined frequencies for these ratings over 5.5%. The two least frequent behaviors were stealing (Item 21, 5.6%) and being destructive (Item 18, 5.8%). However, these items were included because of their importance in the group of antisocial behaviors, and both subsequently showed communalities comparable with the other items.

The factor analysis of the 30 remaining items resulted in four factors with eigenvalues greater than one. The eigenvalues prior to rotation were 11.76, 3.06, 2.09, and 1.38; the eigenvalue of the fifth factor extracted was 0.93. The first four factors accounted for 60.9% of the variance prior to iteration. Presented in Table 1 are the sorted factor loadings after rotation for these four factors. Factor I, Inattention, showed highest loadings for items relating to poor concentration, distractability, difficulties in organizing and completing work, shifting from activities, not listening, jumping into activities without thinking, needing help and attention, and lacking self-confidence. Factor II, Antisocial Behavior, replicates and extends the Aggressiveness factor identified by McGee et al. (in press). This factor loaded most highly for ratings of fighting, bullying, disobedience, destructiveness, irritability, impatience, lying and stealing, and not being liked. Factor III, Hyperactivity, had high loadings for restlessness, squirminess, trouble sitting still, and calling out in class. Finally, Factor IV, Worry-Fearful, loaded on worries, fearful, lacks self-confidence, unhappy, and solitary. The item

measuring fussy behavior had a loading of 0.37 on this last factor and had loadings below 0.05 on the first three factors.

To study further the properties of the behavioral dimensions identified, four measures were calculated from the unweighted sums of items shown in Table 1. As Item 10 (lacks self-confidence) had loadings greater than 0.45 on two factors, it was not included in either the Inattention (Factor I) or Worry-Fearful (Factor IV) measure. Consequently, Inattention was based on Items 1-9 in Table 1; Antisocial Behavior was based on Items 11-21; Hyperactivity, on Items 22-25; and Worry-Fearful, on Items 26-29. The reliability of these four measures was examined using coefficient alpha, an index of internal consistency (Nunnally, 1967). This measure is an estimate of the expected correlation of a test with all alternate forms of the test having the same number of items. Coefficient alpha was .93 for Inattention, .91 for Antisocial Behavior, .87 for Hyperactivity, and .71 for Worry-Fearful. An examination of the corrected item-total correlations for each of the four measures indicated that all correlations were significant ( $p < .05$ ). Consequently, no items were deleted from the subscales. These results showed that the measures based on the factor analysis of the teacher ratings had a high level of reliability based on internal consistency.

The parent ratings were also factor analyzed, and a four-factor solution accounted for 46.0% of the variance prior to iteration. The four factors identified were very similar in terms of item composition to those based on the teacher ratings. For example, in the case of the Inattention factor, the following items all had loadings above 0.45: being easily distracted, poor concentration, difficulty staying with play, not listening to instructions, shifting activities, failing to complete tasks, difficulty organizing work, and needing help and attention. Acts before thinking loaded 0.38 on this factor and had low loadings on the other three factors. The main difference between the teacher and parent factor structure was that in the latter, being miserable loaded more highly on the Antisocial Behavior factor (0.46) than on the Worry-Fearful factor (0.39). However, given the overall similarity in factor structures, the results of the teacher

Table 2

*Correlations Among the Teacher and Parent Measures of Inattention, Antisocial Behavior, Hyperactivity, and Worry-Fearful at Age 9*

Measure	Teacher				Parent			
	1	2	3	4	1	2	3	4
<b>Teacher</b>								
1. Inattention		.58*	.65*	.43*	.35*	.29*	.24*	.02
2. Antisocial Behavior			.66*	.33*	.14*	.25*	.15*	-.01
3. Hyperactivity				.24*	.24*	.28*	.26*	-.03
4. Worry-Fearful					.16*	.08	.10	.16*
<b>Parent</b>								
1. Inattention						.57*	.46*	.41*
2. Antisocial Behavior							.45*	.41*
3. Hyperactivity								.20*
4. Worry-Fearful								

\*  $p < .05$  (adjusted  $p < .001$  for each correlation), otherwise correlation is nonsignificant.

factor analysis were used to form the measures of inattention, antisocial behavior, hyperactivity, and worry-fearful for the parent ratings. This procedure resulted in comparable measures for the teacher and parent ratings and appeared preferable to constructing a slightly different set of measures for each set of ratings. Coefficient alphas for the parent measures were as follows: .86 for inattention, .81 for antisocial behavior, .74 for hyperactivity, and .59 for worry-fearful. As was the case with the teacher measures, all item-total correlations were significant ( $p < .05$ ).

The product-moment intercorrelations between the various derived scales are presented in Table 2. Most correlations were significant, although many indicated relatively weak associations between some of the measures. This is at least partially due to the power of the statistical tests, given the large sample size. Inspection of Table 2 indicates that correlations within a particular rating source (teacher or parent) were higher than those between the two sources. Of particular interest are the correlations among the measures of inattention, antisocial behavior, and hyperactivity. For both the parent and teacher ratings, these scales showed moderately high intercorrelations. To examine the pattern of relations among these latter three scales more closely, partial correlations between pairs of measures were calculated while controlling for the remaining two measures. These partial correlations were as follows: inattention-antisocial behavior (controlling for hyperactivity

and worry-fearful), .21 and .37 for teachers and parents, respectively; inattention-hyperactivity, .45 and .27; and antisocial behavior-hyperactivity, .46 and .28. All partial correlations were significant ( $p < .05$ ). Those for the teacher ratings suggest a weaker relation between inattention and antisocial behavior than is shown in Table 2. Hyperactivity still correlated moderately with both of these behaviors. The results for the parent measures suggest weaker relations between all three behaviors.

The final analyses to be reported investigate the relations between the behavior measures derived from the factor analysis and the background variables. These relations are reported in terms of canonical correlations between linear combinations of predictor variables (cognitive, speech-motor, and family characteristics) and the four behavioral measures. This form of analysis is equivalent to a multiple regression with  $k$  independent and  $m$  dependent variables (Kerlinger & Pedhazur, 1973). The aim was to investigate whether differential relations existed between the background variables and the behavior measures. For each canonical analysis two solutions are reported. The first is the traditional canonical correlation; the second solution is based on linear functions where the values of the canonical weights are constrained or limited to +1, 0, and -1 (De Sarbo, Hausman, Lin, & Thompson, 1982). One difficulty with the traditional canonical correlation concerns the somewhat arbitrary inclusion-exclusion

of variates resulting from any subjective evaluation of whether coefficients are large enough to be considered significantly different from zero (Share, 1984). Constrained canonical correlation (see De Sarbo et al., 1982, for a fuller discussion of this topic) provides a method of avoiding the problem of subjective interpretation of coefficient size by deriving a solution in which variates can have only positive (+1), negative (-1), or null (0) effects. Given these constraints on the values of the canonical correlation coefficients, the method derives a globally optimum correlation between two linear combinations of variables.

Presented in Table 3 are the unconstrained and constrained solutions for the canonical analysis of the cognitive variables and the behavioral measures for the teacher and parent ratings.<sup>3</sup> The first point to note is that the unconstrained and constrained solutions provide very similar values of the canonical correlations. Second, it is clear from the table that the cognitive variables were related only

Table 4  
*Results of the Canonical Correlation Analysis for the Speech-Motor Measures and the Behavioral Measures*

Measure	Unconstrained		Constrained	
	Teacher	Parent	Teacher	Parent
Speech				
7	0.33	0.45	1	1
9	0.56	0.49	1	1
Tapping				
7	0.19	0.33	1	1
9	0.34	0.12	1	0
Long jump				
7	-0.08	-0.21	-1	0
9	-0.10	-0.06	0	0
Behavioral				
Inattention	-1.20	-0.79	-1	-1
Antisocial Behavior	0.08	-0.29	0	0
Hyperactivity	0.24	-0.13	0	0
Worry-Fearful	0.08	0.15	0	0
Rc	0.38*	0.31*	0.36*	0.29*

Note. The numbers 7 and 9 refer to ages. Rc represents canonical correlation.

\*  $p < .05$ .

Table 3  
*Results of Canonical Correlation Analysis for the Cognitive and Behavioral Measures Showing Unconstrained and Constrained Solutions*

Measure	Unconstrained		Constrained	
	Teacher	Parent	Teacher	Parent
Cognitive				
VIQ				
7	0.14	0.18	0	0
9	0.01	0.13	0	0
PIQ				
7	-0.17	-0.10	0	0
9	0.47	0.42	1	1
Reading				
7	0.35	0.19	1	1
9	0.06	0.12	0	1
Spelling				
9	0.33	0.29	1	1
Behavioral				
Inattention	-1.14	-0.86	-1	-1
Antisocial Behavior	-0.03	-0.08	0	0
Hyperactivity	0.26	-0.24	0	0
Worry-Fearful	0.01	0.11	0	0
Rc	0.51*	0.38*	0.48*	0.36*

Note. V = verbal; P = performance. The numbers 7 and 9 refer to ages. Values shown are canonical coefficients. Rc represents canonical correlation.

\*  $p < .05$ .

to the behavioral measure of inattention, and this was true for both teacher and parent ratings. Third, the same three cognitive measures (reading at age 7, PIQ at age 9, and spelling at age 9) were predictive (in inverse fashion) of poorer inattention ratings by teachers and parents. Reading at age 9 was also predictive of parent ratings of inattention.

The results of the analysis for the speech-motor variates and the behavioral measures are presented in Table 4. Once again there was little difference between the two solutions in terms of the canonical correlations. The speech-motor measures were related to the measure of inattention only, and again there was a reasonable degree of similarity between the solutions for the teacher and parent ratings. Speech articulation at ages 7 and 9 and

<sup>3</sup> These analyses are reported for the whole sample in the interests of a more parsimonious presentation of results. Canonical correlations were obtained for boys and girls separately, and in general, the values of the canonical correlation and the pattern and size of the canonical coefficients did not differ markedly between the sexes.

tapping ability at age 7 were associated with parent and teacher ratings of inattention. In addition, tapping ability at age 9 was predictive of teacher ratings of inattention, as was long jump (in inverse fashion) at age 7. The interpretation of this latter finding, however, is unclear.

The final set of results are shown in Table 5, which presents the canonical analysis for the family background measures and the behavior ratings. Low SES indicated an SES Level V or VI (semiskilled or unskilled) according to the Elley and Irving (1976) index. Reported quality of family relationships was indicated by the Family Relations Index (FRI; Holahan & Moos, 1983). The FRI combined scores on the FES subscales of Cohesion, Expressiveness, and Conflict; the higher the score, the greater the level of social support within the family. In contrast with the previous canonical analysis, the canonical correlations for the parent ratings were some-

what higher than were those for the teachers. In addition, there was rather less similarity between the parent and teacher solutions for the background measures than was the case with the cognitive and motor measures. Teacher ratings of inattention and antisocial behavior were predicted primarily by the more visible aspects of the family (SES, solo parenting, and separated parents). Parental ratings of antisocial, hyperactive, and fearful behaviors were predicted by low SES and solo parenting in combination with maternal psychological symptoms and poor relationships within the family.

## Discussion

An examination of factor analytic studies indicates several studies that have identified a Hyperactivity factor distinct from an Antisocial or Aggressiveness factor (e.g., Lahey et al., 1978; Loney et al., 1978; Milich et al., 1982; Trites & Laprade, 1983). However, the Hyperactivity factor in these studies had elements of both inattention and restlessness-overactivity. Other analyses (Aman et al., 1983; Conners, 1969) have reported separate factors of Inattention and Hyperactivity. There is some evidence to suggest that a general Hyperactivity factor and an Antisocial factor are differentially related to other background variables (Loney et al., 1978; Milich et al., 1982). On the other hand, Lahey et al. (1980) argued that inattentiveness represents a disorder distinct from both hyperactivity and antisocial behavior and that the latter two are probably not separate disorders. Others have similarly stressed the importance of attention difficulties as the core disorder in the hyperactive syndrome (Rosenthal & Allen, 1978).

The present study examined the factor structure of ratings of inattentive, impulsive, hyperactive, antisocial, and anxious behaviors. The emergence of a Worry-Fearful factor replicated the findings of the earlier factor analysis on the sample at age 7 (McGee et al., in press) and is in agreement with numerous other studies (e.g., Quay, 1979). Of more interest was the fact that separate factors of Inattention, Hyperactivity, and Antisocial Behavior were identified. The Inattention factor described a behavioral dimension relating to the planning, organization, and execution

**Table 5**  
*Results of the Canonical Correlation Analysis for the Family Background and Behavioral Measures*

Measure	Unconstrained		Constrained	
	Teacher	Parent	Teacher	Parent
<b>Family background</b>				
Low SES	0.42	0.14	1	1
Solo parent	0.63	0.20	1	1
Parent separation	0.31	0.07	1	0
<b>Malaise</b>				
7	0.17	0.35	0	1
9	0.12	0.29	1	1
<b>FRI</b>				
7	-0.04	-0.22	0	-1
9	-0.09	-0.39	0	-1
<b>Behavioral</b>				
Inattention	0.37	0.09	1	0
Antisocial Behavior	0.64	0.69	1	1
Hyperactivity	0.01	0.24	0	1
Worry-Fearful	0.19	0.23	0	1
<b>Rc</b>	<b>0.23*</b>	<b>0.39*</b>	<b>0.21*</b>	<b>0.37*</b>

*Note.* SES = socioeconomic status. Low SES indicates semiskilled or unskilled; Malaise represents the Malaise Inventory (Rutter et al., 1970); the numbers 7 and 9 refer to ages; FRI is the Family Relations Index (Holahan & Moos, 1983); Rc represents canonical correlation.

\*  $p < .05$ .



of tasks or activities. In addition, it included some of the items that appear under the heading "Impulsivity" in DSM-III (acts before thinking, difficulty organizing work, and shifts activities), and it is of some interest that there was no impulsivity grouping, as such. The Hyperactivity factor described a dimension of restlessness and overactivity. The Antisocial Behavior factor was similar to other factors so-named in the literature (Quay, 1979). There was relatively little agreement between the teacher and parent ratings on these dimensions. For example, the highest correlation was only .35 for the inattention measure. This relatively low agreement between parent and teacher ratings is not new (e.g., Rutter et al., 1970; Touliatos & Lindholm, 1981) and is part of a more general phenomenon of information tending to cluster together according to its source (Loney et al., 1978). Arguments concerning the situational specificity of behaviors have been advanced to account for previous findings of low agreement between parent and teacher ratings of hyperactive and antisocial behavior. However, the hypothesis that there is a generalized attention deficit in individuals classified as having ADD (which is implicit in DSM-III criteria) is not supported in the present study by the low correlation between parent and teacher ratings of inattention. Brown and Wynne (1984) reported low correlations among different measures of attention during task performance. It would appear, therefore, that lack of agreement among measures is likely to be as much a problem in the assessment of attention deficit as it has been for hyperactivity.

As far as the independence of these ratings is concerned, the results support Lahey et al.'s (1980) argument for considering attention deficits as separate from antisocial behavior. The two were only moderately correlated (.21 for teachers and .37 for parents) when their relations with hyperactivity and worry were controlled. Hyperactivity, on the other hand, correlated a little more highly with both inattention and antisocial behavior. These present results suggest that the Inattentive, Hyperactive, and Antisocial factors represent dimensions describing at least partially different aspects of behavior. In this regard, the emergence of Inattention and Hyperactivity

as separate factors is in agreement with some previous factor analyses (Aman et al., 1983; Conners, 1969) and corresponds to the DSM-III distinction between attention deficit and hyperactivity. However, other studies on both whole population and clinic-referred samples have not found distinct Inattentive and Hyperactive factors. The question, then, as to the importance of this distinction and the further differentiation between these behaviors and antisocial behaviors cannot be decided on the results of factor analyses, per se. The results of any factor analysis will inevitably depend on the nature of the item pool and the characteristics of the sample.

Although it is possible to distinguish between inattentive, hyperactive, and antisocial behaviors in a phenomenological or descriptive sense, whether such distinctions have clinical importance depends on whether or not these behaviors are differentially related to other variables (Achenbach, 1981). The research of Loney et al. (1978) and Milich et al. (1982), based on this approach, provides strong support for the distinction between aggressive and inattentive-hyperactive behaviors. In the present study, the results of the canonical correlation analyses provide further evidence for the continued distinction between inattentive, hyperactive, and antisocial behaviors.

For both parent and teacher ratings, the cognitive and speech-motor variables predicted inattention but did not predict hyperactivity or antisocial behavior. Reading, spelling, performance IQ, speech articulation, and fine motor ability were the best predictors of inattention. Milich et al. (1982) found that full-scale IQ was unrelated to their Hyperactive and Aggressive factors. The results of this study, however, suggest that verbal and performance IQ may need to be considered separately. More important, the findings indicate the need for a theory of attention dysfunction that predicts the kinds of performance decrements associated with attention deficit disorder (Rosenthal & Allen, 1978). The findings do not support the hypotheses that deficits in verbal abilities (Prentice & Kelly, 1963) or reading disability (Rutter et al., 1970) are associated with antisocial behavior. The relation between inattention and speech articulation and fine motor ability is

of interest given previous reports of an association between motor abnormalities and hyperactivity (Denckla & Rudel, 1978). Earlier research has suggested that hyperactive children are slower than nonhyperactive controls on motor tasks (Rosenthal & Allen, 1978), and the results from the tapping test support this. Speech articulation problems have also been associated with the hyperactive syndrome (Thorley, 1984). The findings of our study suggest slow motor performance and articulation problems are predictive of the inattentive, rather than the hyperactive, component of behavior.

Although cognitive and motor variables were associated with ratings of inattention, family background measures were related to the other behaviors. In the case of the teacher ratings, low SES, solo parenting, separations, and maternal symptoms predicted both inattention and antisocial behavior. For the parent ratings, low SES, solo parenting, family conflict, and mother's psychological health predicted antisocial behavior, hyperactivity, and worry. These results partially confirm the Loney et al. (1978) findings that family background variables are associated more with aggressive behaviors than with hyperactive behaviors. However, the source of the ratings appears to be an important determinant of both predictor variables and the behaviors predicted, with the cognitive measures showing more consistency between parents and teachers.

Overall, the findings of this article suggest that a group of inattentive behaviors closely resembling the DSM-III category of attention deficit disorder can be identified. Furthermore, these behaviors have cognitive and speech-fine motor correlates that distinguish them from both hyperactivity and antisocial behavior. As such, inattention may represent the core dysfunction in the hyperactive syndrome. One question arising from this is whether hyperactivity in the sense of overactivity-restlessness-fidgetiness represents a disorder at all. Lahey et al. (1980) argued that it does not. However, it is clear that children who achieve a high score on hyperactivity alone can be found (Lynn et al., 1983), and Klein and Young (1979) identified low problem hyperactives who showed neither inattentiveness nor conduct disorder. We

would therefore argue that for the present, the behavioral dimension of hyperactivity should continue to be differentiated from both inattention and antisocial behavior.

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