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Cognitive and Behavioral Effects of
Methylphenidate on Conduct Disordered Boys

by

Harry N. Bawden

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

Department of Psychology

Carleton University

Ottawa, Ontario

November, 1985

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Abstract

Children with conduct disorders have a poor prognosis and a significant minority of them continue to exhibit aggressive and antisocial behavior in adolescence and adulthood. They often have difficulty at school, poor peer relations, and family problems. They are at risk for the development of adult antisocial spectrum psychiatric disorders and many will experience as adults difficulties in several areas of psychosocial functioning. They are difficult to work with and many treatments have proved ineffective. Thus, it is clear that alternative therapies should be investigated.

The purpose of this study was to determine whether methylphenidate is effective in the short-term treatment of conduct disordered children. Five boys, aged 6 to 12, who fulfilled the DSM-III diagnostic criteria for Conduct Disorder were selected as subjects. Children who met the diagnostic criteria for any other psychiatric disorder including Attention Deficit Disorder with or without Hyperactivity were excluded. The subjects were residents of the Child Study Centre, University of Ottawa, a children's mental health centre. A single-case reversal design was used. A baseline phase was followed by 4 experimental phases and methylphenidate and placebo were alternated across phases. The initial administration of medication or placebo was counterbalanced across subjects. A standard dose of 10 mg of methylphenidate or an

equivalent amount of placebo was administered twice a day under double-blind conditions to four subjects, and the remaining subject received 15 mg in the morning and at lunch and 10 mg after school.

Some of the boys exhibited favorable responses to methylphenidate in terms of improved classroom behavior, enhanced cognitive performance, and improved dynamic fine motor coordination. Some of the boys were less disruptive, impulsive, and active in the classroom as measured by reductions in the Hyperactivity, Conduct Problem, and Emotional Overindulgent factor scores of the Conners Teacher Questionnaire. Scores on the Hyperkinesis Index of the Conners Teacher Questionnaire also were reduced for some subjects. Improvements in classroom behavior also were evident mainly from reductions in various target behaviors coded during daily classroom behavioral observations. Improvements in target behaviors varied from subject to subject, but included less disruptive behavior, self-orienting, and time off task as well as reduced activity levels. As expected, given that the last daily dose of medication was administered to four of the boys at noon, few behavioral effects were detected with the use of Conners Parent Questionnaires filled out by child care workers who looked after the subjects after school when they returned to the residence.

Methylphenidate improved the ability of some subjects to sustain attention and inhibit impulsive responding on the Continuous Performance Test and recall words on a verbal memory task.

Methylphenidate increased the perceptual sensitivity (d') for some subjects, whereas for others it resulted in them adopting a more conservative response bias ($\ln B$). Methylphenidate facilitated the free recall of words for one subject and the cued recall of words for two subjects on a verbal memory task. The data also suggested that there was a stimulant-induced facilitation of the recall of semantically processed words, but not acoustically processed words. The medication did not improve performance on a paired-associate learning task. Small clinically insignificant improvements were evident on a handwriting task. Methylphenidate produced dramatic improvements in performance, especially nondominant hand performance, on a measure of dynamic fine motor coordination. The boys tolerated the medication very well, and few side effects were reported.

The results demonstrate that single-case experimental designs can be used successfully in human psychopharmacological studies. They also show that methylphenidate is effective, at least in the short-term, in the treatment of some conduct disordered boys. Finally, the results have implications for the current controversy over whether one should distinguish between conduct disordered and hyperactive children. The findings suggest that there may be subtle differences in the ways in which conduct disordered and hyperactive children respond to stimulants, but the similarities in response patterns are likely to be greater.

Table of Contents

	<u>Page</u>
 CHAPTER I	
Introduction	1
Diagnostic Issues	1
Factor Analytic Studies	3
Etiology	8
Biological Antecedents and Correlates	9
Genetics	9
Neurological Soft Signs	14
EEG Abnormalities	17
Minor Physical Anomalies	18
Prenatal and Perinatal Complications	21
Arousal Level	24
Psychosocial Antecedents and Correlates	28
Natural History	31
Response to Treatment	40
Effects of Stimulants on Activity	41
Effects of Stimulants on Social-Adaptive Behavior	49
Effects of Stimulants on Cognition	59
Attention	59
Paired-Associate Learning	70
State-Dependent Learning	73
Memory	75
Intelligence	78
Academic Achievement	81
Diagnostic Nonspecificity of a Favorable Response to Stimulant Medication	85
 CHAPTER II	
Method	89
Subjects	89
Experimental Design	93
Medication	94
Behavioral Measures	95
Conners Teacher Questionnaire	95
Teacher Reports	97
Classroom Behavioral Observations	98
Conners Parent Questionnaire	100
Residence Reports	101
Self-Report Psychiatric Rating Scale	101

Table of Contents cont'd.

	<u>Page</u>
Cognitive Tests	103
Continuous Performance Test	104
Weingartner Memory Task	105
Paired-Associate Learning	106
Psychomotor Tests	108
Maze Test	108
Handwriting	109
Side Effects	109
Side Effects Questionnaire	109
Heart Rate	110
Data Analyses	110
 CHAPTER III	
Results	112
Subjects	112
Behavioral Measures	134
Conners Teacher Questionnaires	134
Teacher Reports	159
Classroom Behavioral Observations	166
Conners Parent Questionnaires	211
Residence Reports	215
Self-Report Psychiatric Rating Scale	222
Cognitive Tests	240
Continuous Performance Test	240
Weingartner Memory Task	248
Paired-Associate Learning	267
Psychomotor Tests	270
Maze Test	270
Handwriting	279
Group Analyses	285
Side Effects	289
Side Effects Questionnaire	289
Heart Rate	297
 CHAPTER IV	
Discussion	300
Behavioral Measures	300
Conners Teacher and Parent Questionnaires	300
Teacher Reports	304

Table of Contents cont'd.

	<u>Page</u>
Classroom Behavioral Observations	306
Residence Reports	314
Self-Report Psychiatric Rating Scales	315
Cognitive Tests	318
Continuous Performance Test	318
Weingartner Memory Task	320
Paired-Associate Learning	323
Psychomotor Tests	325
Maze Test	325
Handwriting	327
General Discussion	329
References	353
Appendices	382

List of Figures

Figure	Title	Page
1	Child Behavior Profile for Subject A	114
2	Child Behavior Profile for Subject B	115
3	Child Behavior Profile for Subject C	116
4	Child Behavior Profile for Subject D	117
5	Child Behavior Profile for Subject E	118
6	Raw scores on the Conduct Disorder and Emotional Overindulgent factors of Conners Teacher Questionnaire for Subject A	135
7	Raw scores on the Hyperactivity factor and the Hyperkinesis Index of Conners Teacher Questionnaire for Subject A	136
8	Raw scores on the Conduct Disorder and Emotional Overindulgent factors of Conners Teacher Questionnaire for Subject B	143
9	Raw scores on the Hyperactivity factor and the Hyperkinesis Index of Conners Teacher Questionnaire for Subject B	144
10	Raw scores on the Conduct Disorder and Emotional Overindulgent factors of Conners Teacher Questionnaire for Subject C	149
11	Raw scores on the Hyperactivity factor and the Hyperkinesis Index of Conners Teacher Questionnaire for Subject C	150
12	Raw scores on the Conduct Disorder and Emotional Overindulgent factors of Conners Teacher Questionnaire for Subject D	153
13	Raw scores on the Hyperactivity factor and the Hyperkinesis Index of Conners Teacher Questionnaire for Subject D	155

List of Figures cont'd.

Figure	Title	Page
14	Raw scores on the Conduct Disorder and Emotional Overindulgent factors of Connors Teacher Questionnaire for Subject E	156
15	Raw scores on the Hyperactivity factor and the Hyperkinesis Index of Connors Teacher Questionnaire for Subject E	158
16	Weekly means of total number of problem behaviors reported daily by Subject A's teachers	160
17	Mean number of problem behaviors for each experimental phase reported daily by Subject C's teacher	163
18	Weekly means of total number of specific problem behaviors reported daily by Subject E's teachers	165
19	Percentage of intervals in which Off-Task and Interference Behaviors were recorded during classroom behavioral observations of Subject A	172
20	Percentage of intervals in which Conversation Initiation and Self-Orienting Behaviors were recorded during classroom behavioral observations of Subject A.	175
21	Percentage of intervals in which Teacher-Pupil Interactions and Changes in Position were recorded during classroom behavioral observations of Subject A	177
22	Percentage of intervals in which no problem behaviors (Absence of Behavior) and mean number of different problem behaviors recorded for each observation interval (Mean Disruptive Behavior) for Subject A	179
23	Percentage of intervals in which Off-Task and Interference Behaviors were recorded during classroom behavioral observations of Subject B	182

List of Figures cont'd.

Figure	Title	Page
24	Percentage of intervals in which Conversation Initiation and Self-Orienting Behaviors were recorded during classroom behavioral observations of Subject B	184
25	Percentage of intervals in which Teacher-Pupil Interactions and Changes in Position were recorded during classroom behavioral observations of Subject B	187
26	Percentage of intervals in which no problem behaviors (Absence of Behavior) and mean number of different problem behaviors recorded for each observation interval (Mean Disruptive Behavior) for Subject B	188
27	Percentage of intervals in which Off-Task and Interference Behaviors were recorded during classroom behavioral observations of Subject C	190
28	Percentage of intervals in which Conversation Initiation and Self-Orienting Behaviors were recorded during classroom behavioral observations of Subject C.	192
29	Percentage of intervals in which Teacher-Pupil Interactions and Changes in Position were recorded during classroom behavioral observations of Subject C	193
30	Percentage of intervals in which no problem behaviors (Absence of Behavior) and mean number of different problem behaviors recorded for each observation interval (Mean Disruptive Behavior) for Subject C	195
31	Percentage of intervals in which Off-Task and Interference Behaviors were recorded during classroom behavioral observations of Subject D	198
32	Percentage of intervals in which Conversation Initiation and Self-Orienting Behaviors were recorded during classroom behavioral observations of Subject D.	199

List of Figures cont'd.

Fig.	Title	Page
33	Percentage of intervals in which Teacher-Pupil Interactions and Changes in Position were recorded during classroom behavioral observations of Subject D	201
34	Percentage of intervals in which no problem behaviors (Absence of Behavior) and mean number of different problem behaviors recorded for each observation interval (Mean Disruptive Behavior) for Subject D	203
35	Percentage of intervals in which Off-Task and Interference Behaviors were recorded during classroom behavioral observations of Subject E	205
36	Percentage of intervals in which Conversation Initiation and Self-Orienting Behaviors were recorded during classroom behavioral observations of Subject E.	207
37	Percentage of intervals in which Teacher-Pupil Interactions and Changes in Position were recorded during classroom behavioral observations of Subject E	208
38	Percentage of intervals in which no problem behaviors (Absence of Behavior) and mean number of different problem behaviors recorded for each observation interval (Mean Disruptive Behavior) for Subject E	210
39	Weekly means of total number of problem behaviors reported daily by Subject A's child care worker	218
40	Weekly means of total number of problem behaviors reported daily by Subject B's child care worker	221
41	Mean number of problem behaviors for each experimental phase reported daily by Subject C's child care worker	223

List of Figures cont'd:

Figure	Title	Page
42	Children's Self-Report Rating Scale profile for Subject A completed during the baseline phase	226
43	Children's Self-Report Rating Scale profile for Subject B completed during the baseline phase	227
44	Children's Self-Report Rating Scale profile for Subject C completed during the baseline phase	228
45	Children's Self-Report Rating Scale profile for Subject D completed during the baseline phase	229
46	Children's Self-Report Rating Scale profile for Subject E completed during the baseline phase	230
47	Number of errors of omission and commission on the Continuous Performance Test recorded for Subject A	241
48	Number of errors of omission and commission on the Continuous Performance Test recorded for Subject B	242
49	Number of errors of omission and commission on the Continuous Performance Test recorded for Subject C	244
50	Number of errors of omission and commission on the Continuous Performance Test recorded for Subject D	245
51	Number of errors of omission and commission on the Continuous Performance Test recorded for Subject E	247
52	Perceptual sensitivity (d') scores on the Continuous Performance Test for Subjects A, C, and E	249
53	Perceptual sensitivity (d') scores on the Continuous Performance Test for Subjects B and D	250

List of Figures cont'd.

Figure	Title	Page
54	Response bias (ln B) scores on the Continuous Performance Test for Subjects A, C, and E	251
55	Response bias (ln B) scores on the Continuous Performance Test for Subjects B and D	252
56	Number of words recalled by Subject A under free recall and cued recall conditions on Weingartner's Memory Task	253
57	Number of words recalled by Subject B under free recall and cued recall conditions on Weingartner's Memory Task	256
58	Number of words recalled by Subject C under free recall and cued recall conditions on Weingartner's Memory Task	259
59	Number of words recalled by Subject D under free recall and cued recall conditions on Weingartner's Memory Task	261
60	Number of words recalled by Subject E under free recall and cued recall conditions on Weingartner's Memory Task	263
61	Percent of words recalled for all subjects under free recall and cued recall conditions on Weingartner's Memory Task	265
62	Numbering of intrusion errors for all subjects under free recall and cued recall conditions on Weingartner's Memory Task	266
63	Total number of errors recorded on the Paired-Associate Learning Test for Subjects A, C, and E	268
64	Total number of errors recorded on the Paired-Associate Learning Test for Subjects B and D	269
65	Total number and duration (s) of contacts recorded on the Maze Test for Subject A	272

List of Figures cont'd.

Figure	Title	Page
66	Total number and duration (s) of contacts recorded on the Maze Test for Subject B	274
67	Total number and duration (s) of contacts recorded on the Maze Test for Subject C	276
68	Total number and duration (s) of contacts recorded on the Maze Test for Subject D	277
69	Total number and duration (s) of contacts recorded on the Maze Test for Subject E	278

List of Tables

Table	Title	Page
1	The Effects of Stimulant Drugs on Activity Levels in Hyperactive Children	43
2	The Effects of Stimulant Drugs on Measures of Attention in Hyperactive Children	61
3	The Effects of Stimulant Drugs on Wechsler Intelligence Test Scores of Hyperactive Children	79
4	Sample Schedule of Test Administration	96
5	Ages and Full Scale WISC-R IQ Scores	118
6	Intraclass Correlations Between CBCL Profiles and the Profile Patterns of Edelbrock and Achenbach	120
7	Child Behavior Checklist Social Competence Subscale Scores	122
8	Conners Teacher Questionnaire Factor Scores	124
9	Stewart's Criteria for the Diagnosis of Unsocialized Aggression	125
10	Raw Scores on the Anxious-Passive, Asocial, and Daydreams/Attendance Problem Factors of the Conners Teacher Questionnaire for Subjects A, C, and E	137
11	Average Baseline and Placebo Ratings on Selected Scales of the Conners Teacher Questionnaire	141
12	Raw Scores on the Anxious-Passive, Asocial, and Daydreams/Attendance Problem Factors of the Conners Teacher Questionnaire for Subjects B and D	145
13	Teacher Ratings on Behavioral Dimensions for Subject A	162
14	Percentage Agreement for the Occurrence of Behaviors of the Observational Code	167

List of Tables cont'd

Table	Title	Page
15	Percentage Agreement for Nonoccurrences of Behaviors of the Observational Code	168
16	Interrater Reliabilities using Kappa Correlations	169
17	Conners Parent Questionnaire Ratings for Subjects A, C, and E	213
18	Conners Parent Questionnaire Ratings for Subjects B and D	214
19	Average Baseline and Placebo Ratings on Selected Factors of the Conners Parent Questionnaire	216
20	Mean Ratings on the Behavioral Dimensions of the Residence Reports for Subject A	219
21	Mean Ratings on the Behavioral Dimensions of the Residence Reports for Subject B	220
22	Mean Frequencies of Occurrence of Problem Behaviors and Use of Time Out for Subject E	224
23	Factor Scores on the Self-Report Psychiatric Rating Scale for Subject B	231
24	Factor Scores on the Self-Report Psychiatric Rating Scales for Subject C	234
25	Factor Scores on the Self-Report Psychiatric Rating Scale for Subject D	237
26	Factor Scores on the Self-Report Psychiatric Rating Scale for Subject E	239
27	Recall of Semantically and Acoustically Processed Words for Subjects A, C, and E	255
28	Recall of Semantically and Acoustically Processed Words for Subjects B and D	258
29	Times Taken to complete the Maze Test	273
30	Mean Handwriting Ratings for Subjects A, C, and E	281

List of Tables cont'd

Table	Title	Page
31	Mean Handwriting Ratings for Subjects B and D	282
32	Within Group Analyses of Medication Effects	286
33	Scale Scores on the Teacher Side Effects Questionnaire for Subjects A, C, and E	290
34	Scale Scores on the Teacher Side Effects Questionnaire for Subjects B and D	291
35	Scale Scores on the Parent Side Effects Questionnaire for Subjects A, C, and E	292
36	Scale Scores on the Parent Side Effects Questionnaire for Subjects B and D	293
37	Heart Rate	298

List of Appendices

	Page
A DSM-III criteria	382
B Achenbach Child Behavior Checklist	388
C Conners Teacher Questionnaire	392
D Letter of consent for study	393
E Stewart's structured psychiatric interview	395
F Letter of consent for interview	409
G Classroom Behavioral Observation Code	410
H Conners Parent Questionnaire	412
I Self-Report Psychiatric Rating Scale	413
J Side Effects Questionnaire	416
K Handwriting paragraph	418

CHAPTER 1

Introduction

Diagnostic Issues

Despite widespread agreement on the core symptoms of overactivity, inattention, impulsivity, and excitability which characterize the "hyperactive syndrome" (Cantwell, 1977; Schragar, Lindy, Harrison, McDermott, & Killins, 1966), the validity and usefulness of this disorder have been questioned repeatedly. This controversy is illustrated clearly by the disparate diagnostic practices of British and North American psychologists and psychiatrists.

In Britain the diagnosis of hyperkinetic syndrome is rarely made on children of normal intelligence. In the carefully conducted Isle of Wight epidemiological study, Rutter, Tizard, and Whitmore (1970) found that 1 out of 1,000 disturbed children were hyperkinetic. Furthermore, one and a half percent of nonretarded psychiatric clinic attenders were diagnosed as hyperkinetic (Rutter, Shaffer, & Shepherd, 1975). British clinicians regard hyperkinesis as a rare disorder which is seen primarily in retarded children who have definite indications of brain damage or dysfunction such as epilepsy (Graham & Rutter, 1968; Sandberg, Rutter, & Taylor, 1978).

In North America, on the other hand, the hyperkinetic

syndrome is regarded as the most common childhood behavior disorder, and approximately 30 to 40 percent of children referred to child guidance clinics are diagnosed as hyperkinetic (Safer & Allen, 1976). Most of the children with this disorder are of normal intelligence, show few unequivocal signs of neurological dysfunction, and often exhibit associated symptoms such as anxiety, low self-esteem, aggression, and learning problems (Sandberg et al., 1978; Shaffer & Greenhill, 1979; Stewart, Cummings, Singer, & de Blois, 1981). Thus, it is clear that hyperactive children constitute a heterogeneous group (Cantwell, 1978; Loney, 1980).

Although there are no direct comparisons of diagnostic practice, it is likely that the disparity in rates of the hyperkinetic syndrome between North America and the United Kingdom reflects differential usage of this diagnostic label and not a true difference in prevalence. The symptoms of overactivity and inattention have been reported to be common in British children (Rutter et al., 1970), but the diagnosis of hyperkinetic syndrome is used rarely.

Clinical descriptions suggest that many children diagnosed as hyperkinetic in North America would be regarded as having a conduct disorder in Britain. The conventional way of selecting the hyperkinetic child in North America has

included the presence of the core symptoms as well as aggressiveness, resistance to discipline, destructiveness, and antisocial behavior (August & Stewart, 1982; Prinz, Connor, & Wilson, 1981; Shaffer, McNamara, & Pincus, 1974).

Thus, it is not surprising that the independence of the hyperkinetic syndrome from conduct disorders has been questioned (Quay, 1979, 1980; Sandberg et al., 1978; Shaffer et al., 1974; Shaffer & Greenhill, 1979).

Factor Analytic Studies

Factor analytic studies of ratings of child behavior have provided evidence for and against the independence of these disorders. A number of studies have found that items related to excessive activity, inattention, and impulsivity cluster together, and it appears reasonable to label these clusters as hyperactivity factors (Achenbach, 1978; Arnold & Smeltzer, 1974; Conners, 1969; Dreger et al., 1964; Goyette, Conners, & Ulrich, 1978; Lahey, Stempniak, Robinson, & Tyroler, 1978; Loney, Langhorne, & Paternite, 1978; Miller, 1972; Patterson, 1964; Spivack & Levine, 1964; Trites & Laprade, 1981; Werry, Sprague, & Cohen, 1975). Separate factors representing hyperactivity and conduct disorders have been found in some of these studies (Achenbach, 1978; Conners, 1969; Goyette et al., 1978; Loney et al., 1978; Trites & Laprade, 1981; Werry et al., 1975). For example,

Loney et al. (1978) identified independent symptom dimensions of aggression and hyperactivity in a factor analytic study of data obtained from a single source, judges' ratings of the frequency and severity of hyperactive children's symptoms as outlined in clinic files. On the other hand, some factor analytic studies have failed to yield a hyperactivity factor (Conners, 1970; Langer et al., 1976; Langhorne, Loney, Paternite, & Bechtoldt, 1976; Roß, Lacey, & Parton, 1965; Walker, 1969). For example, Langhorne et al. (1976) asked parents and teachers to rate hyperactive children for whom drug treatment was being considered on the Conners scales. These data were factor analyzed along with a psychiatrist's original diagnosis and ratings made by two psychologists-in-training of the children's symptoms as described in their clinic charts. They reported that the derived factors primarily reflected the source of information, rather than core symptoms which clustered together across situations. In addition, some investigators have reported that items reflecting overactivity load on a conduct disorder factor, and in studies in which a hyperactivity factor emerged, ratings on this factor often were correlated with ratings on a conduct disorder factor (Sandberg et al., 1978; Sandberg, Wieselberg, & Shaffer, 1980). Sandberg and coworkers have reported high correlations between

hyperkinetic behavior and conduct problems as measured by Connors Parent and Teacher Rating Scales for normal public school children as well as for children referred to psychiatric clinics (Sandberg et al., 1978; Sandberg et al., 1980).

Other investigators also have reported that conduct problems and hyperactivity factors are related. Campbell and Steinert (1978) used the Connors scales and the Behavior Problem Checklist developed by Peterson and Quay and found that the conduct problem ratings of one scale and the hyperactivity ratings of the other scale were highly correlated for both clinic and nonclinic subjects.

These findings appear to contradict the results of factor analytic studies because factor scores are derived from a combination of positive and negative weightings from every item on the scale in such a way as to minimize correlations between factors derived in the same analysis. The scores correlated by Sandberg and coworkers reflect the way that rating scales are used in clinical practice. Observed symptoms were rated on a scale which roughly measured the frequency and severity of the symptoms, scores were summed for items loading on a particular factor, and the total was used as the score for that factor. When correlated with other factors in this way, orthogonal factors may turn

out to be highly correlated. Thus, the discrepancy is due to the use of two different methods for correlating factor scores.

The conflicting findings of the factor analytic studies are the result of differences in subject samples, rating instruments, and statistical techniques. Procedural and methodological features strongly influence the results of factor analytic studies (Loney, 1980). For example, the number and type of factors derived from a given correlation matrix obviously depends upon the number of items in the correlation matrix as well as decisions about item-loading criteria, eigenvalue levels, and iteration of communalities (Harris, 1975). When data is obtained from numerous sources, such as ratings obtained from teachers, parents, and psychologists, much of the variance in the intercorrelation matrix is associated with differences between sources; whereas data obtained from a single source tends to yield higher intercorrelations because the data is usually obtained at the same time with similar measurement techniques (Miller, 1976). Thus, it is not surprising that Loney and coworkers derived source factors when they factor analyzed across-source correlation matrices.

Achenbach and Edelbrock (1978), in a review of empirical efforts to classify childhood behavior disorders, concluded

that there was persuasive evidence for the generality of hyperactivity and aggression (conduct problem) factors since these factors have been reported in diverse samples of disturbed children. They noted that although not all factor analytic studies have found these narrow band factors, whether they emerged depended upon the number of items rated, the source of the rating, and whether the factor solution was rotated. They also pointed out that items representing these two types of disorder may load on the same broad band factor, but that does not mean that they cannot represent separate narrow band entities.

To summarize, factor analytic studies can be cited in support of the independence of hyperactivity from conduct disorders and for the association of these disorders. A decision about whether these disorders are separate cannot be made by referring to the results of factor analytic studies because the findings are heavily dependent upon procedure and methodology. When procedures and methodology favor the emergence of several factors, it is likely that separate conduct disorder and hyperactivity factors will be found, but when a correlation matrix is formed from an item pool with wide content and when the methodology favors the elicitation of a small number of factors, then broadly defined factors will emerge. In this situation it is likely that the

behaviors characterizing hyperactivity and conduct disorders will comprise a broad band Undercontrolled syndrome as described by Achenbach and Edelbrock (1978).

An important question overlooked by some critics, such as Quay (1979) and Schuckit, Petrich, and Chiles (1978), of classification systems which distinguish between these disorders, is not whether these disorders are correlated, but whether they can each make independent contributions to questions about concurrent and predictive functioning in children with these disorders. In other words, if these categories are valid, then the groups should differ with respect to etiology, natural history, response to treatment, or some variable other than the symptoms which define the disorder (Rutter, 1977b).

Etiology

In this section, the role of organic and psychosocial factors in the development of hyperactivity and conduct disorders will be reviewed. Particular attention will be paid to studies which have compared the incidence of adverse biological and psychosocial variables in samples of hyperactive and conduct disordered children, and these studies will be put into a broader context with respect to current hypotheses about the etiology of these childhood behavior disorders. Literature on the possible role of

genetic heritability will be reviewed first, and this section will be followed by reviews on the role of organic and neurological factors and a section on the current status of arousal theories. A brief review of studies which have examined the role of psychosocial factors in the etiology of hyperactivity and conduct disorders follows.

Biological Antecedents and Correlates

Genetics. A first step in determining whether genetic factors are operative is to see if the disorder runs in families. A familial pattern of occurrence often provides the impetus for investigators to consider a genetic component, although familial resemblance only provides weak evidence for a genetic influence.

Family studies of hyperkinetic children and normal controls have suggested that alcoholism and antisocial personality are more common in the biological parents of hyperactive children than in the parents of control children and that hysteria is more common in the mothers of hyperactive children (Cantwell, 1972; Morrison & Stewart, 1971). In addition, the childhood histories of fathers and uncles suggested that hyperactivity had been commoner among the male relatives of probands than controls. However, these studies have several serious methodological weaknesses including the fact that blind-interviewing conditions were

not used, parental diagnoses of hyperactivity were made on a retrospective basis, and the fact that neither of these studies included a control group of children who were referred to a psychiatric clinic with problems other than hyperactivity. There might be a general association between parental psychopathology and childhood attendance at a psychiatry clinic and not a specific association with hyperactivity. In fact, Stewart and colleagues have shown that antisocial personality and alcoholism are more common in the fathers of aggressive, antisocial boys than in the fathers of boys with other diagnoses who had been referred to the same psychiatric clinic (Stewart, de Blois, & Cummings, 1980; Stewart & Leone, 1978). The prevalence of these disorders in fathers of boys who were hyperactive was similar to that found in fathers of boys who were not hyperactive. These studies point out the importance of distinguishing between hyperactive children and children with conduct disorders.

The questionable practice of diagnosing hyperactivity on a retrospective basis can be avoided by studying the siblings of hyperactive children. Welner, Welner, Stewart, Palkes, and Wish (1977) used this design and found a nonsignificant tendency for more brothers of probands to be hyperactive than brothers of normal controls. Unfortunately it is not clear

whether the psychiatric interviews were conducted on a blind basis.

A drawback of family studies is that first-degree relatives share similar environments as well as genes. Adoption studies are more powerful because they can separate out genetic and environmental factors. The prevalence of a trait or disorder is determined in genetically unrelated individuals living together and in genetically related individuals living apart.

Some investigators have compared the prevalence of psychiatric diagnoses in families of hyperactive children raised by their biological parents, hyperactive children raised by nonbiological adoptive parents, and normal control children (Cantwell, 1975; Morrison & Stewart, 1973). Both of these studies found that biological fathers had higher rates of alcoholism, sociopathy, and childhood hyperactivity and that biological mothers had higher rates of hysteria than adoptive and control parents. McMahon (1980) and Rapoport and Ferguson (1981) have pointed out several methodological weaknesses in these studies, such as the use of nonblind-interviewing techniques, a lack of information on the reliability of diagnostic procedures, the use of retrospective parental reports in determining if the parents were hyperactive as children, and the fact that the

biological and adoptive parents did not share the same hyperactive children. In each of these studies, the two groups of hyperactive children were selected from different settings, and thus the groups may not be comparable. In any event these results are not surprising because adoptive parents are selected for their positive attributes.

Cadore and coworkers have assessed psychiatric disability and number of antisocial behaviors in adoptees and have related these conditions and symptom counts to the psychiatric diagnoses of the biological parents (Cadoret, 1978; Cadoret & Cain, 1980; Cadoret, Cunningham, Loftus, & Edwards, 1975). Cadoret (1978) did not find a greater incidence of conduct disorders or childhood psychiatric disability in the adoptees of antisocial biological parents, and this finding is in agreement with the results of Bohman (1972). On the other hand, Cadoret reported that having an antisocial or alcoholic biologic relative were two of the significant predictors of the amount of antisocial behavior (Cadoret, 1978; Cadoret & Cain, 1980).

Lopez (1965) found that all four pairs of monozygotic twins were concordant for hyperactivity and that only one out of six dizygotic twin pairs were concordant for this disorder. Although these results suggest that there is a genetic contribution to hyperactivity, they are of limited

importance because of the small sample size and because most of the dizygotic twins were of opposite sex. In some of these pairs the male twin was hyperactive and the female twin was normal. Thus, these results may be nothing more than an indication of the well known fact that hyperactivity is more common in boys than in girls (Ross & Ross, 1982).

To date, no twin studies have been carried out on children with conduct disorders, but this method has been used to determine if there is a genetic influence on the development of delinquency. Rosanoff, Handy, and Rosanoff (1934) studied pairs of twins, and at least one member of each pair was brought before the juvenile court authorities for some offense and placed on probation or committed to a correctional institution. The concordance rate for delinquency for male dizygotic pairs was almost 70% whereas for dizygotic females it was 100%. The high rate of concordance among dizygotics suggests that environmental factors may play a significant role in the development of juvenile delinquency.

In summary, no firm conclusions about a genetic contribution to the etiology of conduct disorder can as yet be made because only a limited number of subjects in the studies of Cadoret and coworkers exhibited aggressive and antisocial behavior. There is suggestive evidence for a

genetic mechanism of transmission for hyperactivity, but definitive evidence could be provided only by segregation and linkage studies which would identify the genetic marker associated with hyperactivity (Cantwell, 1975). Recent work by Stewart and colleagues has shown that the parental psychopathological correlates of hyperactivity and conduct disorders are different (Stewart et al., 1980). Conduct disorders are associated with parental antisocial personality, alcoholism, and hysteria while hyperactivity is not associated with these parental disorders.

Neurological Soft Signs. It has long been recognized that behaviorally disordered children often exhibit minor neurological signs which are not always indicative of cerebral pathology. Many authors have divided these neurological soft signs into two groups (e.g., Rutter, 1977a). The first group consists of age-dependent signs, such as clumsiness, which are manifestations of developmental delay. Although these signs can be elicited reliably, their significance is obscure. The second type of sign includes mild abnormalities such as reflex asymmetries, choreiform movements, and nystagmus. These signs are difficult to detect reliably and are soft because of the subjective factors that play a role in the examiner's decision concerning their presence (Rutter, 1977a). Neurological soft

signs are useful indicators of a child's current maturational level, but they are unreliable as indicators of brain damage (Mikkelsen, Brown, Minichiello, Millican, & Rapoport, 1982).

Some investigators have reported that hyperactive children have a higher incidence of soft signs than normal control children (Mikkelsen et al., 1982; Werry et al., 1972; Wikler, Dixon, & Parker, 1970), while others have found a trend in the expected direction (Werry & Aman, 1976) or have reported no differences (Camp, Bialer, Press, Sverd, & Winsberg, 1978). It is important to note that many hyperactive children do not exhibit any neurological soft signs (Kenny et al., 1971) and that there is a substantial amount of overlap in the number of signs exhibited by hyperactive children and normal children (Werry & Aman, 1976).

Little information is available on the prevalence of neurological soft signs in children with conduct disorders. Lucas, Rodin, and Simpson (1965) administered neurological examinations to children placed in a special class because of behavior problems and/or learning difficulties. They reported a nonsignificant correlation between the presence of antisocial behavior as the chief complaint and any abnormality detected by the neurological examination.

A higher than normal incidence of neurological soft signs

has been reported in a variety of different patient populations including children with learning difficulties (Adams, Kocsis, & Estes, 1974), encopretics (Mikkelsen et al., 1982), and children with varied problems of adjustment (Kinsbourne, 1973). Since this is the case, it is unlikely that hyperactive and conduct disordered children will exhibit differences in the number of neurological soft signs. August and Stewart (1982) reported no differences in the number of soft signs between hyperactive children and hyperactives with associated aggressive conduct disorder. On the other hand, Sandberg et al., (1978) found that hyperactive children, selected on the basis of stringent British criteria, performed significantly worse on tests of sensorimotor coordination than children with conduct disorders. However, no one has compared the incidence of soft signs in these groups defined according to current North American diagnostic criteria.

To summarize, hyperactive children exhibit more neurological soft signs than age-matched normal controls. It is not known whether children with conduct disorders have a higher than normal incidence of soft signs, but it is likely given the general relationship between childhood psychiatric disorder and neurological soft signs. If this is the case, then these data would not support theories which suggest that

hyperactivity is caused by developmental lag in the maturation of the central nervous system (e.g., Kinsbourne, 1977), because such theories fail to note the higher than normal incidence of soft signs in other childhood psychiatric populations.

EEG Abnormalities. Since some EEG abnormalities are indicative of brain dysfunction, researchers have used the EEG to determine if neurological factors play an etiological role in childhood behavior disorders. Some investigators have reported a relatively high percentage of EEG abnormalities in groups of hyperactive children (Kenny et al., 1971; Klinkerfuss, Lange, & Weinberg, 1965), but the results of these studies are questionable because they did not include control groups and the EEG records were not evaluated under nonblind conditions. Controlled studies have yielded mixed results with some investigators reporting a higher frequency of EEG abnormalities in hyperactive children than in normal controls (Burks, 1960), while others have reported no significant differences (Werry et al., 1972; Wikler et al., 1970). Werry, Weiss, and Douglas (1964) found differences in the type of abnormality but not in the incidence of abnormality. There is a general consensus that the most common type of EEG abnormality found in hyperactive children is excessive slow wave activity; the significance of

which is highly uncertain.

Studies of children whose principal symptoms were temper tantrums, destructive behavior, aggressiveness, and antisocial behavior have found that the incidence of abnormal EEG records was between 50 and 60%, and excessive slowing of the EEG was the most frequent type of abnormality (Aird & Yamamoto, 1966; Small, 1968).

Although direct comparisons of the incidence of EEG abnormalities in hyperactives and conduct disordered children have not been carried out, the frequency and type of EEG abnormalities found in hyperactive children do not differ in number or in kind from those found in neurotics (Werry et al., 1972) or in a heterogeneous group of children referred to a psychiatric clinic (Wikler et al., 1970). Thus, it is unlikely that hyperactive and conduct disordered children will differ on these measures. Electroencephalography has been of limited help in solving diagnostic and etiological problems in abnormal child psychology because EEG abnormalities lack diagnostic specificity and because of the lack of a clear relationship between the type of EEG abnormalities frequently seen in these categories of patients and brain dysfunction.

Minor Physical Anomalies. Minor physical anomalies (MPAs) are developmental deviations of form, structure, or position

of the head, eyes, ears, mouth, feet, and hands. For a full description of MPAs and a method for scoring the presence and severity of these stigmata see Waldrop and Goering (1971).

MPAs are believed to result from genetic transmission or from some type of insult in the first weeks of pregnancy.

(Rapoport, Quinn, Burg, & Bartley, 1979). These congenital deviations are found in children with genetic disorders such as Down's syndrome, but they also occur, to a lesser extent, in the general population.

Hyperactive children have more MPAs than normal controls (Firestone, Lewy, & Douglas, 1976; Firestone, Peters, Rivier, & Knights, 1978; Firestone & Prabhu, 1983), and normal elementary school boys selected by their teachers as being the most hyperactive in their classes have more MPAs than boys selected as not being hyperactive (Waldrop & Goering, 1971). On the other hand, Mikkelsen et al. (1982) did not find a difference between hyperactives and normal controls in the number of MPAs. Quinn and Rapoport (1974) reported that the stigmata score was correlated with the Hyperactivity factor score of the Conners Teacher Rating Scale, but Firestone et al. (1976) did not find that these variables were related. This discrepancy is probably due to the fact that these investigators used subjects from different diagnostic categories. Although the patients of Quinn and Rapoport (1974) were referred for

hyperactive and/or distractible behavior, their subjects were diagnosed as hyperactive, unsocialized aggressive, or overanxious. Firestone and coworkers used samples of hyperactive children selected partly on the basis of having a Hyperactivity factor score greater than 1.5. Thus, it is likely that the relatively restricted range of factor scores attenuated the value of the correlation coefficient.

The incidence of MPAs in children with conduct disorders has not been investigated. However, MPAs were associated with scores on a factor reflecting peer aggression and impulsivity (Waldrop, Bell, McLaughlin, & Halverson, 1978).

To summarize, it is not known whether congenital etiological factors play a differential role in hyperactivity and conduct disorders. No differences were found in the number of MPAs in hyperactive boys with and without an associated conduct disorder (August & Stewart, 1982), nor were differences found between hyperactive or conduct disordered children selected on the basis of rating scale criteria and age-matched elementary school children (Sandberg et al., 1980). It is known that retarded children and their families as well as the families of hyperactive children have more MPAs than normal children and their families (Firestone et al., 1978). Diagnostic evaluations of the siblings of the hyperactive and retarded children were not carried out, but

informal conversations revealed that few required psychological treatment. Furthermore, children with other types of psychiatric disorders, such as autism, have an increased incidence of MPAs (Steg & Rapoport, 1975). Thus, it is clear that MPAs are not associated with specific behavioral symptoms, and the results obtained by Firestone and coworkers suggest only a weak relationship exists between MPAs and problem behavior.

Prenatal and Perinatal Complications. It has been known for many years that complications of pregnancy and birth can result in physical disabilities, but the evidence for congenital risk factors as etiological agents for behavior disorders is less clear. The influential work of Pasamanick and Knobloch (1960) helped to change the prevailing emphasis on psychological variables as causative factors in childhood behavior disorders. They suggested that minor dysfunctions of the central nervous system resulted in a range of deviant developmental outcomes which they referred to as a continuum of reproductive casualty. Their work also prompted investigators to determine if prenatal and perinatal factors played a role in the etiology of hyperactivity. Early work in this area produced both positive (Werry et al., 1964) and negative results (Stewart, Pitts, Craig, & Dieruf, 1966), but the data were collected from interviews with mothers, and the

reliability of information gathered by this method is questionable (Wenar, 1963). When data were obtained from hospital birth records, no differences were found between hyperactive and normal control children in the number or severity of pregnancy and birth complications (Minde, Webb, & Sykes, 1968).

A few investigators have examined the pregnancy and birth histories of diagnostically heterogeneous groups of delinquents. Prematurity and birth complications were more prevalent in the histories of incarcerated, violent delinquents than in normal controls (Lewis, 1980) and in the histories of hyperactive delinquents than in nonhyperactive delinquents (Offord, Allen, & Abrams, 1979). However, it is not clear whether these results can be generalized to children with conduct disorders, because groups of delinquents not only include conduct disordered children, but children with other significant problems as well as those who would not be diagnosed as having any type of psychiatric disorder.

No differences were found in the number of prenatal and perinatal complications between hyperactive and conduct disordered children selected on the basis of commonly used rating scale criteria (Sandberg et al., 1978; Sandberg et al., 1980). These studies used both the Conners Teacher and

Parent Rating Scales as well as a teacher questionnaire developed by Rutter (1967). However, when groups of hyperactive and conduct disordered children were selected by British psychiatrists on the basis of criteria outlined in the Ninth International Classification of Diseases (Rutter et al., 1975), hyperactive children had a higher incidence of perinatal complications than children with a conduct disorder (Sandberg et al., 1978). When considered in conjunction with other differences found between these diagnostic groups, these data provide support for the British concept of a less common syndrome of generalized overactivity. Using criteria compatible with North American diagnostic practice, August and Stewart (1982) reported no differences in the number of prenatal and perinatal complications between hyperactive boys with and without an associated conduct disorder.

Evidence from the major epidemiological studies of pregnancy and birth complications suggests that, with the exception of the prediction of severe disabilities such as mental retardation, the effects of prenatal and perinatal factors tend to wash out over time (Nichols & Chien, 1981; Werner & Smith, 1977). Several authors have pointed out that prenatal and perinatal stress factors account for only a small proportion of the variance in a variety of behavioral measures and have noted the relative importance of

psychosocial variables in predicting behavior problems (Rapoport & Ferguson, 1981; Sameroff & Chandler, 1975; Werner & Smith, 1977). Thus, it is not surprising that there is only a limited amount of evidence supporting the existence of a relationship between prenatal and perinatal complications and hyperactivity. We also would not expect to find that these factors play a differential role in the etiology of hyperactivity and conduct disorders. It should be pointed out, however, that a study examining this issue with the use of DSM-III diagnostic categories has not been carried out as yet.

Arousal Level. Several investigators have suggested that the behavior of hyperactive children is the result of abnormalities of either the tonic arousal level or the phasic responsivity of the central nervous system (CNS). According to some theorists (Freibergs & Douglas, 1969; Laufer, Denhoff, & Solomons, 1957), excessive activity and inattentiveness result from overarousal of the CNS due to overactive excitatory processes or underactive inhibitory processes. In this context, the beneficial effects of stimulant medication are thought to result from their paradoxically sedative action (Wender, 1971) or from an augmentation of cortical inhibitory processes (Laufer et al., 1957). On the other hand, underarousal theories also have

been proposed to explain the behavior of hyperactive children (e.g., Satterfield, Cantwell, & Satterfield, 1974). These theories typically implicate underactive excitatory processes as the cause of the low level of CNS arousal. It is thought that hyperactive children are highly active and engage in other types of stimulus-seeking behaviors in order to produce more comfortable levels of arousal or cortical activation. An attractive feature of these theories is that they account for the behavioral symptoms of hyperactive children as well as their apparently paradoxical response to stimulant drugs.

In the past 10 to 15 years numerous psychophysiological studies of hyperactive children have been conducted, and most of these studies either have compared phasic or tonic indices of arousal in hyperactive and normal children or have examined the effects of stimulant drugs on the arousal level of hyperactive children. Only a brief summary of this body of literature will be presented because it has been reviewed thoroughly by Ferguson and Pappas (1979), Hastings and Barkley (1978), and Rosenthal and Allen (1978).

In general, the results suggest that hyperactive children do not differ from normal children in resting levels of autonomic functions and that at least a subgroup of hyperactive children are underreactive to environmental stimulation, especially when they are required to pay

attention to signal stimuli in task situations. Although there are many conflicting findings with respect to the effects of stimulants on measures of arousal, the data suggest that these drugs affect measures of tonic arousal more than measures reflecting responsivity of the CNS. In fact, there are only a few studies which have reported that stimulants alter phasic measures of arousal. Thus, the underarousal hypothesis is supported by some of the empirical data which suggests that a subgroup of hyperactive children are underaroused.

The psychophysiological responses of groups of children with conduct disorders have not been studied, but there is a limited amount of evidence suggesting that antisocial adults and delinquents are autonomically underreactive to simple stimuli (Hare & Cox, 1978; Siddle, 1977; Siddle, Mednick, Nicol, & Foggitt, 1976; Siddle, Nicol, & Foggitt, 1973). It also has been reported that delinquents have slower electrodermal recovery times (Siddle et al., 1976). It should be pointed out, however, that it is not clear whether these results are generalizable to children with conduct disorders because delinquents comprise a heterogeneous population of adolescents. Many of these children would not be regarded as suffering from a psychiatric disorder while others have additional behavioral problems.

Quay (1965) has hypothesized that antisocial behavior is a consequence of an unpleasant affective state caused by lowered autonomic reactivity and that antisocial individuals engage in pathological stimulation-seeking behavior in order to reduce the discomfort resulting from this underaroused state. Although there is a limited amount of evidence supporting this hypothesis, underarousal hypotheses are weakened by their nonspecificity. That is, they fail to explain why hyperactive, inattentive, and impulsive behavior develops in some instances, while antisocial behavior results in other cases.

In summary, the results of psychophysiological studies suggest that a subgroup of hyperactive children are underaroused, and it has been hypothesized that antisocial children exhibit similar patterns of reactivity. Delamater and Lahey (1983) recently suggested that physiological differences previously attributed to hyperactivity may be associated with aggressive and antisocial behavior. They found that a mixed group of hyperactive and learning disabled children who scored high on the conduct problem dimension of the Conners Teacher Rating Scale had smaller skin conductance responses to simple tones and lower skin conductance levels than children who scored low on this scale. Further research on the psychophysiological correlates of these

disorders is needed to clarify the relationship between hyperactivity and conduct disorders.

Psychosocial Antecedents and Correlates

Very little research has been conducted on psychosocial factors that may cause hyperactive behavior. Block (1977) has suggested that hyperactivity is a cultural phenomenon resulting from an interaction between the child and the fast-paced tempo of modern industrialized society. Bettelheim (1973) argued that deficiencies in the parents' child-rearing skills, especially those of the mother, and a constitutional predisposition of the child to hyperactivity resulted in this type of behavior. Both of these theories have little empirical support, and they rarely are mentioned in the current literature. The fact that many investigators believe that there is a biological basis for hyperactivity undoubtedly has led them to concentrate their research efforts in these areas and to underestimate the possible influence of environmental factors and types of parent-child interactions on the development or maintenance of hyperactive behavior.

The results of studies which have examined the role of environmental variables on the expression of conduct disorders suggest that many of these variables including community and familial factors play a role in the development

of conduct disorders. Since this literature has been reviewed thoroughly by Bawden and Ferguson (1983), it will not be discussed here. Instead, studies which have compared the prevalence of environmental factors in the backgrounds of hyperactive and conduct disordered children will be reviewed in order to see if these groups can be distinguished on the basis of their psychosocial circumstances.

Sandberg and coworkers compared the psychosocial backgrounds of hyperactive and conduct disordered children referred to a psychiatric clinic (Sandberg et al., 1978). They used scores on the Conners Parent and Teacher Rating Scales to divide the children into low- and high-activity groups and found no differences between the groups in social class, number of broken homes, incidence of marital discord, or number of parents who were psychiatrically disturbed. Similar results were found when the subjects were divided into hyperactive or conduct disordered groups on the basis of clinical diagnoses by British psychiatrists. In fact, the only significant difference between the groups was the tendency of highly active children to come from families with three or more children at home. Furthermore, when normal school children were divided into hyperactive and conduct disordered groups on the basis of their scores on the Conners Rating Scales or on Rutter's Teacher Rating Scale, both

groups had a high social disadvantage index. These findings indicate that a high percentage of both groups of children came from broken homes and their families had low socioeconomic status (Sandberg et al., 1980). In addition, the mothers of both groups of children scored highly on the Malaise Inventory which measures mental distress. Taken together, these findings indicate that the psychosocial backgrounds of hyperactive and conduct disordered children are similar, at least when these groups of children are selected on the basis of rating scale scores or diagnoses by British psychiatrists.

Stewart and coworkers have extended these results by selecting hyperactive and conduct disordered children not just on the basis of rating scale data, but by selecting them on the basis of this type of data, by looking for the presence of symptoms of these disorders as reported by the parents during a structured psychiatric interview, and by the clinical diagnoses made by staff psychiatrists (August & Stewart, 1982; Stewart et al., 1981). This method of combining data collected in different ways from more than one source is more typical of the ways in which North American researchers select hyperactive subjects than is the method used by Sandberg and colleagues. There were no differences between hyperactive children, conduct disordered children,

and a mixed group of children who fulfilled the diagnostic criteria for both of these disorders in socioeconomic status, ordinal position of the proband, and number of siblings in the home (Stewart et al., 1981). August and Stewart (1982) compared hyperactives with a mixed group of hyperactive and conduct disordered children and did not find any differences in the marital status, occupational status, or level of educational attainment, by the parents.

In summary, no differences have been found in the psychosocial backgrounds of hyperactive and conduct disordered children. Furthermore, hyperactive and nonhyperactive delinquents could not be distinguished on the basis of their family backgrounds (Offord, Sullivan, Allen, & Abrams, 1979). These data do not support the position that separate diagnostic categories should be used for hyperactive and conduct disordered children. However, it is possible that the psychosocial variables, such as socioeconomic status or number of siblings in the home, that have been examined are too crude to be specifically related to only one group and that more sensitive dependent measures such as types of parent-child interactions might reveal consistent differences between the groups.

Natural History

Another potentially useful way of determining if one

should distinguish between behavior disorders is to follow over time groups of children meeting the diagnostic inclusion criteria to see if they have differential outcomes.

Many of the follow-up studies of hyperactive children have been conducted by a group of investigators in Montreal. They followed into adulthood a cohort of children who were overly active both at home and in school at the time of initial referral. They found that the target symptoms of the probands diminished in intensity, but their behavior was in many respects more problematic than that of a normal control group matched for age, sex, socioeconomic status, and IQ (Minde et al., 1971; Minde, Weiss, & Mendelson, 1972; Weiss, Kruger, Danielson, & Elman, 1975; Weiss, Minde, Werry, Douglas, & Nemeth, 1971). As adolescents, the hyperactive children had difficulty sustaining attention, were fidgety, and were judged to be immature and lacking in self-esteem; however only 25% exhibited antisocial behavior (Hoy, Weiss, Minde, & Cohen, 1978; Minde et al., 1972; Weiss, Minde, Werry, Douglas, & Nemeth, 1971; Weiss et al., 1975). They continued to have difficulty in school, were doing poorly in all academic subjects, and the majority had failed a grade (Minde et al., 1971). As young adults, the probands exhibited symptoms, such as impulsiveness and restlessness, which are characteristic of the hyperkinetic child syndrome,

but they did not differ from a normal control group in job status and their employers were satisfied with their performance (Weiss, Hechtman, & Perlman, 1978; Weiss, Hechtman, Perlman, Hopkins, & Wener, 1979). Use of inefficient cognitive strategies persisted into adulthood. Adult hyperactives were more field dependent, more easily distracted by irrelevant stimuli, and less able to inhibit incorrect verbalizations and to correctly choose an alternative in a situation of high response uncertainty than matched controls (Hopkins, Perlman, Hechtman, & Weiss, 1979). They also had social skills deficits and scored lower than matched controls on a number of self-esteem tests (Hechtman, Weiss, & Perlman, 1980), but they did not differ from controls in self-ratings of psychopathology (Weiss et al., 1978). Few of the probands exhibited serious antisocial behavior, and they did not differ from controls in the number of court referrals (Weiss et al., 1979).

Generally speaking, the results of other follow-up studies (Mendelson, Johnson, & Stewart, 1971; Riddle & Rapoport, 1976; Stewart, Mendelson, & Johnson, 1973) are consistent with those reported by the Montreal investigators. One important difference is that Mendelson et al. (1971) reported a higher rate of antisocial behavior in their probands.

The other major series of follow-up studies has been carried out by Loney and her colleagues in Iowa. Initially, they performed a factor analysis on a variety of measures of hyperactive symptomatology and found two relatively independent behavioral dimensions which they labelled as Aggression and Hyperactivity (Langhorne et al., 1976; Loney et al., 1978). They then performed a series of multiple regression analyses in order to find predictors of adolescent outcome. The Aggression factor, socioeconomic status, and paternal autonomy-to-control, but not the Hyperactivity factor, made a significant contribution to symptom variation at follow-up (Loney, Langhorne, Paternite, Whaley-Klahn, Blair-Broeker, & Hacker, 1980). More aggressive, lower SES boys who had less controlling fathers tended to have more severe symptoms at follow-up. Although the degree of hyperactive symptomatology at referral was not related to adolescent behavioral outcome, it was predictive of academic achievement (Loney et al., 1980). Further analyses revealed that an indicator of aggressivity at referral was the single best predictor of aggressive and hyperactive symptomatology at follow-up (Paternite & Loney, 1980). Langhorne and Loney (1979) found that the degree of aggression at referral, but not the degree of hyperactivity, predicted self-esteem deficits in adolescence. Thus, as Milich and Loney (1979)

have pointed out, it is possible that the widely reported self-esteem deficits of hyperactive adolescents may not be the result of their hyperactivity but rather a consequence of their aggressivity. These findings indicate that the level of aggression, a so-called secondary symptom, as well as a type of family interaction related to aggression are significant predictors of adolescent outcome. This series of studies points out the crucial importance of distinguishing between hyperactive and aggressive symptomatology because each makes independent contributions to the prediction of outcome of hyperactive children. The obvious implication is that we should continue to distinguish between hyperactive children and children with conduct disorders.

Laufer (1971) followed a group of hyperactive children who were treated with stimulants for varying periods of time and reported a good outcome for most subjects. Little confidence can be placed in these results because self-report methodology was used, and thus the results are of unknown reliability. In addition, one third of the former patients did not respond to his questionnaire. It is possible that the nonrespondents had more unfavorable outcomes than those who filled out the questionnaire.

Menkes, Rowe, and Menkes (1967) conducted a retrospective follow-up study on the adult functioning of individuals who

were identified as hyperactive or learning disabled with the use of clinic records. As adults, many of the probands had signs of neurological dysfunction, and over a quarter of the subjects were diagnosed as psychotic. These results are not congruent with those reported by other investigators, and it is likely that their method of retrospectively diagnosing hyperactivity led to the selection of an atypically severely disturbed sample. In addition, at the time when these probands were children the diagnosis of hyperactivity rarely was used. The practice of retrospectively diagnosing a condition which was not part of the prevailing psychiatric nomenclature also was used by Borland and Heckman (1976), and their results also are of questionable validity.

Schuckit et al. (1978) conducted a retrospective follow-up study of hyperactive children who required help for psychiatric problems or drug abuse as young adults. They reported a pessimistic outcome as many of the children had a variety of psychiatric problems or exhibited antisocial behavior. It is somewhat ironic that the authors were critical of the diagnostic concept of hyperactivity, and yet they used vague subject selection procedures. Not only was the presence of hyperactive symptoms determined on a retrospective basis, but some subjects were diagnosed as hyperactive by school personnel. No information on who made

the diagnosis and on what basis it was made were presented. Thus, these results are suspect, and they are not consistent with the findings of the prospective studies.

Children with conduct disorders have a poorer adult prognosis than children suffering from any other childhood psychiatric disorder with the exception of a childhood psychosis (Offord & Waters, 1983; Robins, 1979). Aggressive behavior in childhood, especially when accompanied by school failure, is associated with delinquency in adolescence (Conger & Miller, 1966; Havighurst, Bowman, Liddle, Matthews, & Pierce, 1962; Robins, 1970). For example, in a retrospective study Conger and Miller (1966) found that future delinquents exhibited more antisocial behavior than controls and were less well liked and less accepted by their peers during their early years in public school. In the British National Survey, children who were subsequently adjudicated as delinquent disobeyed teachers, quarreled and fought, and played truant (Mulligan, Douglas, Hammond, & Tizard, 1963). All of these childhood behaviors typically are exhibited by children with conduct disorders.

Robins (1966) conducted a landmark follow-up study on a large sample of children referred to a child guidance clinic because of severe antisocial behavior. Most of these children would certainly qualify as having a conduct

disorder. She found that over a third of the boys who exhibited persistent antisocial behavior experienced serious psychosocial difficulties including sociopathy, criminality, alcoholism, drug abuse, marital disruption, poor work record, poor health, and financial dependency in adult life.

In fact, there were increased rates of problem behavior along almost every dimension of adult adjustment. Childhood aggression and adult sociopathy were rare in girls, and there was not an association between them. The results for boys have been replicated in retrospective follow-up studies of young black men and Vietnam veterans (Robins, 1978). These latter studies are not as impressive as the earlier work of Robins because information on the childhood behavior of the subjects was obtained from interview and school records. Thus, the information was less complete and of unknown reliability. In all of her studies, Robins (1978) found that the variety of antisocial behavior in childhood was a better predictor of adult antisocial behavior than was any particular childhood behavior. This is an encouraging finding because current diagnostic practice requires that a child exhibit several types of aggressive or antisocial behavior before being diagnosed as conduct disorder.

To summarize, follow-up studies of hyperactive children have shown that the cardinal symptoms of impulsivity and

inattention persist into adulthood and that the extreme degree of restlessness exhibited in childhood is often manifested as fidgetiness in later years. Although hyperactive symptomatology leads to poor academic performance and behavioral difficulties in the school setting, the evidence apparently indicates that these behaviors constitute less of a handicap when the subjects leave school. Approximately 20 to 25 percent of hyperactive children will exhibit aggressive and antisocial behavior in adolescence and adulthood. It has been reported in both major series of prospective follow-up studies of hyperactive children that ratings of aggressive behavior at referral were related to antisocial behavior at follow-up (Loney et al., 1980; Weiss, Minde, Werry, Douglas, & Nemeth, 1971). It may be that these aggressive individuals would have satisfied the diagnostic criteria for both hyperactivity and conduct disorder at referral. Thus, it would be quite useful to follow over time cohorts of hyperactive, conduct disordered, and mixed hyperactive-conduct disordered children to see if they have differential outcomes. Although most children with conduct disorders do not become antisocial adults, a sizeable minority become delinquent and exhibit a wide variety of antisocial behaviors as adults. At the present time, then, the evidence suggests that children with conduct disorders

have a poorer prognosis than hyperactive children. Further research is needed to confirm these findings, but at the present time it would be prudent to continue to distinguish these disorders because they have different consequences.

Response to Treatment

Differential responsiveness to a specific treatment could prove to be a valuable way of distinguishing between children with conduct disorders and children with attention deficit disorders. The three most common forms of treatment used for children with attention deficit disorders are behavior therapy, stimulant medication, and to a much lesser extent, special diets. Behavioral therapies will not be discussed because they are nonspecific in the sense that they are effective in controlling a wide variety of problem behaviors and typically are individualized in order to accomplish this task. The use of special diets also will not be discussed because this form of treatment is effective only for a small minority of hyperactive children (Conners, 1980). The most common form of medical treatment for hyperactivity is the use of stimulant drugs, especially methylphenidate. A brief review of the behavioral and cognitive effects of the stimulants on children with attention deficit disorders will be presented followed by a discussion of the evidence pertaining to the diagnostic nonspecificity of a favorable stimulant drug response. Since there is little information in the literature on the cognitive and behavioral effects of stimulants on children with conduct disorders, discussion of

these findings will be confined to the section on the diagnostic nonspecificity of a favorable stimulant drug response.

Effects of Stimulants on Activity

At first glance the results of studies of stimulant drug effects on motor activity appear to be somewhat inconsistent. These conflicting findings are due to methodological weaknesses in some of the studies and to the variety of instruments and procedures that have been used to measure several different kinds of activity. Actometers have been used to assess limb movement, stabilimetric cushions have been used to assess seat movement, pedometers and ultrasonic generators have been used to measure locomotor activity, and human observers have assessed levels of locomotor activity and more specific behaviors such as out of seat and away from table.

There are several problems with mechanical and electronic methods of measuring activity level. Ultrasonic generators and stabilimetric cushions typically are used in laboratory settings and are unsuitable for naturalistic studies. In addition, the cost and complexity of ultrasonic generators has limited their use. Actometers are modifications of self-winding wristwatches and are more sensitive to acceleration and deceleration of limb movements than they are to the amount of distance travelled (Johnson, 1971). Another drawback is that they are only sensitive to movements in a

plane parallel to their face (Johnson, 1971; Werry, 1978). Not only has their reliability been questioned, but it also has been claimed that they do not record slow movements (Johnson, 1971). Since these devices measure different kinds of activity, it is not surprising that their intercorrelations are at best modest (Barkley & Ullman, 1975).

The results of experiments which have examined the effects of stimulants on objective measures of activity in hyperactive children are summarized in Table 1. Generally speaking, stimulants reduce activity levels of hyperactive children in structured situations, such as the classroom or laboratory, where the child is required to perform a cognitive task. Decreases in wrist, ankle, and seat movements have been documented in these settings (Barkley, 1977; Christensen & Sprague, 1973; Porrino, Rapoport, Behar, Ismond, & Bunney, 1983; Rie, Rie, Stewart, & Ambuel, 1976a, 1976b; Sprague, Barnes, & Werry, 1970; Werry & Aman, 1975). However, there are a few studies which have reported negative results. Schleifer et al. (1975) reported that methylphenidate did not reduce the number of times a child got out of his seat or moved away from his table, but these behaviors occurred so infrequently that there was little room for improvement. In addition, their subjects were

Table 1

The Effects of Stimulant Drugs on Activity Levels in Hyperactive Children

Author(s) & Year	No. of Subjects	Drug ^a	Dose	Setting	Measuring Device	Type of Activity	Results
Millichap & Boldrey (1967)	4	M	.25-.5	Hospital	Actometer	Wrist	Increase
Millichap, Avnat, Sturgis, Larsen, & Egan (1968)	30	M	.3-2.3 mg/kg	Laboratory	Actometer	Wrist	No Effect
Sprague, Barnes, & Werry (1970)	12	M	.25 & .35 mg/kg	Laboratory Classroom	Stabilimetric Cushion Observer	Seat Out of Seat	Decrease No Effect
Rapoport, Abramson, Alexander, & Lott (1971)	19	D	10 mg	Playroom	Observer Pedometer	Locomotor Locomotor	Decrease No Effect
Christensen & Sprague (1973)	12	M	.3 mg/kg	Classroom	Stabilimetric Cushion	Seat	Decrease
Ellis, Witt, Reynolds, & Sprague (1974)	29	M	.1, .3 & 1.0 mg/kg	Cymnasium	Filmed Observations	Locomotor	No Effect
Schleifer, Weiss, Cohen, Elman, Gvejjic, & Kruger (1975)	26	M	2.5-20 mg	Nursery School	Observer	Off Chair Without Leaving Table Away from Table	No Effect No Effect No Effect
Montagu & Swarbrick (1975)	6	D, L	10 mg/m ² -10 mg	Playroom	Ultrasonic Generator Pressure Floor Mats	Total Body Locomotor	Decrease/No Effect ^b Decrease/No Effect ^b
Werry & Aman (1975)	24	M	.3 mg/kg	Laboratory	Stabilimetric Cushion	Seat	Decrease/No Effect ^c
Rie, Rie, Stewart, & Ambuel (1976a,b)	28	M	5-40 mg	Laboratory	Actometer	Wrist Ankle	Decrease No Effect

Table 1 continued

Author(s) & Year	No. of Subjects	Drug	Dose	Setting	Measuring Device	Type of Activity	Results
Barkley (1977)	18	M	10 mg	Playroom	Observer	Locomotor	Decrease
				"Free Play"	Actometer	Wrist	Decrease
						Ankle	Decrease
				Playroom	Observer	Locomotor	No Effect
				"Restricted Play"	Actometer	Wrist	Decrease
						Ankle	Decrease
Barkley & Cunningham (1979b)	14	M	X=10.2 mg	Laboratory	Actometer	Wrist	Decrease
						Ankle	Decrease
					Stabilimetric	Wrist	Decrease
					Cushion	Ankle	Decrease
Rapoport, Tepsic, Grice, Johnson, & Langer (1980)	10	D	.5 mg/kg	Gymnasium	Actometer	Wrist	Decrease
					Observer	Ankle	No Effect
						Locomotor	No Effect
Porrino, Rapoport, Behar, Ismond, & Runney (1983)	12	D	5-15 mg .23-.75 mg/kg	Gymnasium	Pedometer	Locomotor	Decrease
					Pedometer	Locomotor	Mixed ^d

^a M-methylphenidate, D-dextroamphetamine, L-levamphetamine.

^b Levoamphetamine decreased activity whereas dextroamphetamine had no effect.

^c They found a decrease in activity when their subjects performed a short-term recognition memory task but not during a continuous performance task.

^d Activity decreased in the classroom but not at home, and increased during physical education classes.

hyperactive preschoolers, and it is not yet clear if stimulants are as effective with this population as they are with older hyperactives. Sprague et al. (1970) also used an unusual subject sample. Most of their subjects were described as hyperactive and distractible, but some were characterized as extremely shy and socially withdrawn. It is unlikely that these introverted subjects exhibited a high rate of out of seat behavior in either the placebo or drug conditions. Thus their failure to find a stimulant-induced decrease in out of seat behavior was probably due to their mixed subject sample.

Millichap, Aymat, Sturgis, Larsen, and Egan (1968) conducted a controlled clinical trial of the effects of methylphenidate on motor activity while their subjects performed a number of neuropsychological tests. They found that methylphenidate tended to reduce wrist movements of the nondominant arm during performance on the test battery, but the results just failed to reach significance. Their report had one serious deficiency in that no information was provided on the amount of time that elapsed between administration of the medication and testing. Since methylphenidate and its active metabolites have a short half-life (Shaywitz et al., 1982), it is possible that they tested their patients after methylphenidate had exerted its

maximal effects.

Rie et al. (1976a, 1976b) and Werry and Aman (1975) reported mixed results. Rie et al. (1976a, 1976b) reported that methylphenidate significantly reduced arm movement and tended to reduce leg movement. Werry and Aman (1975) found that methylphenidate reduced seat movement on a memory task but not on a continuous performance task (CPT). They noted that movement was confounded with the appropriate act of responding on the CPT and used this fact to explain their negative results. It is unlikely that this confound was the reason because the difference between the methylphenidate and placebo conditions in the number of errors of omission was similar to the number of errors of commission. Thus, their failure to find the expected decrease in seat movement in the methylphenidate condition was not produced by more appropriate levels of responding in this condition. It is not clear why they obtained negative results.

Stimulants also have been found to reduce activity in less structured situations, such as playrooms in which the child is provided with toys (Barkley, 1977; Montagu & Swarbrick, 1975; Rapoport, Abramson, Alexander, & Lott, 1971). Stimulant-induced reductions in activity have been reported for free play periods as well as for restricted play periods in which the child was instructed to remain in one

part of the room and play with only one toy (Barkley, 1977). Montagu and Swarbrick (1975) reported that levoamphetamine, but not dextroamphetamine, reduced locomotor activity and total motor activity in the playroom setting. However, dextroamphetamine tended to reduce activity, and it is likely that they would have obtained significant results if they had used a larger sample size.

When one examines the effects of stimulants on activity in situations such as a gymnasium where normal children typically exhibit high levels of gross motor activity, the results are equivocal. Ellis, Witt, Reynolds, and Sprague (1974) reported that a fairly high dose of 1.0 mg/kg of methylphenidate had no effect on locomotor activity of hyperactive children in a playroom equipped with climbing equipment. Barkley and Cunningham (1979b) found that methylphenidate did not reduce locomotor activity in a physical therapy gymnasium. However, stimulants did reduce wrist, but not ankle, movements. Finally, Rapoport and coworkers found that dextroamphetamine reduced locomotor activity during physical education periods in one study, but they found opposite effects in a later study (Porrino et al., 1983; Rapoport, Tepsic, Grice, Johnson, & Langer, 1980). It is difficult to determine the reasons for the discrepancy in the results because these studies differed with respect to a

number of methodological features. They differed in the type of stimulant that was administered and in the length of time between drug administration and data collection. Dosages of the different stimulants also varied widely, and some investigators used individually titrated doses making it impossible for other investigators to replicate their experiments. In addition, differences in settings ranged from playrooms with climbing equipment (Barkley & Cunningham, 1979b; Ellis et al., 1974) to a basketball court (Rapoport, Tepsic, Grice, Johnson, & Langer, 1980), and it is likely that types of activity varied across situations. In any event, a number of different measures of activity were used in these studies. It is clear that investigators should pay more attention to these variables in future studies. The types of behaviors exhibited by hyperactive children in these settings should be fully specified, and a number of different measures should be recorded in each future study so that it can be determined if the studies are truly comparable.

To summarize, stimulants reduce the activity levels of hyperactive children in structured situations, such as the classroom, as well as in less structured situations, such as playrooms. At the present time, it is not clear whether stimulants reduce activity levels in settings such as gymnasiums where high activity levels are the norm. It should be noted that an increase in activity levels in free

play settings would be expected as a result of an increase in on task behavior. For example, hyperactive children on medication might become more involved for a longer period of time in a particular sporting activity such as a basketball game.

Effects of Stimulants on Social-Adaptive Behavior

It is widely recognized that stimulant therapy results in an overall improvement in the behavior of most hyperactive children. Several relatively specific behavioral improvements have been documented using direct observational methods as well as standardized rating scales. Because of their simplicity in administering and scoring, low cost, and data reducing capacity, rating scales are probably the most frequently used measure in drug research with hyperactive children. However, there are problems with their use. A few investigators have published scales without adequately investigating their reliability (Davids, 1971; Werry, Weiss, Douglas, & Martin, 1966). In addition, the scales are usually interpreted as if they measure what they claim to measure, but there is usually little information on the relationship between the scale or its factors and empirical correlates of the same constructs. Some scales are susceptible to practice or regression effects (see Milich, Roberts, Loney, & Caputo, 1980), but this problem can be overcome with an adequate experimental design. There also is

the possibility of "halo" effects; rating a child who shows any improvement as improved across all areas. This is not a problem if the Conners scales are used because specific changes in behavior as a consequence of stimulant drug treatment have been documented with these scales (Arnold, Wender, McCloskey, & Snyder, 1972; Gittelman-Klein, Klein, Katz, Saraf, & Pollack, 1976; Rapoport, Quinn, Bradbard, Riddle, & Brooks, 1974; Schleifer et al., 1975).

The Conners Teacher and Parent Questionnaires (CTQ and CPQ) are the rating scales used most frequently in assessing stimulant drug effects. The CTQ consists of the following five orthogonal factors: Hyperactivity, Conduct Disorder, Daydreaming-Inattention, Anxiety, and Sociability (Conners, 1973). The CTQ Hyperactivity factor consistently has been shown to improve with stimulant drug treatment, and the Conduct Disorder and Daydreaming-Inattention factors frequently showed improvement as well, while the Anxiety and Sociability factors typically have not been affected (e.g., Arnold et al., 1972; Gittelman-Klein et al., 1976; Rapoport et al., 1974; Schleifer et al., 1975). Not all of the six items comprising the Hyperactivity factor are related to excessive activity. Some of the items on this factor such as "Teases other children" and "Hums and makes other odd noises", as well as the items loading on the Conduct Disorder

factor, reflect socially inappropriate and disruptive behavior.

The CPQ is a 93 item checklist of symptoms commonly associated with behavior disorders of childhood. A factor analysis of the scale produced eight orthogonal factors: Conduct Problem, Anxiety, Impulsive-Hyperactive, Learning Problem, Psychosomatic, Perfectionism, Antisocial, and Muscular Tension (Conners, 1970). The CPQ has been less successful detecting changes in behavior resulting from the administration of stimulant drugs than the CTQ. A few investigators have reported decreases on the Impulsive-Hyperactive factor (e.g., Conners, Rothschild, Eisenberg, Stone, & Robinson, 1969; Rapoport et al., 1974), but the rest of the factors have not proven to be consistently sensitive to stimulant-induced changes in the behavior of hyperactive children (see Conners et al., 1969; Gittelman-Klein et al., 1976; Knights & Viets, 1975; Rapoport et al., 1974). Items loading on the Impulsive-Hyperactive factor are concerned with excessive activity, impulsive actions, or inattention.

Much less research on the behavioral effects of stimulants has been carried out with other rating scales. The Werry-Weiss-Peters Activity Scale consists of seven categories, five for activity occurring in specific contexts,

such as at mealtime or while watching television, and two for more general areas of activity such as behavior away from home. The senior developer of this scale has claimed that it is more a measure of various kinds of socially unacceptable motor behavior than of activity level per se (Werry, 1978). Stimulant-induced decreases in activity have been documented with the use of this parent-rating scale (Conners & Rothschild, 1968; Knights & Hinton, 1969; Zahn, Abate, Little, & Wender, 1975). However, it is important to point out that there is little information on the psychometric properties of this scale.

Dauids (1971) developed a rating scale for assessing the specific traits and behaviors of prime importance in hyperkinesis. Although the psychometric properties of this scale have not been fully investigated, a few investigators have used it and found that teachers and parents rated hyperactive children on stimulant medications as exhibiting milder symptoms of hyperkinesis (Arnold et al., 1976; Denhoff, Davids, & Hawkins, 1971).

The Peterson-Quay Behavior Problem Checklist has not proven sensitive to behavioral changes produced by stimulant drugs (Knights & Hinton, 1969; Millichap et al., 1968). Others have developed their own behavior rating scales and have reported on their sensitivity to stimulant drug effects.

For example, Rie et al. (1976a, 1976b) found that both parents and teachers rated hyperactive children receiving methylphenidate as less active, more attentive, and also as achieving more in their school work.

Direct behavioral observations also have been used in the assessment of stimulant drug effects partly as a result of the limitations of rating scales. The advantage of this type of measure are objectivity, freedom from observer bias, and relevance to the hyperactive child's problems. In general, results of studies using behavioral observations of hyperactive children in the home, classroom, or during performance of laboratory tasks have confirmed the results of studies which have used behavioral rating scales to assess stimulant drug effects

On medication, hyperactive children are less distractible, less noisy, more cooperative, engage in fewer negative interactions and negative verbalizations with family and peers, and spend more time working on their classroom assignments (Gittelman-Klein et al., 1976; Rapoport et al., 1974; Sprague et al., 1970; Whalen, Henker, Collins, Finck, & Dotamoto, 1979; Whalen, Henker, & Finck, 1981). Thus, studies which have used behavioral observation methods to assess stimulant drug effects indicate that disruptive behavior is reduced by these drugs. However, behavioral

observation methods have not been as successful in detecting drug effects as rating scales (Cantwell & Carlson, 1978).

One of the reasons for this deficiency is the cost and logistical difficulties of sampling behavior which is representative of the child's everyday activities. Although the typical observation categories appear to be appropriate in terms of behavioral domain and bandwidth, there is the possibility that the behaviors which provoke adult concern may be relatively infrequent but highly salient (Whalen, Henker, Collins, Finck, & Dotemoto, 1979). Despite these disadvantages there are some potentially useful procedures being developed which could be used in the assessment of medication effects in the classroom (e.g., Abikoff, Gittelman-Klein, & Klein, 1977; Jacob, O'Leary, & Rosenblad, 1978; Whalen, Henker, Collins, Finck, & Dotemoto, 1979).

Studies using rating scales and direct behavioral observations have shown that stimulant drugs affect the social interactions of hyperactive children. These positive findings have led investigators to examine these effects in more detail. Stimulant drug effects on the interactions of hyperactive children with their mothers, teachers, and peers will be reviewed.

The effects of stimulants on mother-child interactions during free play as well as during performance of specific

tasks requiring cooperation for successful completion have been studied. Mothers became less controlling, less intrusive, and gave more praise and less criticism when their sons were on methylphenidate than when they were on placebo (Humphries, Kinsbourne, & Swanson, 1978). Using a more detailed behavioral coding system, Barkley and Cunningham (1979a) and Cunningham and Barkley (1978) have documented similar changes in response to methylphenidate treatment. They also found that medication effects were more pronounced during performance of structured tasks than free play periods (Barkley, Karlsson, Pollard, & Murphy, 1985; Barkley, Karlsson, Strzelecki, & Murphy, 1984). Methylphenidate improved the frequency and duration of compliance of hyperactive children to their mother's commands. As a result, mothers decreased the frequency of their commands and increased the frequency of positive interactions with their child. These latter effects occurred only with moderately high doses (0.5 and 0.7 mg/kg). The effects of Ritalin on parent-child interactions were not a function of age, and the medication tended to normalize these interactions (see Cunningham & Barkley, 1979). The findings of these recent studies did not support their previous contention that stimulants reduce the sociability of hyperactive children (Barkley & Cunningham, 1979a).

Whalen and coworkers have examined the effects of

stimulant medications on teacher-child interactions during a summer school research program (Whalen, Henker, & Dotemoto, 1980, 1981). The teacher was less intense and controlling when the hyperactive children were on methylphenidate than when they were on placebo. When the hyperactive boys were taking placebo, their names were called by the teacher more frequently than when they were taking methylphenidate (Whalen, Henker, & Finck, 1981). There were no differences in teacher behaviors between the medicated hyperactive group and a normal comparison group suggesting that medication normalized teacher-pupil interactions. These important findings indicate that the impact of medication extends beyond the individual hyperactive child to affect the behavior of the classroom teacher. However, these results need to be replicated as the entire data set focused on the behavior of only one teacher and the classrooms contained an unusually high ratio of hyperactive to normal children. It is tempting to conclude that stimulants lead to changes in child behaviors which then lead to changes in teacher behaviors. After this sequence is initiated, bidirectional effects would be expected as the hyperactive child and teacher continue to engage in complex interactions. Although beneficial effects of methylphenidate on the classroom behavior of hyperactive children have been documented by

these investigators (Whalen, Henker, Collins, Finck, & Dotemoto, 1979), such a conclusion would be premature because conditional probabilities were not calculated and sequential behavioral analyses were not carried out.

It is worth noting that the literature is inconsistent with respect to the question of whether stimulants reduce the sociability of hyperactive children in the classroom. Sprague et al. (1970) reported that methylphenidate increased the frequency of pupil-initiated teacher contacts, whereas Whalen, Henker, Collins, Finck, and Dotemoto (1979) found that methylphenidate reduced the frequency of social initiations to a level comparable to that of normal control boys. The reason for the discrepancy is not clear as these studies differed with respect to several methodological features including subject selection criteria, drug dosage, classroom environment, and definition of the behavioral categories.

The effects of stimulants on peer interaction patterns have been studied to a much lesser extent. Whalen and coworkers have focused on the behavioral styles of hyperactive and normal children while they performed a small group consensus-seeking task (Whalen, Henker, Dotemoto, Vaux, & McAuliffe, 1981). Methylphenidate significantly increased task involvement, produced a mild dysphoria, and decreased positive affect as well as the intensity of the hyperactive

children's actions. These latter two findings also have been reported in a dyadic communication game in which a child had to relay messages regarding construction of a block design to another child (Whalen, Henker, Collins, McAuliffe, & Vaux, 1979). In the latter situation methylphenidate appeared to have a greater effect on behavioral style than on communicative competence.

Despite the fact that satisfactory peer relations are considered to be crucial for normal development, there is a surprising lack of empirical data on the peer interactions of hyperactive children (see Campbell & Paulauskas, 1979; Pelham & Bender, 1982). Since hyperactive and conduct disordered children typically are referred for treatment because they have come into conflict with their social environment, it seems clear that additional research should be conducted in this area from both a research and treatment perspective.

To summarize, studies which have used standardized rating scales or direct behavioral observations clearly have shown that stimulants reduce the inattentive, impulsive, disruptive, and socially inappropriate behavior of hyperactive children. Stimulant drugs improve the quality of hyperactive children's interactions with teachers, parents, and peers, but they may also reduce the frequency and intensity of social interactions. Additional research

including dose-response analyses of these social effects is warranted.

Effects of Stimulants on Cognition

In the past fifteen years the effects of stimulant drugs on cognitive processes of hyperactive children have been studied extensively. This literature has been divided into subsections on the basis of the construct or group of constructs that were examined. The order of the subsections is a rough indication of the level of the cognitive process with later subsections reflecting higher cognitive processes. The effects of stimulants on attention will be discussed first, and then subsections on paired-associate learning, state-dependent learning, memory, intelligence, and academic achievement follow.

Attention. A variety of tests have been used to measure stimulant drug effects on various attentional constructs. Attention span is the aspect of attention that has been measured most frequently, often with the use of the Continuous Performance Test. Other tests used to assess aspects of attention have included measures of reaction time, the Porteus Mazes, and the Matching Familiar Figures Test. Obviously, these tests measure other psychological functions in addition to aspects of attention, but it has been argued that they contain a common source of variance which can be

labeled as attention span (Douglas, 1972; Douglas & Peters, 1979). In order to apply perceptual search strategies which are necessary for successful performance on the Porteus Mazes and the Matching Familiar Figures Test, the hyperactive child must be able to sustain his attention and inhibit impulsive responding. In other words, Douglas and Peters (1979) have suggested that processes tapped by vigilance tasks are necessary for optimal performance of purposeful, organized perceptual search strategies.

Table 2 summarizes the results of studies which have examined the effects of stimulants on the performance of hyperactive children on these tasks. With respect to the Continuous Performance Test, the majority of investigators have found that stimulants reduce the number of errors of omission and commission (Conners, 1972; Michael, Klorman, Salzman, Borgstedt, & Dainer, 1981; Rapoport, Buchsbaum, et al., 1980; Sykes, Douglas, & Morgenstern, 1972; Sykes, Douglas, Weiss, & Minde, 1971; Werry & Aman, 1975; Werry, Aman, & Diamond, 1980). Only Conners, Taylor, Meo, Kurtz, and Fournier (1972) reported that methylphenidate and pemoline did not affect performance on this vigilance task. Sostek, Buchsbaum, and Rapoport (1980) used signal detection theory to analyze the vigilance performance of hyperactive and normal children and the effects of dextroamphetamine on their

Table 2

The Effects of Stimulant Drugs on Measures of Attention in Hyperactive Children

Author(s) & Year	Drug ^a	Dose	Use of Placebo	Double -Blind	Design ^b	Results
Continuous Performance Task						
Conners & Rothschild (1968)	D	15-25 mg	Yes	Yes	Uncrossed	↓ errors of omission, commission
Sykes, Douglas, Weiss, & Minde (1971)	M	?	Yes	Yes	Uncrossed	↓ errors of omission, commission
Conners (1972)	M D	10-30 mg 5-15 mg	Yes	Yes	Uncrossed	↓ errors of omission, commission ↓ errors of omission, commission
Conners, Taylor, Hen, Kurtz, & Fournier (1972)	D P	5-40 mg $\bar{X}=20$ mg 25-125 mg $\bar{X}=82$	Yes	Yes	Uncrossed	no effect no effect
Sykes, Douglas, & Morgenstern (1972)	M	10-100 mg $\bar{X}=57$ mg	Yes	Yes	Crossed	↓ errors of omission, commission
Werry & Aman (1975)	M	.3 mg/kg	Yes	Yes	Crossed	↓ errors of omission, commission
Rapoport, Buchsbaum, Weingartner, Zahn, Ludlow, & Mikkelsen (1980)	D	.5 mg/kg	Yes	Yes	Crossed	↓ errors of commission
Werry, Aman, & Diamond (1980)	M	.4 mg/kg	Yes	Yes	Crossed	↓ errors of omission, commission
Michael, Klotzman, Salzman, Borgstedt, & Dainer (1981)	M	.3 mg/kg	Yes	Yes	Crossed	↓ errors of omission, commission

Table 2 continued

Author(s) & Year	Drug	Dose	Use of Placebo	Double-Blind	Design	Results
Reaction Time Tasks						
Conners, Eisenberg, & Barcal (1967)	D	10 mg	Yes	Yes	Crossed	no effect
Conners & Rothschild (1968)	D	15-25 mg	Yes	Yes	Uncrossed	decrease
Sprague, Barnes, & Perry (1970)	M	.25, .35 mg/kg	Yes	Yes	Crossed	decrease
Cohen, Douglas, & Morgenstern (1971)	M	5-50 mg $\bar{X}=31.5$ mg	Yes	Yes	Crossed	decrease
Sykes, Douglas, & Morgenstern (1972)	M	10-100 mg $\bar{X}=57$ mg	Yes	Yes	Crossed	decrease
Spring, Greenberg, Scott, & Hopwood (1974)	M	$\bar{X}=13$ mg	No	Yes	Off-On	
Sroufe, Sonies, West, & Wright (1973)	M	.5 mg/kg	Yes	Yes	Uncrossed	decrease
Porges, Walter, Korb, & Sprague (1975)	M	.3 mg/kg	Yes	?	Crossed	no effect
Zahn, Abate, Little, & Wender (1975)	D, M	?	No	No	Off-On	decrease
Rapoport, Buchsbaum, Weingartner, Zahn, Ludlow, & Mikkelsen (1980)	D	.5 mg/kg	Yes	Yes	Crossed	decrease
Zahn, Rapoport, & Thompson (1980)	D	.5 mg/kg	Yes	Yes	Crossed	decrease
Ackerman, Dykman, Holcomb, & McGraw (1982)	M	10-60 mg $\bar{X}=1.3$ mg/kg	Yes	Yes	Crossed	decrease

Table 2 continued

Author(s) & Year	Drug	Dose	Use of Placebo	Double-Blind	Design	Results ^d
Porteus Mazes						
Connors & Eisenberg (1963)	M	20-60 mg	Yes	Yes	Uncrossed	Increase
Connors, Eisenberg, & Sharpe (1964)	M	20-60 mg	Yes	Yes	Uncrossed	Increase
Connors & Rothschild (1968)	D	15-25 mg	Yes	Yes	Uncrossed	Increase
Epstein, Lasagna, Connors, & Rodriguez (1968)	D	10-20 mg	Yes	Yes	Crossed	Increase
Connors, Rothschild, Eisenberg, Stone, & Robinson (1969)	D	10-25 mg	Yes	?	Uncrossed	Increase
Connors (1972)	M D	10-30 mg 5-15 mg	Yes	Yes	Uncrossed	Increase Increase
Connors, Taylor, Meo, Kurtz, & Fournier (1972)	D P	5-40 mg $\bar{X}$ =20 mg 25-125 mg $\bar{X}$ =82 mg	Yes	Yes	Uncrossed	Increase Increase
Greenberg, Deem, & McMahon (1972)	D	5-? mg $\bar{X}$ =25 mg	Yes	Yes	Uncrossed	Increase
Winsberg, Bialer, Kupietz, & Tobias (1972)	D	15-30 mg	Yes	Yes	Crossed	no effect
Hoffman, Engelhardt, Margolis, Polizos, Waizer, & Rosenfeld (1974)	M	10-20 mg	No	No	Off-On	Increase
Rapoport, Quinn, Bradbard, Riddle, & Brooks (1974)	M	10-30 mg $\bar{X}$ =20 mg	Yes	Yes	Uncrossed	Increase
Knights & Viets (1975)	P	37.5-112.5 mg	Yes	Yes	Uncrossed	no effect

Table 2 continued

Author(s) & Year	Drug	Dose	Use of Placebo	Double -Blind	Design	Results
Matching Familiar Figures Test						
Campbell, Douglas, & Morgenstern M (1971)		5-50 mg $\bar{X}=30$ mg	Yes	Yes	Crossed	↓ errors, ↑ reaction time
Rapoport, Quinn, Bradbard, Riddle, & Brooks (1974)	M	10-30 mg $\bar{X}=20$ mg	Yes	Yes	Uncrossed	↑ reaction time
Garfinkel, Webster, & Sigmund (1975)	M	20 mg	Yes	Yes	Crossed	↓ errors
Schleifer, Weiss, Cohen, Elman, M Cvejic, & Kruger (1975)		2.5 -20 mg	Yes	Yes	Crossed	no effect ^e
Ackerman, Dykman, Holcomb, & McCray (1982)	M /	10-60 mg $\bar{X}=1.33$ mg/kg	Yes	Yes	Crossed	↓ errors, ↑ reaction time

^a M-methylphenidate, D-dextroamphetamine, P-pemoline

^b Crossed means a crossover design in which each subject received all of the possible drug and placebo conditions in a randomized order. Uncrossed means a design in which children were assigned to either a drug or placebo group. Off-On means a design in which all children received the drug and were evaluated both on and off drug.

^c They conducted a time-response analysis and found that reaction time was decreased 50 and 140 minutes after drug administration but not 230 or 350 minutes after drug administration.

^d These results refer to quantitative test quotients. No investigator has found that stimulants affect qualitative test quotients.

^e They used a modified and simpler version called The Early Childhood Familiar Figures Test.

performance. Dextroamphetamine significantly increased perceptual sensitivity or attentiveness (d') and also shifted the response bias (B) of both groups so that it reflected a more mature, less impulsive motivational state. These effects were larger for children aged 6 to 9 than for 10 to 12-year old children.

Michael et al. (1981) recorded visual evoked potentials while hyperactive children were given the Continuous Performance Test. Their results suggested that the late positive component (P300) of the evoked response to salient experimental cues reflected hyperactive children's deficits in sustained attention. They found that methylphenidate improved performance on this task and also enlarged the late positive component of the evoked response. This study would have been more informative if it had included a normal control group, but it is unique in that evoked potentials were recorded while hyperactive children performed a task on which they had been shown to be deficient. Most evoked potential research with hyperactive children has examined their responses to simple tones or flashes of light.

Measures of reaction time also have been used as indices of attention. In fact, a delayed reaction time task can be considered as a miniature vigilance situation because alertness must be maintained over a relatively brief

foreperiod, and this state of readiness must be developed repeatedly over the course of the testing session. Table 2 shows that stimulants reduced the reaction times of hyperactive children (Ackerman, Dykman, Holcomb, & McCray, 1982; Cohen, Douglas, & Morgenstern, 1971; Conners & Rothschild, 1968; Rapoport, Buchsbaum, et al., 1980; Sprague et al., 1970; Sroufe, Sonies, West, & Wright, 1973; Sykes et al., 1972; Zahn et al., 1975; Zahn, Rapoport, & Thompson, 1980). As well, stimulants have been reported to decrease the variability of hyperactive children's responses (Cohen et al., 1971), and to prevent the performance decrement across trials that hyperactive children on placebo exhibit (Spring, Greenberg, Scott, & Hopwood, 1974).

The Porteus Maze Test measures the subject's ability to plan, to reason, and to control impulsive responding. Although there have been a few negative reports (Knights & Viets, 1975; Winsberg, Bialer, Kupietz, & Tobias, 1972), most investigators have found that stimulants improve the quantitative test quotients of hyperactive children (Conners, 1972; Conners & Eisenberg, 1963; Conners, Eisenberg, & Sharpe, 1964; Conners & Rothschild, 1968; Conners et al., 1972; Epstein, Lasagna, Conners, & Rodriguez, 1968; Greenberg, Deem, & McMahon, 1972; Hoffmann et al., 1974; Rapoport et al., 1974) (see Table 2). These results indicate

that stimulants improve hyperactive children's ability to plan their actions and to inhibit impulsive responding.

The Matching Familiar Figures Test provides a measure of a subject's speed of decision making in situations with high response uncertainty. Most investigators have reported that methylphenidate decreased error scores and/or increased the reaction time of hyperactive children's responses (Ackerman et al., 1982; Campbell, Douglas, & Morgenstern, 1971;

Garfinkel, Webster, & Sloman, 1975; Rapoport et al., 1974).

These data indicate that hyperactive children became significantly less impulsive while on methylphenidate. In a recent study, Flintoff, Barron, Swanson, Ledlow, and Kinsbourne (1982) recorded the electroculogram while hyperactives were performing a visual matching-to-sample task. Although methylphenidate failed to improve task performance, the authors argued that the drug improved selective attention because the number of visual fixations on the standard stimulus was significantly larger after the children were given methylphenidate. Drug treatment also resulted in a significant increase in the number of systematic comparisons between the standard stimulus and the variants. These data indicate that the administration of methylphenidate resulted in a more effective style of problem solving. Successful performance on visual matching-to-sample

tests undoubtedly requires sustained and selective attention as well as other abilities including the ability to organize perceptual search strategies. The fact that methylphenidate improves performance on these tests could be the result of its effect on any one or a combination of these psychological processes.

Traditionally, selective attention has been thought of as involving some kind of filtering process which an individual uses to notice a particular part of the environment. Incidental learning tasks assess the acquisition of information that is extraneous or irrelevant to task performance, and incidental learning scores typically are judged in relation to measures of central learning or learning on the task that the examiner designates as relevant. In other words, when incidental learning is high, selective attention would be low, and vice versa. There is no evidence to suggest that hyperactive children have deficits in selective attention (Douglas & Peters, 1979), but hyperactive children on methylphenidate recalled more central and less incidental stimuli than those on placebo (Thurston, Sobol, Swanson, & Kinsbourne, 1979). One explanation for these findings is that methylphenidate narrowed the focus of attention. On the other hand, the investigators reported that favorable drug responders overtly labeled the central

stimuli more often when they were on placebo. Thus, methylphenidate may have altered the selective learning of these subjects by increasing the probability of utilizing an efficient encoding strategy (Thurston et al., 1979). This latter explanation is not applicable to the adverse drug responders who did not increase the amount of verbal mediation that they engaged in and yet still recalled more central and fewer incidental stimuli. Using a discrimination learning task, Dykman, Ackerman, and McCray (1980) found that methylphenidate did not alter selective attention as measured by "search rate" which represented the ratio of observed to expected trials to discover each new positive stimulus.

To summarize, stimulants improve the ability of hyperactive children to sustain attention and inhibit impulsive responding. Little information is available on whether these drugs affect selective attention. In fact, except for Douglas and colleagues, few investigators have carried out a systematic research program designed to clarify the nature of the attention deficit of hyperactive children. This is surprising because an attentional deficit currently is regarded as the central problem in hyperactivity. Additional research on selective attention as well as on other attentional constructs would further our understanding of the attentional deficits of hyperactive children. It is

recognized that progress in this area has been limited by the ambiguity of attentional constructs. Nevertheless, if an attentional deficit theory is to be useful, it must be validated both convergently and divergently. Such a theory should be able to predict on which tests hyperactive children will exhibit inferior performance and on which tests they will exhibit average performance.

Paired-Associate Learning. Conners and coworkers have conducted several studies on the effects of stimulants on paired-associate learning (PAL). They reported that both methylphenidate and dextroamphetamine reduced the number of errors on PAL tests (Conners et al., 1969; Conners & Eisenberg, 1963; Conners & Rothschild, 1968), but they also have reported negative results for these stimulants and for pemoline (Conners, 1972; Conners et al., 1972). These discrepant results may have been produced by differences in the type and difficulty of PAL tasks that were used, by differences in the dose of medication, or by differences in subject samples.

In a series of studies, Swanson and coworkers have shown that children who exhibit symptoms of hyperactivity can be divided into favorable or adverse stimulant drug responders on the basis of their performance on PAL tests (Dalby, Kinsbourne, Swanson, & Sobol, 1977; Flintoff et al., 1982;

Swanson, Barlow, & Kinsbourne, 1979; Swanson & Kinsbourne, 1976, 1979; Swanson, Kinsbourne, Roberts, & Zucker, 1978). They have argued that a favorable cognitive response to an acute administration of a stimulant drug provides supplementary evidence for the diagnosis of hyperactivity and that an adverse cognitive response should be taken as evidence against the diagnosis of hyperactivity. The basis for the diagnostic drug trial is that stimulant therapy corrects a presumed brain dysfunction that causes hyperactive behavior. The unspecified brain dysfunction is presumed not to exist in nonhyperactive children and normal adults, and they are not expected to exhibit a favorable response to stimulant medication. In fact, normal adults exhibit a stimulant-induced impairment on PAL tests (Burns, House, Fensch & Miller, 1967; Smith, 1967). This controversial position has not been widely accepted because recent research has shown that hyperactive children, normal children and adults, and children with learning disabilities, including dyslexia, exhibit similar responses to stimulants on several behavioral, psychophysiological, and cognitive measures (Ackerman et al., 1982; Gittelman-Klein & Klein, 1976; Rapoport et al., 1978). In addition, some hyperactive children may have brain dysfunctions, but the evidence for a specific relationship between any biological factor and

hyperactivity is not compelling (see Rapoport & Ferguson, 1981; Rutter, 1982). Swanson and Kinsbourne (1979) have suggested that the critical feature of the PAL test is that it requires the acquisition of new associations through repeated practice. A crucial question that needs to be answered before the diagnostic drug trial procedure can be accepted as valid is whether normal children exhibit stimulant-induced improvements on PAL tests in particular and on learning tests in general.

Even if their theory and their procedure for diagnosing hyperactivity turns out to be invalid, their work is still important because they have provided valuable insights into the cognitive effects of stimulant drugs. Dalby et al. (1977) varied the presentation rate of items on PAL tests and found that hyperactive children on placebo were deficient in utilizing study time when the presentation rate was relatively long. That is, they failed to exhibit fewer errors when total presentation time was increased. Administration of methylphenidate reduced the number of errors across all presentation rates and the reduction was greatest for the longest presentation rate. These data suggest that hyperactive children have deficits in concentration span since normal adults and children exhibit fewer errors as the presentation time is increased and that

methylphenidate improved attention and the use of learning time.

In a series of studies, Conners and coworkers have found that stimulants have an equivocal effect on paired-associate learning. These results could have been produced by changes in the type of PAL test that was used or by changes in the dose of stimulant medication, but they were most likely the result of differences in subject samples. PAL tests can be used to divide children who exhibit symptoms of hyperactivity into favorable or adverse drug responders. Since Conners failed to divide his patients in this manner, his mixed results may have been produced by differences in the relative percentages of favorable and adverse responders in his samples. At the present time there is insufficient information in the literature to determine if the theoretical underpinnings for the diagnostic drug trial procedure advocated by Swanson and Kinsbourne are valid. Nevertheless, their work has been extremely useful in elucidating the cognitive effects of stimulant drugs and in stimulating other research.

State-Dependent Learning. State-dependent learning is said to occur if retention is greater when the drug treatment is given both at the time of acquisition and during testing for retention than on only one of these occasions. The

assumption underlying this phenomenon is that the drug state constitutes a unique stimulus environment during acquisition and retention. If the state is different during testing for retention, then the absence of the drug constitutes a novel stimulus environment and the previously learned response does not recur with maximum strength. Only a few investigators have tested for state-dependent effects in hyperactive children who were receiving stimulant drugs. Aman and Sprague (1974) found that dextroamphetamine and fairly high doses of methylphenidate did not facilitate performance on a recognition test of short-term memory, a paired-associate learning task, or a maze task, nor did they find any evidence for state-dependent learning. On the other hand, Swanson and Kinsbourne (1976) reported that hyperactive children, but not controls, exhibited symmetrical state-dependent learning on a paired associate learning task. That is, hyperactive subjects made more errors in the retention phase when the learning and retention phases differed in state than when they were the same. Using similar procedures, Steinhausen and Kreuzer (1981) failed to replicate these results. Weingartner, Langer, Grice, and Rapoport (1982) also failed to find state-dependent learning and retrieval effects on a serial learning task and a short-term memory task. The reason why these investigators failed to replicate the work

2

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

of Swanson and Kinsbourne is not clear. Although it has been suggested that a stimulant-induced facilitation of initial learning is essential to the demonstration of state-dependency (Swanson & Kinsbourne, 1976), Weingartner et al. (1982) did not find dissociative effects despite a stimulant-induced facilitation of learning. Thus, at the present time, the weight of the evidence suggests that children treated with stimulants will be able to recall what they have learned after completion of stimulant treatment.

Memory. Few investigators have examined the effects of stimulants on memory. Using a short-term recognition memory task, Werry and Aman (1975) found that a 0.3 mg/kg dose of methylphenidate improved performance, but only when the task difficulty was relatively high. These results have been replicated by Sprague and Sleator (1977). They also showed that when relatively large matrices of pictures were used, recognition of test pictures was less accurate when a high dose of methylphenidate (1.0 mg/kg) was administered than when a dose of 0.3 mg/kg was used (Sprague & Sleator, 1977). Rie and Rie (1977) examined the effects of methylphenidate (0.2 to 0.9 mg/kg) on the ability of hyperactive and learning disabled children to recall a story. They reported a positive drug effect on 2-hour story recall, but not on initial or 2-day story retention. This study is

methodologically flawed because all children were tested off drug and then on drug. Thus, the positive drug effect may have been at least partly due to the fact that the children became aware, as a result of their previous testing experience, that their recall of a story would be retested. A counterbalanced crossover design clearly would have been preferable.

Weingartner et al. (1982) reported that dextroamphetamine facilitated the retrieval of information acquired the previous day. They administered a serial learning task to a group of hyperactive children and found that, regardless of retrieval conditions, the free recall of words in the list was superior for words learned under drug conditions than for words learned under placebo conditions.

Recently, Weingartner et al., (1980) have used an information processing approach to examine the effects of dextroamphetamine on encoding and retrieval processes in hyperactive and normal children. When the groups were on placebo, hyperactive children remembered fewer words under free-recall conditions than normal children, but there was no difference between the groups in the amount of information they remembered under cued-recall conditions.

Dextroamphetamine enhanced total free- and cued-recall for both groups of subjects. Under the free-recall conditions,

dextroamphetamine increased the number of both semantically and acoustically processed words that were remembered. Both of these measures were unaffected by drug treatment when cued-recall testing conditions were used. There was a slight tendency for dextroamphetamine to enhance the encoding strategy ordinarily used by each group to process words. Hyperactive children relied more on acoustic processing than on semantic processing, and dextroamphetamine had a greater effect on the recall of acoustically processed words in this group. Normals tended to rely more on semantic processing, and dextroamphetamine enhanced the recall of semantically processed words to a greater extent in this group of children.

In summary, there is a limited amount of evidence which suggests that methylphenidate and dextroamphetamine facilitate mnemonic processes. At least some of these stimulant-induced changes in cognition are independent of the drugs' effects on attention (Weingartner et al., 1980). Additional research on the effects of stimulants on cognition using an information processing framework is warranted. In fact, such research is essential if we are to gain an understanding of why stimulant-induced short-term benefits in cognition are not translated into long-term gains in academic achievement.

Intelligence. The test most frequently used in research on the effects of stimulants on intelligence has been the Wechsler Intelligence Scale for Children (WISC) (Wechsler, 1949). Table 3 shows that although there have been a few reports of positive drug effects on various WISC subtests and the Verbal and Performance scales, most studies have not found that stimulants affect intelligence test scores. Negative stimulant drug effects on other tests of intelligence also have been reported (Millichap et al., 1968; Weiss, Werry, Minde, Douglas, & Sykes, 1968). Two of the studies which have reported positive effects can be dismissed because of their grossly inadequate experimental design (Hoffman et al., 1974; Seger & Hallum, 1974). It has been suggested that these increases in IQ and subtest scores do not reflect changes in intellectual processes, but are the result of stimulant-induced improvements in concentration and attention span (Barkley & Cunningham, 1978; Douglas, 1972). However, scores on the WISC subtests which supposedly require the greatest amount of attentional effort (Arithmetic, Coding, and Digit Span) rarely have been altered by stimulants. In fact, even in unmedicated hyperactive children high levels of attention and concentration typically are elicited during the administration of the WISC because it is given on a one-to-one basis in potentially intimidating

Table 3

The Effects of Stimulant Drugs on Wechsler Intelligence Test Scores of Hyperactive Children

Author(s) & Year	Drug ^a	Dose	Use of Placebo	Double-Blind	Design ^b	Duration of Study	Results ^c
Conners & Rothschild (1968)	D	15-25 mg	Yes	Yes	Uncrossed	1 month	No Effect
Epstein, Lasagna, Conners, & Rodriguez (1968)	D	10-20 mg	Yes	Yes	Crossed	12 weeks	?
Weiss, Merry, Minde, Douglas, & Sykes (1968)	D	5-20 mg	Yes	Yes	Uncrossed	3-5 weeks	No Effect
Conners, Rothschild, Eisenberg, Stone, & Robinson (1969)	D	10-25 mg	Yes	?	Uncrossed	4 weeks	No Effect
Knights & Hinton (1969)	M	20-40 mg	Yes	Yes	Uncrossed	6 weeks	↑ PIQ
Conrad, Dworkin, Shai, & Toblessen (1971)	D	5-? mg	Yes	Yes	Uncrossed	4-6 months	No Effect
Finnerty, Soltys, & Cole (1971)	D	5-15 mg	Yes	Yes	Uncrossed	3 weeks	No Effect
Weiss, Minde, Douglas, Merry, & Sykes (1971)	M D	5-50 mg 5-20 mg	Yes	Yes	Uncrossed	4-6 weeks 3-5 weeks	↑ FSIQ, ↑ VIQ No Effect
Conners (1972)	M	10-30 mg	Yes	Yes	Uncrossed	6 weeks	↑ FSIQ, ↑ VIQ, ↑ Similarities, ↑ Digit Span, ↑ Object Assembly
	D	5-15 mg	Yes	Yes	Uncrossed	6 weeks	No Effect
	P	18.75-125 mg $\bar{X}=82$	Yes	Yes	Uncrossed	8 weeks	No Effect
Conners, Taylor, Meo, Kurtz, & Fournier (1972)	D	5-40 mg $\bar{X}=20$ mg	Yes	Yes	Uncrossed	8 weeks	No Effect
	P	25-125 mg $\bar{X}=82$	Yes	Yes	Uncrossed	8 weeks	No Effect

Table 3 continued

Author(s) & Year	Drug	Dose	Use of Placebo	Double-Blind	Design	Duration of Study	Results
Greenberg, Deem & McMahon (1972)	D	5-? mg $\bar{x}=25$ mg	Yes	Yes	Uncrossed	8 weeks	↑ PIQ
Hoffman, Engelhardt, Margolis, Polizos, Waizer, & Rosenfeld (1974)	M	10-20 mg	No	No	Off-On	12 weeks	↑ FSIQ, ↑ PIQ ↑ Object Assembly
Sager & Hallum (1974)	M	5-60 mg	No	No	Off-On	8 weeks	↑ Digit Span, ↑ Coding
Rapoport, Quinn, Bradbard, Riddle, & Brooks (1974)	M	10-30 mg $\bar{x}=20$ mg	Yes	Yes	Uncrossed	6 weeks	No Effect
Knights & Viets (1975)	P	37.5-112.5 mg	Yes	Yes	Uncrossed	9 weeks	No Effect
Rie, Rie, Stewart, & Ambuel (1976a)	M	5-40 mg $\bar{x}=21$ mg	Yes	Yes	Crossed	24 weeks	↓ Comprehension
Rie, Rie, Stewart, & Ambuel (1976b)	M	5-40 mg $\bar{x}=23$ mg	Yes	Yes	Crossed	30 weeks	No Effect

^a M-methylphenidate, D-dextroamphetamine, P-pemoline.

^b Crossed means a crossover design in which each subject received all of the possible drug and placebo conditions in a randomized order. Uncrossed means a design in which children were assigned to either a drug or placebo group. Off-On means a design in which all children received the drug and were evaluated both on and off drug.

^c FSIQ-Full Scale Intelligence Quotient, PIQ-Performance Intelligence Quotient, VIQ-Verbal Intelligence Quotient.

settings like hospitals. Thus, the inconsistent but largely negative findings in this area may not reflect the well-documented attentional enhancing properties of the stimulants, but may merely be due to chance.

Academic Achievement. Since stimulant drugs reduce the disruptive behavior of hyperactive children, especially in structured situations such as the classroom, and improve their attentional abilities, it is reasonable to suggest that these drugs may thus indirectly facilitate academic achievement. At first glance this assumption appears to be tenable because several investigators have shown that teachers as well as parents subjectively rate hyperactive children on medication as displaying improved achievement (Rapoport et al., 1974; Rie et al., 1976a, 1976b). However, when studies that have used objective measures of academic achievement are examined the results indicate that this may not be the case. The Wide Range Achievement Test (WRAT) (Jastak & Jastak, 1965) is the measure of academic achievement most frequently used. This test is divided into Arithmetic, Spelling, and Reading subtests, but the latter subtest really is a measure of word recognition and pronunciation skills. Although some investigators have reported that stimulants improve performance on the WRAT (Conners et al., 1969; Conners et al., 1972; Rie & Rie, 1977),

the results were inconsistent with respect to the particular subtest that was affected. In addition, most studies have found that stimulants do not affect performance on any of the WRAT subtests (Conners, 1972; Conrad, Dworkin, Shai, & Tobiessen, 1971; Finnerty, Soltys, & Cole, 1971; Hoffmann et al., 1974; Knights & Viets, 1975). All of these short-term studies used treatment periods lasting from a few weeks to half a year. It is important to point out that the WRAT is a rather insensitive dependent measure of academic achievement since it contains a small number of test items at each age level. Thus, in order for a group to show a positive drug effect on this test, it would have to gain at a rate far above the expected average rate considering the limited number of items, the inherent error in measurement, and the short time span of the typical study. It is possible that the negative drug effects are merely due to the insensitivity of the WRAT.

Investigators also have used other dependent measures when examining the effects of stimulants on academic achievement especially achievement in reading. Generally speaking, stimulant drug effects on academic achievement of hyperactive children are scattered and inconsistent (see Conners et al., 1969; Conners et al., 1972; Rie & Rie, 1977; Rie et al., 1976a, 1976b; Weiss, Minde, Douglas, Werry, &

C-

Sykes, 1971; Werry & Sprague, 1974). The few positive findings that have been reported have been attributed to enhanced attentional abilities rather than improved scholastic performance. For example, Rie and Rie (1977) administered academic achievement tests to hyperactive children and then repeated the tests two days later after the subjects were given methylphenidate. Compared to an untreated control group, the hyperactive children exhibited slightly improved test scores even though the short time period precluded skill acquisition.

Long-term studies may provide more appropriate measures of the effects of stimulant drugs on academic achievement because many of the previously mentioned studies may have been too brief for academic achievement to occur (Barkley & Cunningham, 1978). It is difficult to draw conclusions from some of the long-term studies because they often did not include control groups, the children often received more than one type of treatment including other psychoactive agents, and not all of the children remained on stimulants for the entire follow-up period (e.g., Mendelson et al., 1971; Weiss, Minde, Werry, Douglas, & Nemeth, 1971). Long-term studies which have included more adequate controls have shown that hyperactives treated with methylphenidate continue to have academic problems (Quinn & Rapoport, 1975; Riddle & Rapoport,

1976; Weiss et al., 1979; Weiss et al., 1975). However, subjects were not randomly assigned to stimulant treatment and untreated groups in any of these studies for obvious ethical reasons. In addition, it would be useful to predict with a multiple regression equation the amount of progress a particular individual would make over a given time period, and then determine if he makes as much or more progress after he is treated with a stimulant drug. Satterfield and coworkers have used this strategy and have reported that multimodality treatment which consists of stimulant therapy and an individualized psychotherapy program resulted in greater than expected gains in almost all academic areas (Satterfield, Satterfield, & Cantwell, 1980), and that the group which received more treatment was further ahead educationally (Satterfield, Satterfield, & Cantwell, 1981).

In summary, the overall results suggest that stimulants do not improve the academic achievement of hyperactive children. Many of the studies in this area are methodologically flawed and it remains to be seen whether future research will demonstrate a relationship between stimulant treatment and improved academic performance. If this association is to be demonstrated, then more sensitive dependent measures will have to be used (see Sprague & Berger, 1980; Pelham, 1983). Investigators also will need to

carefully examine or control for the effects of dosage, compliance, time course of medication effects, individual differences in medication responsiveness, and concurrent interventions (Pelham, 1983).

Diagnostic Nonspecificity of a Favorable Response to
Stimulant Medication

The stimulants were first used to treat children with a wide variety of behavioral problems (Bradley, 1937; Molitch & Eccles, 1937). In a series of studies, Bradley (1937, 1950; Bradley & Bowen, 1941) found that racemic amphetamine and dextroamphetamine were effective in altering the behavior of a mixed group of institutionalized maladjusted children. There were few additional studies of the effects of stimulants on children with behavior problems until the late 1950s, and at that time most investigators used them to treat hyperactive children. Nevertheless, some investigators continued to study the effects of stimulants on a mixed group of children who had behavior or school problems (e.g., Conners & Eisenberg, 1963; Conners, Eisenberg, & Barcai, 1967; Rie et al., 1976a, 1976b; Sprague et al., 1970). In addition, many of the stimulant drug studies conducted in the 1960s and early 1970s used a heterogeneous population of hyperactive children, and some investigators used symptoms of unsocialized aggression or hyperactivity as criteria for

inclusion in their study (e.g., Christensen & Sprague, 1974; Rapoport & Benoit, 1975; Werry & Aman, 1975; Winsberg et al., 1972). Thus, it is possible that stimulants may reduce the impulsive, disruptive, and socially inappropriate behavior of conduct disordered children as well as of hyperactive children. Furthermore, stimulants also may produce the same type of cognitive effects in conduct disordered children as they do in hyperactive children. Few investigators have addressed this issue, but Swanson et al. (1978) reported that a group of unsocialized aggressive children contained both favorable and adverse responders to stimulant medication.

This group apparently was comprised of children who exhibited symptoms of both hyperactivity and unsocialized aggression. It is possible that the relative percentages of favorable and adverse responders may differ for these diagnostic categories.

Although there are no studies of the effects of stimulant drugs on children with conduct disorders, it has been reported in a few uncontrolled clinical studies that they are effective in reducing the disruptive and impulsive behavior of delinquents (Hill, 1947; Korey, 1944). Eisenberg et al. (1963) and Maletzky (1974) have extended the results of these early reports by conducting double-blind studies with a placebo control on the effects of dextroamphetamine on the

behavior of delinquents. In both of these studies the investigators used rating scales to measure changes in behavior, and they found that stimulant medication reduced the impulsive, disruptive, and aggressive behavior of delinquents.

A study completed by Rapoport, Buchsbaum, et al. (1978, 1980) also supports the notion of the nonspecificity of a favorable stimulant drug response. They found that both hyperactive and normal prepubertal boys responded similarly to dextroamphetamine by exhibiting decreased motor activity, increased vigilance, and improvement on a short-term memory task. Dextroamphetamine had a greater effect on the recall of acoustically processed words in hyperactive children and on semantically processed words in normals (Weingartner et al., 1980). These important studies do not support the concept that hyperactive children exhibit a unique response to stimulant drugs.

In summary, hyperactive and normal children respond in many similar ways to dextroamphetamine. Studies which have used delinquents, children with a wide variety of behavior problems, or a heterogeneous population of hyperactive children including some who would have fulfilled the diagnostic criteria for conduct disorders have shown that, as a group, these children respond favorably to stimulant

medication. Thus, these findings suggest that children with conduct disorders will exhibit positive behavioral and cognitive responses to stimulants. However, it is important to point out that no study has investigated the effects of stimulants on children with conduct disorders or compared their responses to those of children with other types of psychopathology. It is possible that children with conduct disorders may respond to stimulants in at least a few ways that are different from the responses of attention deficit disordered children. Weingartner et al. (1980) have reported some subtle differences between normal and hyperactive children in their responses to dextroamphetamine. Thus, their short-term memory task may be useful in distinguishing between the responses of children with conduct disorders or attention deficit disorders.

The primary purpose of this study was to determine if some conduct disordered children respond favorably in terms of positive behavioral and cognitive changes to methylphenidate. Because stimulants have been used rarely in the treatment of conduct disordered children, a single-case experimental design was employed. Standardized behavior rating scales and direct classroom behavioral observations were used to examine behavioral effects of the medication. In addition, cognitive and psychomotor tasks which had been shown previously to be sensitive to stimulant medication effects in hyperactive children were administered.

CHAPTER II

Method

Subjects

Approximately 40 comprehensive psychological charts of children who were residents or outpatients of the Child Study Centre, University of Ottawa were reviewed by the principal investigator. The charts contained information on the child's social and family history, medical history, psychological test results, current school performance, progress notes, and plan of action. Diagnostic criteria for Conduct Disorder (CD) outlined in the third edition of the Diagnostic and Statistical Manual (DSM-III) of the American Psychiatric Association were used to select subjects (see Appendix A). Children were excluded if they had a neurological dysfunction, or if they met the DSM-III criteria for any other psychiatric disorder including Attention Deficit Disorder with or without Hyperactivity. Previous treatment with a stimulant did not prevent a child from participating in the study. Children selected for the study had to have an IQ, as measured by the WISC-R, of at least 80.

The charts of children who apparently met the criteria for inclusion in the study then were given to the Director and the consulting psychiatrist of the Child Study Centre who independently reviewed them and gave their opinions on

whether a particular child satisfied the inclusion criteria. A unanimous decision regarding the presence of CD and the absence of any other psychiatric disorder was required for a child to be selected for the study.

In the next stage of the selection process, the potential candidates' scores on the parental version of Achenbach's Child Behavior Checklist (see Appendix B) and Conners Teacher Questionnaire were reviewed (see Appendix C). Some of these questionnaires were present in the children's charts, while in other cases parents and teachers at the Child Study Centre or at the children's previous school were contacted and asked to fill them out. Subjects selected for the study scored higher than 2 standard deviations above the mean on the Aggressive and Delinquent factors of the Child Behavior Checklist and below 2 standard deviations above the mean on the Hyperactivity factor. In addition, subjects had to score higher than 1.5 standard deviations above the mean on the Conduct Disorder factor of the Conners Teacher Questionnaire and below 1.5 standard deviations above the mean on the Hyperactivity factor of this rating scale. The normative data of Trites, Blouin, and Laprade (1982), who collected ratings on a large random sample of Ottawa school children, were used for the Conners Teacher Questionnaire, and the normative data of Achenbach (1978) were used for the Child

Behavior Checklist.

A lower cutoff score was used on the Conners Teacher Questionnaire than on the Child Behavior Checklist because many of the potential subjects were to be drawn from special education classes, and it was thought that teachers of these classes may have had atypical frames of reference. That is, they may rate a child's behavior problem as less severe than teachers of normal children because special education teachers are used to working with children with behavior problems.

Parents or the legal guardian of children who met the inclusion criteria were contacted and the family's participation in the study was solicited. Parents were fully informed about the study, effects of the medication, and test procedures, but they were not informed of the drug and placebo administration schedule. Parents who decided to participate were required to sign a letter of consent (see Appendix D). Participation in the study did not prevent a child from receiving ongoing treatment interventions such as remedial education or individual psychotherapy.

At the same time as informed consent was obtained, a structured psychiatric interview (see Appendix E) developed by Stewart and coworkers was administered by the principal investigator to help clarify the nature and severity of the

child's problems and to act as a final check to ensure that the subject only fit the diagnostic category for conduct disorder. Before the interview was conducted, each mother was asked to read and sign a letter of consent (see Appendix F) which outlined the nature of the interview. The interview contained questions about the age of onset, emotional and behavioral symptoms present in the past year, chief concerns of the mother, quality of the marriage, and parent-child separations. Mothers were asked to select one of three alternatives for each of the questions on symptomatology. For example, the question on fighting was phrased "When it comes to fights with other children at school or in the neighborhood, would you say that your son tends to avoid fights, that he gets into as many as the average boy his age, or that he is involved in many more than most boys?". If a mother chose one of the deviant alternatives she was asked to explain how much of a problem the behavior was to her, and how it affected the child's and the family's social life.

Stewart and colleagues have made extensive use of this interview in their studies of children with conduct disorders or attention deficit disorders (e.g., Stewart et al., 1981; Stewart et al., 1980). The interview has a high interrater reliability (Stewart et al., 1981). Stewart and coworkers also found a close correspondence between mothers' responses

in the interview and their responses to the same items in a questionnaire filled out several weeks prior to the clinic visit (Stewart et al., 1981). In addition, there was a good level of agreement between fathers' and teachers' reports on questionnaires and the information given by mothers in the structured interviews. Diagnoses made on information gathered in the structured interview agreed with diagnoses made by staff psychiatrists and with the primary complaints of the parents (Stewart et al., 1981). These findings indicate that information obtained with the use of this structured interview is reliable and has concurrent validity.

Experimental Design

A variation of the basic ABAB single subject experimental design was used. Subjects were randomly assigned by the Director of the Child Study Centre to one of the following treatment orders: AA_1BA_1B or ABA_1BA_1 . Use of two treatment orders helped to maintain the double-blind and helped determine if repeated administration of the tests resulted in practice effects. The-A condition represented a baseline phase in which the subjects did not receive the active medication or placebo. In the A_1 condition subjects received placebo and in the B phase methylphenidate was administered. The baseline phase lasted one week and each of the remaining four phases lasted two weeks. Since methylphenidate has a

short half-life of approximately 2.5 hours (Shaywitz et al., 1982; Swanson et al., 1978), it was anticipated that no carryover effects from weeks in which the active medication was administered to placebo weeks would occur. In addition, methylphenidate has a short onset of action, and a single clinically effective dose of the medication results in behavioral and cognitive changes (e.g., Kinsbourne, Swanson, & Herman, 1979). Thus, it was anticipated that medication effects would appear after the first dose of methylphenidate was administered.

Medication

Each phase of the experiment began on a Saturday and medication was administered on weekends. A standard dose of 10 mg of methylphenidate or an equivalent amount of placebo was administered in gelatin capsules in order to disguise the slight taste difference between substances. The medication was administered between 8 and 9 in the morning and between 12 and 1 in the afternoon. The cognitive tests, the ~~Self-Report Rating Scale~~, and the behavioral observations were collected while medication was exerting its peak effects, between 1 and 3 hours after administration. The medication was administered under double-blind conditions by a child care worker about 15 minutes after breakfast and lunch. On weekends, medication was administered by parents

or by child care workers depending on whether the child was at home or in residence.

Behavioral Measures

Three rating scales were chosen to measure the effects of methylphenidate on the behavior of conduct disordered children. The Conners Parent and Teacher Rating Scales contain Conduct Problem factors which reflect aggressive, disruptive, and acting out behaviors and were useful in documenting the effects of methylphenidate on these symptoms. Beitchman's Self-Report Psychiatric Rating Scale was used to determine if the medication produced alterations in mood. These rating scales provided information on the subjects' behavior as perceived by teachers, by child care workers, and by the subjects themselves. The frequencies of administration of these rating scales are summarized in Table 4.

In addition, teacher and residence reports were available, and they were used in the study. Daily classroom behavioral observations also were conducted.

Conners Teacher Questionnaire

Teachers were asked to fill out a Conners Teacher Questionnaire (CTQ) at the end of each week for each child in the study. The CTQ is the most widely used and researched of the teacher rating scales and is regarded as a good

Table 4

Sample Schedule of Test Administration

Test	Days									
	M	T	W	Th	F	M	T	W	Th	F
Rating scales										
CPQ					*					*
CTQ					*					*
SRPS						*				
Cognitive tests										
CPT						*				
PAL						*				
WMT							*			
Psychomotor tests										
Handwriting							*			
Maze							*			
Behavioral Observations	*	*	*	*	*	*	*	*	*	*

Note. This schedule applied to all of the drug and placebo phases of the study. The baseline phase lasted only one week and all measures were collected during this week. Cognitive and psychomotor tests and the SRPS were administered once during the second week of each phase. These tests were completed during two one-hour sessions in the afternoon. In this sample schedule, these sessions occurred on Monday and Tuesday. However, during the study, these tests were presented in random order during the sessions and the sessions were scheduled on any two days of the second week. All classroom behavioral observations were conducted in the morning. CPQ = Conners Parent Questionnaire; CTQ = Conners Teacher Questionnaire; SRPS = Self Report Psychiatric Scale; CPT = Continuous Performance Test; PAL = Paired-Associate Learning Test; WMT = Weingartner Memory Task.

assessment tool (Ross & Ross, 1982). This scale has high test-retest and interrater reliabilities (Conners, 1973; Trites, Dugas, Lynch, & Ferguson, 1979). Several investigators have shown that the scale is sensitive in detecting the behavioral effects of stimulant drugs (e.g., Arnold et al., 1972; Gittelman-Klein et al., 1976; Rapoport et al., 1974).

Teacher Reports

Teachers at the Child Study Centre were required to fill out a daily report on each child in their class. They were asked to record the frequency of problem behaviors which included incidents of verbal aggression, physical aggression, or defiance, running away, and temper tantrums. They were also asked to rate each child on the following dimensions of behavior: sociable-withdrawn, relaxed-tense, not demanding-demanding, obedient-disobedient, and attentive-distractible. Ratings were made on a 7-point scale with higher scores reflecting undesirable behavior. Halfway through the study, the format of these reports was changed. Teachers then were asked to separately record the frequency of occurrence of verbal aggression, physical aggression, and defiance. They were also required to note the frequency and duration of time out and physical restraint.

Classroom Behavioral Observations

Behavioral observations were carried out during periods of independent academic work under teacher supervision. The observer sat in a corner of the classroom while observing four subjects and behind a one-way viewing screen for the remaining subject. All observations were conducted in the morning between 1 and 3 hours after drug administration. Each subject was observed for a 15 minute observation period per day. Thus, 75 minutes of observational data on each subject was collected during the baseline phase and 150 minutes of observational data was collected for each subject in each of the four remaining phases. Observations were made on a 15 second observe, 5 second record basis. The observers listened with an earphone to a tape-recorded timing signal which indicated the observe-record intervals. The type of activity that the subjects were engaged in while they were being observed was recorded.

A modification of the observational code developed by Kent and coworkers (Kent, Miner, Kay, & O'Leary, 1974) was used. This code and its variations have been used in the assessment of the classroom behavior of both conduct disordered and hyperactive children (Abikoff et al., 1977; Abikoff, Gittelman, & Klein, 1980; Jacob et al., 1978; Kent & O'Leary, 1976, 1977), and in evaluations of the effectiveness

of behavior modification in the treatment of conduct disordered children (Kent & O'Leary, 1976, 1977).

One additional category was added to the code: Change of Position reflected gross motor activity. The categories of behavior and operational definitions are listed in Appendix G. Within a given coding interval, each category was scored as present or absent depending on whether the behaviors fulfilling the criteria occurred. Past research has shown that the interrater reliability of the behavioral categories is satisfactory (Abikoff et al., 1977, 1980; Dubey, Kent, O'Leary, Broderick, & O'Leary, 1977; Jacob et al., 1978; Kent & O'Leary, 1976, 1977; Kent, O'Leary, Diamant, & Dietz, 1974). Furthermore, the code and its variations are valid insofar as they can be used to help distinguish between hyperactive and normal children in formal classroom settings (Abikoff et al., 1977, 1980; Jacob et al., 1978), and to document the reduction in disruptive classroom behavior exhibited by conduct disordered children who were involved in a behavior modification programme.

The primary investigator and his two assistants received extensive training before data was collected. Training consisted of discussion and interpretation of the code and observations and scoring of children's classroom behavior in

vivo. Training continued until acceptable interobserver reliability levels were obtained (defined as a minimum of 60% agreement across observation categories). The primary investigator conducted all of the observations, and the assistants were used in the interrater reliability checks.

Throughout the study, interrater reliability checks were conducted by having the principal investigator and an assistant simultaneously watch the same subject for the entire daily observation period. Reliability checks were conducted on approximately 20% of the behavioral observations. Discussions of the observed behaviors were held immediately after each reliability check.

Conners Parent Questionnaire

The child care worker who primarily was responsible for each resident was asked to fill out the 48-item version of the Conners Parent Questionnaire (CPQ) (see Appendix H) at the end of each week. Satisfactory interrater correlations have been reported for this scale (Goyette et al., 1978). A few investigators have reported that the Impulsive/Hyperactive factor is sensitive to stimulant-induced changes in the behavior of hyperactive children (e.g., Conners et al., 1969; Rapoport et al., 1974), but the rest of the factors have not proven to be consistently sensitive to stimulant drug effects (Conners et

al., 1969; Gittelman-Klein et al., 1976; Knights & Viets, 1975; Rapoport et al., 1974).

Residence Reports

Child care workers at the Child Study Centre were required to fill out a daily residence report on each child they supervised. The format of the residence reports was identical to that used in the teacher reports; the frequency of problem behaviors such as the number of incidents of verbal aggression, open defiance, running away, and temper tantrums were recorded. In addition, subjects were rated on a 7-point scale on the following dimensions of behavior: sociable-withdrawn, relaxed-tense, not demanding-demanding, obedient-disobedient, and attentive-distractible. Lower scores on these scales reflect more desirable behavior. The format of reports was changed during the study, and the child care workers then were asked to record the frequency of occurrence of verbal aggression, physical aggression, temper tantrums, and use of time out and physical restraint.

Self-Report Psychiatric Rating Scale

Despite the widespread interest in the use of parent and teacher rating scales, few investigators have developed and used self-report scales for children. It is important to obtain children's perceptions of their problem, even if they are discrepant with reports obtained from parents and

teachers because of potential bias in parents' and teachers' ratings of children and because alterations of the children's perceptions might be a desirable treatment goal. Another reason why it is important to use self-report questionnaires in a study such as this is that there is little direct information on drug-induced changes in mood and personality of children (Conners & Werry, 1979), despite the fact that stimulants occasionally result in undesirable side effects such as sadness or dysphoria (Conners & Werry, 1979; Werry, 1978).

The Children's Self-Report Psychiatric Rating Scale (see Appendix I) was chosen for this study because it is useful in detecting and diagnosing childhood deviance. Factor analyses have revealed that the 55 items reflect eight dimensions of behavior labelled Conduct Problems, Lie-Immaturity, Positive Self-Peer Relations, Worry, Negative Peer Relations, Antisocial-Permissive, Sensitive-Emotional, and Positive-Family Relations. The factors have good test-retest reliability, factor scores can be used to distinguish between clinical and normal groups, and many factors correlate with other measures of the same constructs (Beitchman, Raman, Carlson, Clegg, & Kruidenier, 1985). In addition, preliminary evidence indicates that some of the factors are sensitive to anti-depressant drug effects (Simeon & Ferguson,

1985). Subjects were asked to fill out a self-report questionnaire during a testing session between 1 and 3 hours after drug administration. Self-Report Psychiatric Rating Scales always were administered at the end of the second testing session within each experimental phase (see the section on cognitive tests).

Cognitive Tests

There is little information on the cognitive abilities and deficits of children with conduct disorders. As outlined in the literature review, numerous investigators have shown that stimulant drugs have a variety of cognitive effects. Cognitive responses to stimulant medication were assessed with the use of two classic laboratory tasks, the Continuous Performance Test and a paired-associate learning task. A short-term memory task which measures storage and retrieval processes also was used.

The 3 cognitive tests were administered to each subject once in the baseline phase and once in the second week of each of the remaining phases of the experiment. The frequencies of administration of these tests are summarized in Table 4. The tests were administered in two 45-minute testing sessions. Thus, each subject missed 1.5 hours of school during each of the five phases of the study. All testing was completed within the time period in which

methylphenidate exerts its peak effects, between 1 and 3 hours after medication administration. Thus, the time between administration of the medication and testing was held constant for each subject. A random order of test administration was used, and all testing was conducted in an anechoic chamber.

Continuous Performance Test

The Continuous Performance Test (CPT) is an extremely sensitive measure of hyperactive children's impaired ability to sustain attention. But there is no information in the literature on the vigilance performance of children with conduct disorders. Given that dextroamphetamine improved the vigilance performance of normal boys and men (Rapoport, Buchsbaum, et al., 1978, 1980), it is likely that methylphenidate will improve the performance of children with conduct disorders, even if their performance under placebo conditions is comparable to that of normal children (normative data is available for this task).

An automated version of the CPT developed by Arthur Blouin was used. A series of letters was presented one at a time on the video screen, and subjects were required to monitor the screen and respond by pressing a key whenever the target stimuli appeared. Each stimulus was presented for 0.5 seconds and the interstimulus interval was 1.3 seconds. A BX version of the task was used and subjects were required to respond to the letter X only when it was immediately preceded

by the letter B. On each of the tests 50 pairs of target stimuli were randomly presented out a total of 290 stimuli and the test took approximately ten minutes of complete. Failure to respond to presentations of the target stimuli (errors of omission) and responses to nontarget stimuli (errors of commission) were recorded.

Weingartner Memory Task

A memory test developed by Weingartner et al. (1980) was administered once in each of the baseline, drug, and placebo phases. The task was presented in the form of a word game. Twenty sets of three words were used in each test with ten sets containing two words that were semantically related and one word that had a different meaning. Each of the remaining ten sets contained two words that sounded alike as well as one word that did not rhyme with the others. Within each set, words were arranged in a random fashion. Common words were used, and the pairs of words that were semantically related had a high response frequency on a word association test (e.g. peas and carrots) (see Battig & Montague, 1969; Palermo & Jenkins, 1964). A total of 5 lists of words was used, and the lists were equated for word frequency and the degree of relatedness of words within each set. Semantic and acoustic sets of words were presented in an alternating fashion. Subjects were asked to select the word that did not

belong in each set on the basis of its meaning or rhyme properties. Errors were corrected by the experimenter. Subjects were told to remember all words and informed that they would be asked to recite them at a later point in time. Subjects then were given a distractor task to complete which prevented rehearsal of previously processed words. Subjects completed a handwriting task which is described in the section on psychomotor tasks. This task took about ten to fifteen minutes to complete. After completing this task, subjects were asked to freely recall previously processed words. Cued recall then was tested by reading the child one of the two related words from each set and asking him to try to recall the other word from the set. These cued words appeared in the same order as they appeared in their initial presentation. Subjects were told if the target word was related by meaning or sound to the cue word.

Paired-Associate Learning

Another test which has proven useful in documenting the cognitive effects of stimulant drugs is the paired-associate learning (PAL) test. An initial PAL testing session was conducted with each child in the baseline phase to determine an appropriate level of difficulty so that ceiling and floor effects could be avoided. Several different lists were prepared so that each child could be retested without

repeating stimulus items. Pictures of animals were used as stimulus items and single digits were used as responses. In the terminology of verbal learning research, the list sequence proposed for this experiment is labeled A-B, C-B to denote that the stimulus items, but not the response items, changed across lists. According to Kausler (1974), the changes in stimuli from list to list should have produced slight negative transfer, and the unchanging response set should have produced slight positive transfer. Since the two transfer effects were opposite in direction and about equal in magnitude, no overall transfer from list to list was expected (Kausler, 1974).

At the beginning of each test, the stimulus items were presented in a random sequence, for approximately five seconds each, for the subject to study. During the initial presentation of a list, the subject was told to associate each animal picture with a number. Each particular response was used for two stimuli. Each subsequent time through the list, the stimuli were presented in a random order, and the subject was asked to give the response associated with each stimulus. Correct responses were reinforced, and incorrect responses were corrected. A criterion of two perfect recitations of the list in a row was used, but the testing session was terminated if the criterion was not reached after

ten trials. The task was subject-paced.

Psychomotor Tasks

A handwriting task and a maze test were administered once during the baseline phase and once in the second week of each of the four remaining phases of the experiment. Table 4 summarizes the frequencies of administration of these tests. Subjects were able to complete both psychomotor tests in 15 minutes, and they were administered in the same testing session as one of the cognitive tests.

Maze Test

Stimulants have been found to improve hyperactive children's gross and fine motor coordination, although it has been argued that their improved performance is a result of a facilitation of sustained attention (Epstein et al., 1968; Humphries, Swanson, Kinsbourne, & Yiu, 1979; Knights & Hinton, 1969). A maze test, which is part of a neuropsychological test battery for children (Knights & Norwood, 1979), was used in this study to determine if methylphenidate improves the fine motor coordination of conduct disordered children. Each child was asked to move a stylus through a maze without touching the sides. The number of touches and duration of each touch were electronically recorded. In each testing session, the task was performed twice with the dominant hand and then twice with the

nondominant hand. Normative data is available for this test (Knights & Norwood, 1980).

Handwriting

Whalen, Henker, and Finck (1981) have reported that methylphenidate improved the handwriting of hyperactive children. Their procedure was used in this study. Subjects were asked to copy a short paragraph, and the quality of their handwriting was assessed independently by two judges. Four specific dimensions of handwriting were evaluated: form, spacing, alignment, and uniformity. On each handwriting dimension, the placebo and medication handwriting samples were compared with the baseline sample on a 5-point scale which indicated whether the samples were "much worse," "somewhat worse," "the same," "somewhat better," or "much better" than the comparisons. Scores on the four performance indexes were summed to yield an overall performance index. Interrater reliabilities were calculated by dividing the number of agreements by the total number of agreements plus disagreements.

Side Effects

Side Effects Questionnaire

In order to monitor the frequency and degree of side effects, child care workers and teachers were asked to fill out one Side Effects Questionnaire (see Appendix J) per week.

No psychometric data is available for this questionnaire, but it systematically covers the various types of side effects that have been reported for methylphenidate.

Heart Rate

Pulse rate was recorded each week at the same time of day. Pulse rate was measured for a 30 second period after each subject had been seated for a three minute rest period.

Data Analyses

Traditionally, when using single-case experimental designs, experimenters have used visual inspection of the data to determine if a given intervention has reliable treatment effects (see Hersen & Barlow, 1976). If after administration of a placebo (A₁ Condition), the administration of methylphenidate (B condition) results in an improvement in behavior or cognitive performance, which is then followed by a deterioration when the placebo is administered, followed by an improvement upon readministration of the drug, then one can conclude with a high degree of certainty that methylphenidate is responsible for the observed changes in the target responses. Under these conditions it is most improbable that the observed changes are due to the effects of some correlated or uncontrolled variable. In addition, replication of these results with different subjects further strengthens the

conclusions about the efficacy of the treatment. The data was presented graphically and visual inspection was used to determine if the results fit the aforementioned pattern.

In certain situations no conclusions can be drawn from visual inspection of the data because the results appear ambiguous. For example, if there is a drift in the baseline or placebo phases then it is possible that the reliable effects of the treatment might be obscured. In these situations statistical analyses can prove useful. However, the number of statistical tests which can be used to analyze this type of data is limited because of the nonindependence of the repeated measures. With the particular design used in this study, statistical tests, such as time series analysis, were not appropriate. Rating scale, classroom behavioral observations, and cognitive test data were analyzed with the use of repeated-measures parametric statistical tests such as one-way analyses of variance and t -tests for correlated means. Scores were summed within each condition, averaged, and then baseline, placebo, and drug scores were compared.

CHAPTER III

Results

Subjects participating in the study will be described first. Then, results for the behavioral measures, cognitive tests, and psychomotor tasks will be outlined. Group analyses will be presented followed by a section on side effects.

Subjects

Five white male conduct disordered boys between the ages of 6 and 12 were selected for this study. The ages and IQs of the sample are presented in Table 5. All of the subjects had a WISC-R IQ of at least 80. All were inpatients at the Child Study Centre and only went home to their biological or foster families on weekends or holidays.

Mothers of four of the subjects filled out Achenbach's Child Behavior Checklist (CBCL) and a child care worker filled this rating scale out on the remaining subject who was a ward of the Children's Aid Society. The child care worker knew Subject E quite well and was primarily responsible for his care. The children's CBCL profiles are plotted in Figures 1 to 5.

All subjects had T scores well over two standard deviations above the mean on both the Aggressive and Delinquent factors. In other words, all of the subjects

Table 5

Ages and Full Scale WISC-R IQ Scores

Subject	Age ^a	I
A	11 - 11	130 .
B	10 - 5	115 .
C	9 - 0	96
D	6 - 5	90
E	11 - 3	81
Mean	9 - 10	102.4

^a Ages are expressed in years and months.

Figure 1. Child Behavior Profile for Subject A.

Figure 2. Child Behavior Profile for Subject B.

Behavior Problem Scales

Figure 3. Child Behavior Profile for Subject C.

Behavior Problem Scales

Figure 4. Child Behavior Profile for Subject D.

Subject E

Behavior Problem Scales

Figure 5. Child Behavior Profile for Subject E.

scored above the 98th percentile on the factors reflecting aggressive and antisocial behavior. The highest T score for 4 subjects occurred on either the Aggressive or Delinquent factor. The exception was Subject B who was rated very highly on the Aggressive factor as well as on the Uncommunicative and Social Withdrawal factors. Subject B was rated over two standard deviations above the mean on 8 of the 9 factors including the Hyperactivity factor. He was retained for the study despite his elevated Hyperactivity factor because it was felt that his mother may have been exaggerating the severity of his behavior problems and because he was not rated as hyperactive on the Conners Teacher Questionnaire. He scored over 1.5 standard deviations above the mean on the Conduct Disorder factor of the Conners Teacher Questionnaire. In addition, his developmental history did not indicate that he had an Attention Deficit Disorder but was indicative of a Conduct Disorder.

Intraclass correlations between each child's individual profile and the profile subtypes outlined by Edelbrock and Achenbach (1980) were calculated and are presented in Table 6. Two of the subjects most closely matched the Depressed-Social Withdrawal-Aggressive profile subtype whereas the profiles of the remaining 3 subjects were most

Table 6

Intraclass Correlations Between CBCL Profiles and the Profile Patterns
of Edelbrock and Achenbach

Profile Subtype	Subject				
	A	B	C	D	E
A. Schizoid - Social					
Withdrawal	-0.22	0.00	-0.32	-0.63	0.10
B. Depressed-Social					
Withdrawal -					
Aggressive	-0.07	0.17	-0.15	-0.49	0.23
C. Schizoid	-0.43	-0.09	-0.54	-0.63	0.10
D. Somatic					
Complaints	-0.39	-0.80	-0.38	-0.09	-0.54
E. Hyperactive	0.07	-0.41	0.31	-0.19	-0.49
F. Delinquent	0.78	-0.31	0.71	0.48	-0.11

similar to the Delinquent profile subtype. Only 2 of the subjects' profiles were positively correlated with the Hyperactivity profile subtype and in these cases the intraclass correlation between the individual profile and the Hyperactivity profile subtype was substantially lower than that between the individual profile and the Delinquent profile subtype.

The Social Competence factors of the Child Behavior Profile are presented in Table 7. All of the boys scored within the average range on the Activities scale reflecting their normal interest and ability in sports and games.

Subjects A and C participated in fewer social activities than normal boys (a T-score below 30 is in the clinical range), but the other 3 boys scored within the normal range.

Although Subjects C, D, and E tended not to participate in organizations and had few friends, they were described as having one friend whom they played with regularly, and they were thought to play well alone. All the boys except Subject D were in special education classes prior to their participation in the study. Subject C was performing poorly in school whereas the academic performance of Subjects A and B was acceptable. Both of these boys had above average IQs. T-scores on the School scale could not be calculated for the remaining subjects because not all of the items on the scale

Table 7

Child Behavior Checklist Social Competence Subscale Scores

Subject	Subscale		
	Activities	Social	School
A	38	21	43
B	53	36	43
C	51	24	26
D	53	34	a
E	53	46	a

Note. Values are T scores. Scores below 30 are considered to be in clinical range.

^a All of the items on the scale were not answered making it impossible to calculate the T Score.

were answered.

The subjects' scores on the Conners Teacher Questionnaire are presented in Table 8. Three of the subjects scored higher than 1.5 standard deviations above the mean on the Conduct Disorder factor. The remaining two subjects scored below this level on the Conduct Disorder factor. Subject C was retained for the study because he was in a special education class in a public school, and it was thought that his teacher underestimated the severity of his behavior problems possibly because of an atypical frame of reference regarding children's behavior. Subject D was rated by his teacher from the previous school year when he was in kindergarten. Minimal demands were placed on him during this year, and he often was left to play on his own. Thus, it was felt that the teacher had underestimated the severity of his conduct problem. In both of these cases, the teachers' behavioral ratings were not consistent with the parents' behavioral ratings, the social history of the subjects, and observations of their behavior during the study. None of the subjects were rated over 1 standard deviation above the mean on the Hyperactivity factor of the Conners Teacher Questionnaire.

The criteria used by Stewart and coworkers to select conduct disordered children are presented in Table 9 (e.g.,

Table 8

Conners Teacher Questionnaire Factor Scores

Factors	Subject									
	A		B		C		D		E	
	Raw	Z	Raw	Z	Raw	Z	Raw	Z	Raw	Z
1. Hyperactivity	14	0.37	19	0.85	20	0.79	8	-0.21	19	0.85
2. Conduct										
Disorder	15	1.56	14	1.54	12	1.15	4	0.05	15	1.56
3. Emotional										
Overindulgent	12	2.26	6	0.74	6	0.68	1	-0.48	13	2.51
4. Anxious-										
Passive	2	-0.46	5	0.35	3	-0.31	1	-0.81	4	0.20
5. Asocial	4	0.94	3	0.54	1	-0.25	4	1.21	2	0.15
6. Daydreams/										
Attendance										
Problem	2	0.08	7	2.56	1	-0.49	1	-0.32	1	-0.41
7. Hyperkinesis										
Index	11	0.66	14	1.12	13	0.97	4	0.30	15	1.28

Note. The normative data of Trites, Blouin, and Laprade (1982) were used to derive the Z scores for the factors, and the normative data of Goyette, Conners, and Ulrich (1978) were to derive Z scores for the Hyperkinesis Index.

Stewart's Criteria for the Diagnosis of Unsocialized Aggression

-
- a) Aggressiveness: 2 or more of
- fights with peers
 - physically attacks adults
 - verbally abuses adults
 - extreme competitiveness
- b) Noncompliance: 2 or more of
- does not follow directions
 - no discipline works
 - does opposite of what's asked
 - stays out late
- c) Destructiveness: 1 or more of
- firesetting
 - damages objects in the home
 - damages neighbours' property
- d) Hostility: 1 or more of
- quarrelsome with peers
 - cruel to children or animals
 - vengeful
-

Note. The criteria for the diagnosis of Unsocialized Aggression were physical aggression, resistance to discipline, and either destructiveness or hostility. The criteria for the diagnosis of probable Unsocialized Aggression were either physical aggression or resistance to discipline and either destructiveness or hostility.

Stewart et al., 1981). The data used to determine if the subjects fit these criteria were gathered during structured psychiatric interviews with the mothers or the primary child-care worker in the case of Subject E. Four out of five subjects fit Stewart's criteria for Unsocialized Aggression. In fact, these subjects satisfied the criteria for all four categories of behavior. The exception was Subject B who met Stewart's criterion for probable Unsocialized Aggression. He satisfied the requirements for noncompliance and destructiveness but not for physical aggression and hostility.

The rating scale data and results of the structured interviews show the type and severity of the behavior problems exhibited by the subjects, but these data do not provide a complete description of the children's behavior, and they do not provide any information on family functioning. Brief psychosocial and medical histories will be presented for each subject so that the reader can get a more vivid picture of the children and their problems, and so that some of the more salient incidents in their lives can be outlined.

Subject A was the product of a normal pregnancy and birth, and his developmental milestones were normal. No early behavioral problems were reported. Both the mother and

Subject A were physically and emotionally abused by the father who rejected Subject A. Apparently, he observed his father abusing his mother several times, and after one of these incidents picked up a butcher knife and threatened to kill his father. Following this incident, the mother separated from the father. Subject A was four years old at the time and has been exhibiting aggressive behavior since the time of these incidents. The mother did not have difficulty adjusting to the role of a single parent, although she did experience financial difficulties.

Subject A was first identified as having behavior problems by the school when he was in Grade 2. He was described as being emotionally and behaviorally disturbed and was placed in a special class in the public school system.

At the time of referral to the Child Study Center when he was 9 years old, Subject A's mother could not control his behavior. He was defiant, disobedient, and verbally abusive and had many temper tantrums. The family could not go on outings in the community because of his inappropriate behavior. He was physically aggressive towards his little sister and other younger and smaller children as well as animals. He had poor peer relationships and was avoided by other children. He was reported to have stolen money from both his mother and a tenant who lived upstairs. He also was

reported to have stolen bicycles. He occasionally destroyed objects in the home. He had been a resident of the Child Study Centre for three years when he entered the study. His behavior had improved somewhat as a result of the structured milieu, behavior therapy program, and administration of 10 mg Ritalin t.i.d., then 5 mg dextroamphetamine b.i.d., and then 25 mg Mellaril q.i.d. According to his mother, he did not exhibit an improvement in his behavior as a result of taking any of these medications, and she was concerned that he was glassy eyed when he was on these medications. Although the staff at the Child Study Centre thought that Subject A's behavior was improved by Ritalin, his mother was unconvinced and refused to give him the medication on the weekends when he came home.

No prenatal or perinatal difficulties were noted in the medical history of Subject B, and developmental milestones were reached at the appropriate ages. Subject B's mother never married and lived apart from the same male companion who had fathered her three children. Apparently, she wished to remain independent. There were longstanding problems in the mother-son relationship, and feelings of mistrust and hostility were apparent on both sides.

At the time of admission, Subject B was noncompliant and defiant both at home and at school and physically destructive

at home. He stole toys from other children and occasionally lied. His mother was unable to manage his behavior. He was anxious, expressed fears about losing control, ate excessively, and had low self-esteem. He had poor peer relationships and preferred to be alone. He was withdrawn and refused to verbally express his feelings or show his emotions. At times, he was enuretic and had been treated with behavioral approaches. One year prior to his admission to the Child Study Center, he was treated as an inpatient at the Royal Ottawa Hospital, the regional psychiatric hospital, for a 6-month period. At that time, he also was thought to have been depressed and was treated for 4 months with amitriptyline while he was an inpatient. He had been placed in an emergency treatment home run by the Children's Aid Society for 3 months immediately prior to his admission to the Child Study Centre, and he was a resident for 3 months before he entered the study.

Subject C was the product of a medically normal pregnancy and delivery, and developmental milestones were attained at appropriate times. This was an unwanted pregnancy and his mother reported that she was upset and angry throughout it. From the beginning his family life has been rather chaotic. His parents separated a few months prior to his birth, and he did not meet his biological father until much later in life.

His mother began to live with his step-father a few months after the separation. The mother-son relationship has always been somewhat ambivalent. Apparently, the mother frequently expressed to him that she did not love him and wanted to give him away. At the same time, she claimed that she loved him but could not show it.

Subject has been exhibiting behavior problems since the age of 6. He exhibited many temper tantrums. He was verbally aggressive, disobedient, vengeful, and cruel. He often swore. Examples of his extreme aggressive and antisocial behavior included one sexual assault which the police investigated, one incident of fire-setting, and vandalism of a building. In addition, he deliberately urinated on household objects, shot a roman candle at a group of children, threatened a younger girl with a steak knife, and attempted to drown another girl. He stole money from his mother and a variety of items from neighbours. He was banned from all stores in the neighbourhood because of his shoplifting. Needless to say, he was unpopular with other children and neighbours and had poor peer relations.

The family had been involved with the Children's Aid Society for a number of years, but circumstances always seemed to interfere with them receiving any long term therapy. For example, at one point when the Children's Aid

Society was trying to get them to participate in family therapy, the mother decided to send him to live for a few months with his biological father who lived in another city. He was admitted to the Child Study Centre one month prior to this study and had never been treated with any type of psychoactive medication.

Subject D was described by his mother as a colicky baby, and he exhibited negative behavior from 18 months of age. His medical history was unremarkable except for recurrent ear infections which were treated successfully by bilateral insertion of tubes. Subject D's family life always has been extremely chaotic. His mother separated from his father when he was 4 months of age. As a toddler, he apparently had a tense relationship with his mother and occasionally smeared excrement on himself and around the room. When he was 4 years old, he was sexually abused by a male stranger. His mother who never remarried had two more children after Subject D. She abused drugs during the latter pregnancy. A few months later she took an intentional overdose and was treated in a detoxification unit at the Royal Ottawa Hospital. The children were placed in foster care for 4 months while the mother recovered. Subject D previously had been treated for a short period of time in the Psychiatric Unit of the Children's Hospital of Eastern Ontario because of

his unmanageable behavior. The mother had adopted a laissez-faire style of discipline. She set few guidelines and placed few responsibilities on the children. In addition, she was inconsistent in that she alternated between closeness and disengagement from the family members.

Subject D was referred to the Child Study Center because of destructive behavior both at home and at school. He was noncompliant, physically aggressive towards his mother, cruel to animals, and verbally abusive. He frequently had intense temper tantrums which lasted for hours. He had few friends as he often hurt other children, and they were scared of him. He set 3 fires. His aggressive and unmanageable behavior intensified after he returned from foster care, and on one occasion his mother had to phone the police in order to get him down from a tree. He was in the day school programme at the Child Study Centre for one week prior to entering the study. He previously was treated with 15 mg of methylphenidate per day, but his mother felt that he was lethargic while on this medication. She was not opposed to the use of medication because Subject D's older brother had been on methylphenidate for two years.

Subject E's birth was reported by his mother to be relatively long and difficult compared to that of her other three children. However, his early medical history was

unremarkable, and developmental milestones were reached at appropriate ages. He was placed in the care of the Children's Aid Society when he was 4 because his parents were judged unable to meet his needs. His parents separated when he was 2, and he was placed with his father who physically abused him. He was returned to his mother where he remained until he was placed into care because of his mother's confusion and depression. He has had a long history of destructive and aggressive behavior both at home and at school. Over the next 8 years, he was placed in 6 different foster homes with the longest placement being 5 years. On each occasion, the foster parents requested the Children's Aid Society to relocate Subject E because they were unable to control his aggressive and defiant behavior. There was an unsubstantiated report of physical abuse in one of the foster homes. On one occasion Subject E vandalized his foster parents' house with a crowbar when they left him in the care of a babysitter. He received emergency psychiatric treatment for a brief period of time at the Children's Hospital of Eastern Ontario. There is no doubt that these chaotic events and continual disruptions in living arrangements played a role in the development of his aggressive and antisocial behavior and led to his admission to the Child Study Centre about 1 year prior to his participation in the study.

Shortly after his admission, he was placed on 10 mg Ritalin t.i.d. and was reported by his primary therapist to have a favorable response. About one month before his entrance into the study, his dosage was raised to 15 mg at breakfast, 15 mg at lunch, and 10 mg after school, and this information was not communicated to the principal investigator.

Behavioral Measures

Effects of methylphenidate on classroom behavior will be described first. Results for the Conners Teacher Questionnaires, the daily reports filled out by the teachers, and the classroom behavioral observations will be outlined. Then, the subjects' behavior in the residence will be discussed. Results for the Conners Parent Questionnaires and the daily residence reports will be outlined.

Conners Teacher Questionnaires

The Conners Teacher Questionnaire factor scores for Subject A are presented in Figures 6 and 7 and Table 10. Although there was a change in raters after Subject A had been in the study for five weeks, each rater had an opportunity to observe him for two weeks when he was on methylphenidate and for two weeks when he was on placebo.

Figure 6 shows that after the baseline week, during which Subject A was unusually well behaved, his aggressive and disruptive behavior, as reflected by the Conduct Disorder and

Figure 6. Raw scores on the Conduct Disorder and Emotional Overindulgent factors of Connors' Teacher Questionnaire for Subject A. (At x a new rater started to complete the questionnaires.)

Subject A

Figure 7. Raw scores on the Hyperactivity factor and the Hyperkinesis Index of Connors' Teacher Questionnaire for Subject A. (At week 8, a new rater started to complete the questionnaire.)

Table 10

Raw Scores on the Anxious-Passive, Asocial, and Daydreams/Attendance Problem Factors of the Conners Teacher Questionnaire for Subjects A,C, and E.

Subject	Phase									
	B1	Rit	Rit	Pl	Pl	Rit	Rit	Pl	Pl	Rit 15
Anxious-Passive factor										
A	2	1	2	2	3	0 ^a	0	0	0	
C	7		5		4		2		0	
E	7	4	3	4	4	3	3	2	3	5
Asocial factor										
A	1	1	2	5	5	0 ^a	0	1	1	
C	3		2		3		0		1	
E	8	0	2	1	4	2	7	3	6	4
Daydreams/Attendance Problem factor										
A	2	1	1	4	3	0 ^a	0	0	2	
C	3		0		2		0		0	
E	6	3	5	5	5	4	6	6	5	6

Note. B1 = Baseline; Rit = Ritalin; Pl = Placebo; Rit 15 = Ritalin 15 mg.

^a At this point, a new rater started to complete the questionnaires.

Emotional Overindulgent factor scores fluctuated markedly depending on which medication he had been given. Subject A had been on methylphenidate before the study started, and it was the teachers' opinion that his behavior during the baseline week was exemplary because he did not like taking the medication and wanted to be taken off it. It is clear from looking at the Connors Teacher Questionnaire data that he was unable to maintain his controlled behavior during subsequent placebo weeks. The Conduct Disorder factor scores for weeks in which he was given placebo often were twice as high as those for weeks in which methylphenidate was administered. These scores increased substantially both times when methylphenidate was withdrawn and dropped sharply when it was readministered during the sixth and seventh weeks of the study. The changes in the Emotional Overindulgent factor scores were less dramatic, but the pattern was the same. These findings strongly suggest that it was the methylphenidate which altered Subject A's behavior and not some uncontrolled variable. An item analysis of the Conduct Disorder factor scores revealed that Subject A was less defiant, quarrelsome, stubborn, impudent, moody, and uncooperative when he was on methylphenidate. He also exhibited fewer temper outbursts and teased other children less frequently when he was on medication. Changes in the

Emotional Overindulgent factor scores largely were accounted for by changes in the three items which load on both the Conduct Disorder and Emotional Overindulgent factors: "Mood changes quickly and drastically"; "Temper outbursts, explosive and unpredictable behavior"; and "Stubborn".

Subject A also was rated as less demanding and less easily frustrated when he was on methylphenidate than when he was on placebo.

Figure 7 shows that Subject A also exhibited fairly large changes in his Hyperactivity factor scores and Hyperkinesis Index during the course of the study. In each case, the baseline score either declined or remained unaltered when methylphenidate initially was administered, substantially increased when methylphenidate was withdrawn, declined when methylphenidate was readministered, and again dramatically increased when placebo was administered. It is extremely likely that the changes in medication produced these alterations in behavior. The changes in the Hyperactivity factor scores resulted from Subject A being rated as less restless, fidgety, demanding, excitable, impulsive, and disturbing when he was on methylphenidate than when he was on placebo. A few items such as "Quarrelsome", "Acts smart", "Teases other children or interferes with their activities", "Impudent" and "Uncooperative", load on both the Hyperactivity

and Conduct Disorder factors (Trites et al., 1982), and Subject A's scores on these items were lower when he was on methylphenidate than when he was on placebo. No changes were evident in the items reflecting inattentive and distractible behavior, and these behaviors were not a problem for Subject A. Changes in the Hyperkinesis Index (see Figure 7) were accounted for by changes in some of the items which this scale shares with the Hyperactivity factor (The relevant items are: "Constantly fidgeting"; "Restless or overactive"; "Excitable; impulsive"; "Demands must be met immediately--easily frustrated"; and "Disturbs other children") as well as by changes in shared items with the Conduct Disorder factor ("Mood changes quickly and drastically"; and "Temper outbursts, explosive and unpredictable behavior"). All of these items were rated as less of a problem for Subject A when he was on medication than when he was on placebo.

Subject A's Z scores on the Hyperactivity factor and the Hyperkinesis Index averaged over the baseline and placebo weeks are presented in Table 11. The mean Z score for each of these measures was less than 1.5 standard deviations above the mean indicating that the teachers rated him as being only mildly to moderately hyperactive. In addition, he never earned high scores on the items reflecting inattentive and

Table 11

Average Baseline and Placebo Ratings on Selected Scales on the Conners
Teacher Questionnaire

Subject	Scale								
	Conduct Problem			Hyperactivity			Hyperkinesis		
	Factor ^a			Factor ^a			Index ^b		
	Raw	<u>M</u>	<u>Z</u>	Raw	<u>M</u>	<u>Z</u>	Raw	<u>M</u>	<u>Z</u>
A	16.4	1.26	1.77	25.4	1.49	1.48	16.2	1.62	1.46
B	4.4	0.34	0.00	20.8	1.22	1.03	14.0	1.40	1.12
C	19.0	1.46	2.22	27.3	1.61	1.49	15.7	1.57	1.38
D	8.1	0.62	0.59	14.2	0.84	0.16	8.6	0.86	0.46
E	21.6	1.66	2.54	36.0	2.12	2.52	22.4	2.24	2.42

^a Normative data of Trites, Blouin, and Laprade (1982) were used to calculate Z scores.

^b Normative data of Goyette, Conners, and Ulrich (1978) were used to calculate Z scores.

distractible behavior.

Anxious-Passive, Asocial, and Daydreams/Attendance Problem factor scores are presented in Table 10. Subject A exhibited low scores on these factors indicating that these behaviors were not characteristic of him and he did not exhibit any consistent changes in these factor scores during the course of the study.

Subject B was in a public school for the first 5 weeks of the study, and then he went to the school at the Child Study Centre for the summer session. Thus, two different teachers rated his behavior during the study, but each teacher had an opportunity to observe him on methylphenidate and on placebo. His Conners Teacher Questionnaire results are presented in Figures 8 and 9, and Table 12.

Figure 8 shows that Subject B was well behaved during the baseline week, and then his scores on the Conduct Disorder factor increased during the weeks when he was on placebo, followed by a reduction on weeks 4 and 5 when he was on methylphenidate. His Conduct Disorder factor scores were very low when he was at the Child Study Centre school, regardless of which type of medication he was on. When he was on medication, his public school teacher thought he was more cooperative, less stubborn, less defiant, and less impudent than when he was on placebo. The teacher also

Figure 8. Raw scores on the Conduct Disorder and Emotional Overindulgent factors of Connors' Teacher Questionnaire for Subject B. (At x a new rater started to complete the questionnaires.)

Figure 9. Raw scores on the Hyperactivity factor and the Hyperkinesis Index of Conners' Teacher Questionnaire for Subject B. (At x a new rater started to complete the questionnaires.)

Table 12

Raw Scores on the Anxious-Passive, Asocial, and Daydreams/Attendance
Problem Factors of the Conners Teacher Questionnaire for Subjects B and
D

Subject	Phase							
	B1	Pl	Pl	Rit	Rit	Pl	Pl	Rit
Anxious-Passive factor								
B	3	1	2	3	2	8 ^a	4	7
D	6	6	5	9	6	5	6.5	8.5
Asocial factor								
B	0	0	0	0	0	0 ^a	1	4
D	0	1	3	0	3	4	4.5	1.5
Daydreams/Attendance Problem factor								
B	5	4	3	2	2	0 ^a	4	1
D	3	1	2	2	1	5	3	1

Note: B1 = Baseline; Rit = Ritalin; Pl = Placebo

^a At this point, a new rater started to complete the questionnaires.

thought he lied and teased other children less frequently.

Figure 8 also shows that there were no effects on the Emotional-Overindulgent factor scores.

Conduct Disorder factor scores for Subject B were averaged over baseline and placebo weeks and the results are presented in Table 11. His overall score was within the average range, and it is inconsistent with the pre-baseline (subject selection) rating on the Conduct Disorder factor made by his public school teacher. Factors accounting for this discrepancy include the change in raters and settings as well as the longer time period of observation for the pre-baseline measure. Instead of a one week observation period, pre-baseline measures assessed each subject's behavior over a two-month period.

Subject B's scores on the Hyperactivity factor and the Hyperkinesis Index are graphed in Figure 9. On both measures, Subject B showed a large favorable response to methylphenidate. Each time the medication was administered, the weekly ratings decreased from the previous two weeks when he was on placebo. An item analysis revealed that differences between the medication and placebo weeks were the results of changes in the items reflecting activity, inattention, impulsiveness, and teasing and disturbing other children. Improvements in these behaviors occurred when

Subject B was on medication. Table 11 shows the mean Hyperactivity factor score and Hyperkinesis Index averaged over baseline and placebo weeks, and the scores are within the normal range. Figure 9 also shows that there was an overall decrease in his ratings on these measures during the course of the study. This tendency can be accounted for by the change in raters and/or settings. He certainly had less of an opportunity to disturb other children and to engage in irrelevant activities when he was in the school at the Child Study Center because of the lower teacher-pupil ratio and the more structured milieu.

There were no consistent differences between medication and placebo weeks in the Anxious-Passive, Asocial, and Daydreams/Attendance Problem factor scores for Subject B (see Table 12). After the change in schools, Subject B's scores on the Anxious-Passive factor increased largely as a result of higher ratings on the items "Appears to lack leadership" and "Shy". These differences might be accounted for by the change in raters, but the school personnel felt that he had some difficulty adjusting to the new class, and he mostly kept to himself for the first couple of weeks.

Subject C entered the Child Study Centre school during the summer programme. Because of the limited duration of the summer session, only 5 teacher ratings were collected. The

baseline observation was recorded after 4 school days, and the remaining ratings each were based on an observation period of 7 school days.

Subject C clearly exhibited a favorable response to methylphenidate. His score on the Conduct Disorder factor decreased each time he was on medication and increased when he switched to placebo (see Figure 10). The same pattern was evident with respect to his scores on the Emotional Overindulgent factor. His teacher thought that he was less moody, quarrelsome, stubborn, and demanding when he was on methylphenidate than on placebo. In addition, he exhibited fewer temper outbursts and lied less frequently while on medication.

The Hyperactivity factor and Hyperkinesis Index scores of Subject C are graphed in Figure 11. The Hyperactivity factor score was 31 for the baseline phase, decreased to 21 after medication was introduced, rose to 27 when he was placed on placebo, declined to 8 when he was methylphenidate, and rose to 24 during the last placebo phase. The Hyperkinesis Index scores followed the same pattern: Ratings for the time periods when Subject C was on methylphenidate were much lower than those for the baseline and placebo phases (see Figure 11). Subject C was regarded as less demanding, inattentive, and quarrelsome when he was on medication than when he was on

Figure 10. Raw scores on the Conduct Disorder and Emotional Overindulgent factors of Connors' Teacher Questionnaires for Subject C.

Subject C

Figure 11. Raw scores on the Hyperactivity factor and the Hyperkinesis Index of Conners' Teacher Questionnaire for Subject C.

placebo. Furthermore, he disturbed other children and hummed and made other odd noises less frequently while he was on methylphenidate.

Table 10 shows that there were no changes in the Anxious-Passive, Asocial, and Daydreams/Attendance Problem factor scores for Subject C as a result of the administration of methylphenidate. There was a decrease in the Anxious-Passive factor score during the course of the study which was the result of lower scores on the following items: "Appears to be easily led", "Appears to lack leadership", and "Overly anxious to please". Since Subject C only had been in the Child Study Centre school for one week prior to his participation in the study, this decrease probably reflects his adaptation to the setting. His scores on the other two factors remained consistently low throughout the study.

Subject D was well behaved during the first 5 weeks of the study, and consequently his scores on the Conduct Disorder factor were consistently low. He entered the school at the Child Study Centre at the beginning of the fall term and he entered the study two weeks later. Thus, he probably was going through a "honeymoon period" while he adjusted to the new setting; and this contributed to his overall low score on the Conduct Disorder factor (see Table 11). His Conduct Disorder factor scores were much higher

during weeks 6 and 7 when he was on placebo, and they decreased considerably during the final two weeks of the study when he was on methylphenidate (see Figure 12). He was rated as less quarrelsome, moody, defiant, impudent, stubborn, and uncooperative when he was on the medication in the last two weeks of the study than on the previous two weeks when he was on placebo. In addition, he exhibited fewer temper outbursts during the second medication phase of the experiment than he did during the second placebo phase.

There was not a consistent medication effect on Subject D's Emotional Overindulgent factor scores on the Conners Teacher Questionnaire. Although his ratings on this factor were lower during the last two medication weeks than they were during the previous two weeks when he was on placebo as a result of lower scores on the items reflecting mood shifts, stubbornness, and temper outbursts, his ratings on this factor during the first medication phase were higher than those of the first placebo phase and were comparable to those of the second placebo phase (see Figure 12).

The data suggested that Subject D exhibited a favorable response to methylphenidate on both the Hyperactivity factor and Hyperkinesis Index. His scores on these measures were fairly stable during the first 5 weeks of the study, although the scores increased slightly from the first placebo phase to

Figure 12. Raw scores on the Conduct Disorder and Emotional Overindulgent factors of

the first methylphenidate phase (see Figure 13). These scores then increased when Subject D was switched to placebo and then decreased during the second methylphenidate phase. However, the pattern was not entirely clear because of his relatively low week 7 placebo score. The Hyperactivity factor scores were lower during the medication phases than during the second placebo phase because of lower scores on the following items: "Hums and makes other odd noises"; "Inattentive, easily distracted"; "Quarrelsome"; "Impudent"; and "Uncooperative". It is interesting to note that the last 3 items also load on the Conduct Disorder factor and changes in these items partially accounted for changes in the Conduct Disorder factor score. The Hyperkinesis Index followed the same pattern during the last 6 weeks of the study because of changes in items reflecting inattentiveness, mood shifts, and temper outbursts. These problem behaviors were rated as less severe when Subject D was on medication.

No consistent effects due to the administration of methylphenidate were seen in Subject D's Anxious-Passive, Asocial, and Daydreams/Attendance Problem factor scores (see Table 12). Subject D's scores on these measures were consistently low throughout the study.

The Conduct Disorder and Emotional Overindulgent factor scores for Subject E are presented in Figure 14, the

Figure 13. Raw scores on the Hyperactivity factor and the Hyperkinesis Index of

Subject E

Figure 14. Raw scores on the Conduct Disorder and Emotional Overindulgent factors of Conners' Teacher Questionnaire for Subject E.

Hyperactivity Factor scores and Hyperkinesis Index in Figure 15, and the remaining factors of the Conners Teacher Questionnaire in Table 10. Subject E exhibited a great deal of variability in his factor scores. In the first 7 weeks of the study, there was a tendency for his factor scores to alternate in magnitude between high and low. Thus, there were no clear-cut medication effects on Subject E's classroom behavior during the 9-week study. Because of the absence of medication effects and the fact that the standard dose of 10 mg of methylphenidate was slightly lower than his usual dose of 15 mg, a decision was made to extend the study for a one week period and to administer 15 mg of methylphenidate in the morning and at lunch, and 10 mg in the evening. Subject E's scores on most of the factors remained unchanged, but his scores on the Hyperactivity factor and the Hyperkinesis Index were lower than any rating made during the baseline or placebo weeks (see Figure 15). He was rated as less fidgety, restless, inattentive, noisy, and impulsive during this week than at any other time in the study except for week 2 when he was on Ritalin.

Subject E was the only subject whose average Hyperactivity factor score during the baseline and placebo weeks was greater than 1.5 standard deviations above the mean (see Table 11). This score is much higher than that of his

Figure 15. Raw scores on the Hyperactivity factor and the Hyperkinesis Index of "Conners' Teacher Questionnaire for Subject E.

pre-baseline Conners Teacher Questionnaire score which was collected while he was on medication. It was not possible to collect a pre-baseline Conners Teacher Questionnaire score while he was off methylphenidate because the staff was thoroughly convinced that he was a favorable responder and they even were reluctant to allow him to participate in the study.

Teacher Reports

A complete set of teacher reports was available for Subject A, and a complete set of revised reports was available for Subject E. Incomplete sets of reports were available for the remainder of the subjects. Daily teacher reports were blocked in 5-day intervals, except for Subject C for whom they were blocked in 7-day intervals, in order to reduce the variability of the data and thus highlight medication-placebo differences.

Methylphenidate did not reduce the frequency of problem behavior exhibited by Subject A (see Figure 16). The frequencies of problem behavior were stable for the first 3 weeks and then increased when he was switched to placebo. However, the frequencies of problem behavior exhibited during the last 4 weeks were quite variable; he exhibited a relatively high frequency of problem behavior during week 6 when he was on medication and a relatively low frequency of

Figure 16. Weekly means of total number of problem behaviors reported daily by Subject A's teachers.

problem behavior during week 9 when he was on placebo.

On the other hand, medication effects were evident on the ratings of the 5 dimensions of behavior. Each time the medication was administered Subject A was rated as less tense, less demanding, more obedient, more attentive, and more sociable (see Table 13). He also was rated as more withdrawn. When he was switched from methylphenidate to placebo, all of these ratings increased indicating that the teachers regarded him as more tense, demanding, disobedient, and distractible, and less withdrawn.

Subject B was in a public school for the first 5 weeks of the study, and reports only were available for 2 weeks when he was on placebo and then 2 weeks on methylphenidate. There were not any differences in the number of problems exhibited or adjective ratings between the weeks when he was on placebo and medication.

Methylphenidate clearly reduced the frequency of problem behavior exhibited by Subject C. Figure 17 shows that each time the medication was administered, the frequency of problem behavior decreased, and each time the medication was withdrawn, the frequency of problem behaviors increased. Adjective ratings were filled out inconsistently for the first 14 school days of the study. Thereafter, there was a slight increase in the ratings on each of the adjectives

Table 13

Teacher Ratings on Behavioral Dimensions for Subject A

Behavioral dimension	Phase								
	B	Rit	Rit	Pl	Pl	Rit ^a	Rit	Pl	Pl
sociable-									
withdrawn	3.2	3.2	3.75	4.8	4.67	3.75	3.0	4.4	4.4
relaxed-									
tense	5.0	3.6	4.25	6.2	5.67	4.75	3.8	6.0	5.4
not demanding-									
demanding	5.0	3.6	3.5	6.0	6.0	4.5	3.6	6.2	5.6
obedient-									
disobedient	3.8	3.2	3.0	5.0	4.33	4.0	2.6	6.2	4.0
attentive-									
distractible	3.2	2.4	2.75	4.2	4.33	3.5	2.4	5.4	3.8

Note. Ratings were made on a 7-point scale with higher scores reflecting more undesirable behavior. B₁ = Baseline; Rit = Ritalin; Pl = Placebo

^a A new rater started to complete the questionnaires.

Figure 17. Mean number of problem behaviors for each experimental phase reported daily

across phases, and no medication effects were apparent.

The format of the teacher reports was changed after Subject D had completed 6 weeks of the study. No differences in the frequency of problem behavior between medication and placebo weeks were apparent in the first 6 weeks. Ratings on the 5 dimensions of behavior were not available for Subject D. Revised teacher reports were available for one placebo week and the last 2 medication weeks. Administration of methylphenidate did not reduce the amount of verbal aggression or physical aggression or the number of temper tantrums or sessions in time out. The frequency of all of these measures was low during the placebo week and there was little room for improvement.

The number of incidents of verbal aggression, physical aggression, and defiance were recorded for Subject E. The administration of either 10 or 15 mg methylphenidate did not alter the frequency of occurrence of these behaviors (see Figure 18). In addition, the frequency of use and duration of physical restraint and time out were recorded. Subject E acted up fairly frequently in class and had difficulty accepting the consequences of his actions and controlling his temper. He was physically restrained 5 times, for a total of 31 minutes during the course of the study, and he was sent to the time-out room 8 times where he spent a total of 115

Figure 18. Weekly means of total number of specific problem behaviors reported daily by Subject E's teachers.

minutes. He was sent to the quiet room 4 times and physical restraint was used 3 times during the baseline phase, which was his worst week as far as these incidents were concerned. However, he was sent to the time out room twice during week 6 and twice during week 7 when he was on 10 mg methylphenidate. He also had weeks both on placebo and on low and high doses of methylphenidate when neither of these punishments were used. Thus, medication effects were not apparent on the frequency or duration of physical restraint or time out.

Classroom Behavioral Observations

A total of 15 interrater reliability checks were conducted during the course of the study, and 4 out of 5 subjects were observed simultaneously. Seven of the checks were conducted during placebo phases, seven during Ritalin phases, and the remaining check was conducted during a baseline phase. Five of the reliability checks were carried out with Observer B, and the remainder with Observer C.

Measures of interobserver agreement are presented in Tables 14, 15, and 16. Point-by-point agreement ratios for occurrences of the target behaviors were calculated by dividing the number of agreements (A) that the target behavior had occurred during the interval by the number of agreements plus disagreements (D) and then multiplying the product by 100 (i.e., $(A/(A+D)) \times 100$). These data are

Table 14

Percentage Agreement for Occurrence of Behaviors of the Observational Code

Target Behaviors	Comparisons								
	Raters A and B			Raters A and C			Total		
	A	D	%	A	D	%	A	D	%
1. Interference	14	17	45.2	23	25	47.9	37	42	46.8
2. Conversation									
Initiation	2	1	66.7	7	7	50.0	9	8	52.9
3. Vocalization	1	2	33.3	1	6	14.3	2	8	20.0
4. Non-Compliance	-	-	-	-	-	-	-	-	-
5. Aggression	-	-	-	0	1	0	0	1	0
6. Self-Orienting	14	10	58.3	3	3	50.0	17	13	56.7
7. Teacher-Pupil									
Interaction	34	20	63.0	155	21	88.1	189	41	82.2
8. Off-Task	34	27	55.7	35	31	53.0	69	58	54.3
9. Day-Dreaming	1	2	33.3	0	1	0	1	3	25.0
10. Change of									
Position	18	11	62.1	33	13	71.7	51	24	68.0
Absence of									
Behavior	78	26	75.0	210	41	83.7	288	67	81.1
Mean Disruptive									
Behavior	84	70	54.5	102	87	54.0	186	157	54.2

Note. Percentage agreements were calculated by dividing the number of agreements the number of agreements plus disagreements and then multiplying by 100.

A = number of agreements; D = number of disagreements; % = percentage agreements.

Table 15

Percentage Agreement for Nonoccurrences of Behaviors of the Observational Code

Target Behaviors	Comparisons								
	Raters A and B			Raters A and C			Total		
	A	D	%	A	D	%	A	D	%
1. Interference	189	17	91.7	410	25	94.3	599	42	93.4
2. Conversation									
Initiation	217	1	99.5	444	7	98.4	661	8	98.8
3. Vocalization	217	2	99.1	451	6	98.7	668	8	98.8
4. Noncompliance	220	0	100	458	0	100	678	0	100
5. Aggression	220	0	100	457	1	99.8	667	1	99.9
6. Self-									
Orienting	196	10	95.1	452	3	99.3	648	13	98.0
7. Teacher-Pupil									
Interaction	166	20	89.2	282	21	93.1	448	41	91.6
8. Off-Task	159	27	85.5	392	31	92.7	551	58	90.5
9. Day-Dreaming	217	2	99.1	457	1	99.8	674	3	99.6
10. Change of									
Position	191	11	94.6	412	13	96.9	603	24	96.2
Absence of									
Behavior	116	26	81.7	207	41	83.5	323	67	82.8
Mean Disruptive									
Behavior	1826	70	96.3	3933	87	97.8	5759	157	97.3

Note. Percentage agreements were calculated by dividing the number of agreements by the number of agreements plus disagreements and then multiplying by 100.

A=number of agreements; D=number of disagreements; %=percentage agreements.

Table 16

Interrater Reliabilities using Kappa Correlations

Target Behavior	Comparisons		
	A + B	A + C	Total
1. Interference	.58	.62	.61
2. Conversation Initiation	.77	.67	.68
3. Vocalization	.50	.24	.33
4. Non-compliance	0	0	0
5. Aggression	0	0	0
6. Self-Orienting	.72	.63	.72
7. Teacher-Pupil Interaction	.72	.90	.86
8. Off-Task	.64	.65	.65
9. Day-Dreaming	.50	0	.43
10. Change of Position	.74	.82	.79
Absence of Behavior	.59	.82	.80
Mean Disruptive Behavior	.69	.69	.69

presented in Table 14. These agreement ratios averaged over all raters ranged between 46.8% and 82.2% for those target behaviors which occurred more than ten times. The average agreement ratio, excluding the ratio for Mean Disruptive Behavior which is a summary category, was 63.1 for those target behaviors which occurred more than ten times.

The point-by-point agreement ratios for nonoccurrences of the target behaviors are presented in Table 15. These ratios were calculated in a similar manner to those in Table 14 except that agreements and disagreements about nonoccurrences of the target behaviors were tabulated and then inserted into the standard formula (i.e., $(A/(A+D)) \times 100$). The ratios averaged across all three raters ranged from 82.8% to 100%, and the average ratio, excluding the ratio for Mean Disruptive Behavior, was 95.4. If one examines the set of target behaviors which occurred more than ten times, then the point-by-point agreement ratios calculated over all interreliability checks for the nonoccurrences of these target behaviors ranged from 82.8% to 98.8%, and the mean was 93.9.

Agreement between observers partly depends on the base rate of occurrence of the target behaviors (Kazdin, 1982). If a particular behavior occurred with a relatively high frequency, then observers were likely to have higher levels

of agreement as a function of chance than if the behavior occurred with a lower frequency. In order to provide a measure of interobserver agreement which takes into account agreement due to chance, kappa correlations (Cohen, 1965) were calculated using standard procedures (Kazdin, 1982). These data are presented in Table 16. For target behaviors which occurred more than ten times, the kappa correlations calculated on the total number of interobserver reliability checks ranged from 0.61 to 0.86. The average correlation was 0.64. The kappa correlation for Mean Disruptive Behavior was not included in this average.

A few of the target behaviors such as Vocalization, Non-Compliance, Aggression, and Day-Dreaming occurred very infrequently and with the exception of Aggression will not be discussed. The Aggressive incidents will be discussed because they often were highly salient for the staff and other students in the class.

Observations could not be conducted on some days due to statutory holidays, teacher professional development days, class outings, and special classroom activities. Limitations on data interpretation as a consequence of less than satisfactory interobserver reliabilities for some of the target behaviors will be addressed in the Discussion section.

Figure 19 shows that Subject A interfered with classroom

3

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

Figure 19. Percentage of intervals in which Off-Task and Interference Behaviors were recorded during classroom behavioral observations of Subject A.

activities less often when he was on Ritalin than when he was on placebo or no medication. In addition to the consistent stimulant-induced changes in mean number of interfering acts exhibited, the level of this behavior also was affected. That is, the percentage of interfering acts exhibited during the first observation period of each Ritalin phase was lower than the number exhibited during the last observation session of the preceding baseline or placebo phase. In addition, the percentage of interference behaviors during the first observation period of each placebo phase was higher than the corresponding percentage of the last observation period of the preceding methylphenidate phase. These findings indicate that Subject A disrupted the class by calling out to the teacher, making noises, or bothering his classmates less frequently when he was on Ritalin than during the other phases.

The changes in mean percentage of intervals off task did not consistently follow the expected pattern (see Figure 19). The mean percentage of intervals off task was higher for the first Ritalin phase than the following placebo phase, but Subject A was most attentive during the second Ritalin phase. However, the level of off-task behavior consistently changed each time medication was introduced and withdrawn. The percentages of off-task behavior declined from the last

observation session of the baseline or placebo session to the first observation session of the following medication phase. Furthermore, the opposite pattern was seen when placebo phases were instituted. The percentage of intervals spent off task increased from the last observation session of a medication phase to the first observation session of a placebo phase. These findings indicate that Subject A tended to be more attentive and spent more time on task when he was on Ritalin than when he was on no medication. The Ritalin-placebo differences in mean percentage of intervals off task were less clear.

Figure 20 shows that there was a slight tendency for methylphenidate to reduce the percentage of intervals in which Subject A initiated a conversation. There was a slight decrease in the mean percentage of intervals in which he initiated a conversation when he was on Ritalin compared to the other conditions. The changes in level also followed the expected pattern. A decrease in the percentage of intervals in which a conversation was initiated from the last observation period of the baseline or placebo phase to the first Ritalin observation period occurred, and an increase in the percentage of intervals in which a conversation was initiated occurred between the transition points at the end of a Ritalin phase and the beginning of the following placebo

Subject A

Figure 20. Percentage of intervals in which Conversation Initiation and Self-Orienting Behaviors were recorded during classroom behavioral observations of Subject A.

phase. However, it should be pointed out that the differences in means and levels were small and that Subject A did not initiate conversations with his peers during most of the observation sessions especially when he was on Ritalin.

There was a decline in the percentage of intervals in which self-orienting behavior was scored during the course of the study. Although there was a change in the levels of self-orienting behavior at the transition points of the study, the changes in mean percentages of self-orienting did not consistently follow a pattern indicative of a medication effect (see Figure 20). It was not clear whether methylphenidate reduced the amount of self-orienting behavior because of the overall decrease in the incidence of this behavior during the study.

Subject A engaged in one-to-one teacher-pupil interactions more when he was on Ritalin than when he was on placebo (see Figure 21). The mean percentage of intervals that Subject A spent engaged in teacher-pupil interactions during the baseline phase was higher than that of the Ritalin and placebo conditions. Some of these contacts were initiated by Subject A while others were initiated by his teachers. However, some of the changes in level at the transitions between the Ritalin and placebo phases did not fall in the expected direction. That is, the percentage of

Figure 21. Percentage of intervals in which Teacher-Pupil Interactions and Changes in Position were recorded during classroom behavioral observations of Subject A.

teacher-pupil interactions in the last observation period of a Ritalin phase was not greater than the corresponding figure for the first observation period of the placebo phase. However, the expected increase in level did occur at the transition from the placebo to the Ritalin phase.

Both the means and levels of gross motor activity (Change in Position) followed a pattern which indicated that methylphenidate caused a decrease in this behavior for Subject A (see Figure 21). The percentage of intervals in which Change in Position was scored was smallest during the methylphenidate phases and was comparable in magnitude for the baseline and placebo phases. The percentage declined at the transition point, from the baseline phase to the first Ritalin phase but not from the first placebo phase to the second Ritalin phase. The percentage of intervals in which Change in Position was scored increased from the last observation session of each Ritalin phase to the first observation session of the following placebo phase.

Absence of Behavior is a category which reflects an absence of disruptive behavior and was scored only when none of the other behaviors were scored. When it was scored, it indicated that the subjects did not exhibit any disruptive behavior during the entire observation interval. Figure 22 shows that Subject A was not exhibiting any disruptive

Figure 22. Percentage of intervals in which no problem behaviors (Absence of Behavior) were recorded and mean number of different problem behaviors recorded for each observation interval (Mean Disruptive Behavior) for Subject A.

behavior for slightly longer periods of time when he was on medication than when he was on placebo. The means followed the expected pattern but the difference between the means of the first medication and placebo phases was very small. Observations taken immediately prior to and after the transition points also followed the expected pattern except for the transition from the first placebo to the second Ritalin phase. Instead of decreasing, the percentages of intervals in which Absence of Behavior was scored rose.

Mean Disruptive Behavior is a summary category of all disruptive behaviors (excluding Teacher-Pupil Interaction). Figure 22 shows that Subject A exhibited less disruptive behavior when he was on medication than during the other phases of the experiment. Both the means and levels followed the expected pattern. These findings indicate that Subject A was less active, inattentive, and disruptive when he was on methylphenidate than when he was on placebo or no medication.

Subject A exhibited two aggressive incidents during the observation periods, one while he was on placebo and the other when he was on Ritalin. No observations were conducted on one morning because he was in time out for most of the morning. He was on placebo at the time.

The effects of Ritalin on the amount of interference exhibited by Subject B were equivocal. The mean percentage

of intervals in which Interference was scored was the same for the first placebo and Ritalin phases, but the percentage during the second Ritalin phase was lower than for any other phase of the experiment (see Figure 23). Changes in level tended not to support the expectation that Ritalin would reduce the amount of interference shown by Subject B. The change in levels from the first placebo to the first methylphenidate phase fell in the opposite direction from what was expected, and there was not a change in level at the transition between the first Ritalin and second placebo phases. Only the change in levels during the last transition from placebo to Ritalin was in the direction consistent with a medication effect. The results, then, suggest that Ritalin only slightly reduced the amount of interference exhibited by Subject B. Subject B was fairly well behaved during the course of the study, and the percentage of intervals in which this behavior was scored was never higher than 10%. Furthermore, he exhibited a slight decline in the amount of interference during the course of the study which was partly accounted for by the change in classrooms after the first Ritalin phase.

Subject B was off task more when he was on placebo than when he was on methylphenidate, and he was most inattentive during the baseline phase (see Figure 23). The average

Figure 23. Percentage of intervals in which Off-Task and Interference Behaviors were recorded during classroom behavioral observations of Subject B.

percentage of off-task behavior declined each time methylphenidate was administered. Except for the transition from the first methylphenidate phase to the second placebo phase, the levels followed a pattern which was consistent with a medication-induced increase in on-task behavior. That is, the percentage of off-task behavior decreased from the final observation session of a placebo phase to the first observation session of the following medication phase. There was a reduction in the amount of off-task behavior exhibited by Subject B over the course of the study. This likely was the result of his switching from a regular classroom to a smaller class where his behavior could be monitored by the teachers more closely.

Methylphenidate slightly reduced the number of conversation initiations by Subject B. The mean percentage of intervals in which this behavior was scored was lower during the methylphenidate phases than during the other phases of the experiment (see Figure 24). The changes in level also support the assertion that methylphenidate reduced the number of conversation initiations. Each time there was a transition from placebo to methylphenidate, the number of conversation initiations decreased. However, the expected increase in level from the first methylphenidate phase to the second placebo phase did not occur, as the levels stayed the

Figure 24. Percentage of intervals in which Conversation Initiation and Self-Orienting Behaviors were recorded during classroom behavioral observations of Subject B.

same. There also was a decline in the number of conversations started by Subject B during the course of the study. This again reflected his transfer from a regular classroom of 35 children to a smaller class of 10. His behavior was monitored closely in the smaller class, and the population density was less.

Methylphenidate clearly reduced the percentage of intervals in which Self-Orienting was scored for Subject B. Both the changes in the means and levels support this interpretation (see Figure 24). The means for the medication phases were lower than those for the baseline and placebo phases, and the levels decreased at the placebo-methylphenidate transitions. The only finding which did not support this interpretation was the stable levels across the transition from the first methylphenidate phase to the second placebo phase. Most of the self-orienting behaviors that Subject B performed consisted of unusual seat postures or fiddling with small objects, pencils, and toys. He exhibited fewer of these behaviors when he was on methylphenidate than when he was on placebo or no medication. He also engaged in more of these self-orienting behaviors when he was in a regular classroom than when he was in the small class at the Child Study Centre.

A medication effect was not evident in the percentage of

intervals in which teacher-pupil interactions occurred.

Figure 25 does show that more intervals were scored as containing a teacher-pupil interaction when Subject B was in the small class as compared to a regular sized class.

Methylphenidate did not affect the amount of gross motor activity (Change of Position) exhibited by Subject B (see Figure 25). There was not a consistent pattern apparent in either the means or levels.

The mean percentage of intervals in which Absence of Behavior was scored was highest during the last phase when Subject B was on Ritalin. The mean percentages for the placebo phases tended to be lower, although the means for the first Ritalin phase and second placebo phase were comparable. The average percentage for the baseline phase was approximately half that of the Ritalin phases (see Figure 26). Although the changes in levels across the placebo-Ritalin transitions increased, the change in levels across the Ritalin-placebo transition did not decrease, but increased. Nevertheless, these findings suggest that Subject B was more attentive and less disruptive when he was on Ritalin than when he was on placebo or no medication.

This interpretation is supported by the results for the Mean Disruptive Behavior category. Most of the means and two out of three changes in level fell in a pattern which

Figure 25. Percentage of intervals in which Teacher-Pupil Interaction and Change in Position were recorded during classroom behavioral observations of Subject B.

Figure 26. Percentage of intervals in which no problem behaviors (Absence of Behavior) were recorded and mean number of different problem behaviors recorded for each observation interval (Mean Disruptive Behavior) for Subject B.

indicated that Ritalin reduced the disruptive and inappropriate behavior of Subject B (see Figure 26). The means and levels decreased when Ritalin was introduced, but did not increase when Subject B was switched from Ritalin to placebo. These latter findings can be accounted for by the change in schools which took place after the first Ritalin phase. Subject B clearly was less disruptive and was watched more closely by the teachers at the Child Study Centre. His scores on the Mean Disruptive Behavior category for the first Ritalin phase and the second placebo phase were comparable, but neither of them was as low as his score on the second Ritalin phase. These interesting findings suggest that both a change in environment and the administration of Ritalin were effective in reducing the amount of disruptive behavior exhibited by Subject B.

Subject B did not exhibit any aggressive behavior during the coding sessions.

~~Methylphenidate did not alter the number of intervals in~~
which Interference was scored for Subject C (see Figure 27). He exhibited a decreasing trend in the amount of interference behavior over the course of the study.. These findings suggest that he gradually adapted to the classroom situation and became less disruptive as time went by.

Figure 27. Percentage of intervals in which Off-Task and Interference Behaviors were recorded during classroom behavioral observations of Subject C.

No medication effects were apparent on Off-Task Behavior (see Figure 27). Subject C was just as likely to be off-task when he was on placebo as he was on methylphenidate, and both of these conditions were superior to his performance during the baseline phase.

Figure 28 shows that Ritalin did not affect the number of intervals in which conversations were initiated by Subject C. He initiated more conversations during the first Ritalin phase than the first placebo phase, but this trend was reversed in the next two phases.

Ritalin also did not affect the frequency of intervals in which Subject C exhibited self-orienting behaviors (see Figure 28). Self-orienting behavior was scored less often when he was on Ritalin than during the baseline week, but the frequencies of intervals in which this behavior was scored were comparable for the placebo and Ritalin weeks.

No medication effects were apparent in the amount of time that Subject C spent in individual instruction with his teacher (see Figure 29). There was a fair degree of day to day variability in the data. The mean number of intervals in which Teacher-Pupil Interaction was coded was lower for the Ritalin phases than the baseline week. One of the means for the placebo phases was higher than the Ritalin phases while the other placebo mean was lower. The changes in level also

Figure 28. Percentage of intervals in which Conversation Initiation and Self-Orienting Behaviors were recorded during classroom behavioral observations of Subject C.

Figure 29. Percentage of intervals in which Teacher-Pupil Interaction and Change in Position were recorded during classroom behavioral observations of Subject C.

were not consistent at the transitions between Ritalin and placebo phases. On the first of these transitions, the number of intervals in which teacher-pupil interaction occurred increased while on the second transition the opposite occurred.

Subject C was less active on Ritalin than during the other conditions of the experiment. The mean number of intervals in which Change of Position was scored was lower during the Ritalin phases than it was during the baseline and placebo phases (see Figure 29). The changes in level were less consistent. The levels increased from the baseline to the first Ritalin phase and from the placebo to the second Ritalin phase instead of decreasing. The increase in levels from the second Ritalin phase to the second placebo phase was consistent with the changes in mean activity. There was not a change in level of activity from the last observation period of the first Ritalin phase to the first observation period of the following placebo phase.

Absence of Behavior was coded more frequently when Subject C was on Ritalin than when he was on placebo or no medication. Figure 30 shows that each time Ritalin was administered, the mean percentage of intervals in which Absence of Behavior was scored increased. The means for the placebo phases also were higher than the average for the

Figure 30. Percentage of intervals in which no problem behaviors (Absence of Behavior) were recorded and mean number of different problem behaviors recorded for each observation interval (Mean Disruptive Behavior) for Subject C.

baseline phase. Except for the transition from the second Ritalin phase to the second placebo phase where the number of intervals in which Absence of Behavior was coded decreased, all of the other changes in levels were in directions opposite to the changes in mean. Taken together, these findings indicate that Subject C exhibited slightly less disruptive behavior and appeared to be on task for slightly longer periods of time while he was on Ritalin. The number of intervals in which Absence of Behavior was coded was higher for the placebo weeks than the baseline week but not as high as it was during Ritalin weeks.

No medication effects were apparent on the summary category of Mean Disruptive Behavior for Subject C. The means showed a steady decline for the first 4 phases of the study and then increased for the last phase when he was on placebo. Three of the changes in level went in a direction which suggested that Ritalin increased disruptive behavior, while the last change in level went in the expected direction. That is, disruptive behavior increased from the last observation session of the second Ritalin phase to the first observation period of the second placebo phase. Thus, methylphenidate did not affect the overall amount of disruptive behavior exhibited by Subject C.

Three aggressive behaviors were recorded for Subject C;

one during the baseline week, one when he was on placebo, and one when he was on Ritalin.

Interference was coded less often when Subject D was on Ritalin than when he was on placebo but not when he was on no medication (see Figure 31). The mean percentage of intervals in which interference occurred was comparable for the Ritalin and baseline phases. The changes in levels were consistent with the changes in means. That is, when the medication was switched from placebo to Ritalin, the amount of interference decreased, and when the medication was switched from Ritalin to placebo, the percentage of intervals in which Interference was coded increased.

Figure 31 shows that there was not a medication effect on off-task behavior. The means for the Ritalin phases were comparable to those of the placebo and baseline phases.

There was a slight but steady decline in the amount of off-task behavior exhibited by Subject D during the last six weeks of the study. The changes in levels also do not support the contention that Ritalin reduced the amount of off-task behavior exhibited by Subject D.

Methylphenidate slightly reduced the number of conversations initiated by Subject D, but the results were not very strong (see Figure 32). The mean number of intervals in which conversation initiation occurred was lower

Figure 31. Percentage of intervals in which Off-Task and Interference Behaviors were recorded during classroom behavioral observations of Subject D.

Figure 32. Percentage of intervals in which Conversation Initiation and Self-Orienting Behaviors were recorded during classroom behavioral observations of Subject D.

in the first methylphenidate phase than in the preceding placebo phase but was comparable to the means for the baseline phase and the following placebo phase. Subject D initiated ~~fewest~~ conversations during the final methylphenidate phase. Two out of three changes in level followed the expected pattern. That is, conversation initiations decreased at the first transition point from placebo to methylphenidate and increased at the transition point from methylphenidate to placebo. A change in level did not occur at the last transition point.

Self-Orienting Behaviors were recorded very infrequently for Subject D and will not be discussed in detail. The means for the medication phases were higher than the means for the other phases, but this was due to the effects of a few outlying data points.

There was not a medication effect on the frequency of teacher-pupil interactions (see Figure 33). The means were fairly consistent during the study and a pattern indicative of a medication effect was not evident. The changes in levels did not help to clarify the findings.

Figure 33 also shows that Ritalin did not alter the amount of gross motor activity exhibited by Subject D. The average number of intervals in which Change in Position was coded was stable during the course of the study. The changes

Figure 33. Percentage of intervals in which Teacher-Pupil Interaction, and Change in Position were recorded during classroom behavioral observations of Subject D.

in level were small and did not constitute persuasive evidence for a medication effect.

A pattern indicative of a medication effect also was not apparent on Absence of Behavior for Subject D (see Figure 34). The mean for the first Ritalin phase was slightly lower than the average for the first placebo phase, but the means were reversed in magnitude for the second Ritalin and placebo phases. The inconsistent changes in levels at the transition points of the experiment also indicate that the medication did not alter the frequency of occurrence of this category of behavior.

The data suggests that Ritalin reduced the overall amount of disruptive behavior exhibited by Subject D, but the evidence is not entirely clear. The averages for this summary category of behavior tended to be lower when Subject D was on Ritalin than when he was on placebo or no medication (see Figure 34). The changes in levels at the transition points provided some additional support for this interpretation. Although the amount of Mean Disruptive Behavior increased at the last transition from placebo to Ritalin, the changes in levels at the other transition points were consistent with a medication-induced reduction in disruptive behavior. A decrease in levels occurred at the first transition from placebo to Ritalin, and an increase in

Figure 34. Percentage of intervals in which no problem behaviors (Absence of Behavior) were recorded, and mean number of different problem behaviors recorded for each observation interval (Mean Disruptive Behavior) for Subject D.

levels was apparent at the following transition from Ritalin to placebo.

Aggressive behavior was recorded in one interval for Subject D. He was on methylphenidate at the time.

Subject E exhibited slightly more interference behaviors when he was on 10 mg Ritalin than on placebo or no medication (see Figure 35). These data were not consistent with the relatively low amount of interference that he exhibited when he was on 15 mg Ritalin which was comparable to his baseline score. The changes in level did not help to clarify the situation. Thus, these data do not provide convincing support for the assertions that Ritalin either increased or decreased the amount of interference.

Ritalin also did not affect the amount of off-task behavior exhibited by Subject E. Figure 35 shows that the amount of off-task behavior he exhibited was comparable for the placebo and Ritalin periods. The data suggest that the higher dose of Ritalin may have decreased this behavior, but the data is not convincing since he was slightly less inattentive during the baseline week than during the final week. In addition, the absence of a placebo week following the week in which he was on the higher dose of Ritalin makes the data difficult to interpret.

There was a consistent trend for the low dose of Ritalin,

Figure 35. Percentage of intervals in which Off-Task and Interference Behaviors were recorded during classroom behavioral observations of Subject E.

but not the high dose, to slightly reduce the number of conversations initiated by Subject E (see Figure 36). No change in levels occurred for three of the transition points, and the increase in levels from the first Ritalin phase to the first placebo phase supported the aforementioned interpretation. However, the data are not very convincing because the higher dose of Ritalin did not reduce the number of conversations initiated, as demonstrated by the mean which was comparable to the preceding placebo average.

Both doses of Ritalin slightly reduced the number of intervals in which Self-Orienting was coded. The means for the phases in which Subject E was on Ritalin were lower than those for the baseline phase and the placebo phases (see Figure 36). The changes in levels provided weak support for this assertion. Self-orienting behavior decreased at the transition from the first placebo phase to the second Ritalin phase and then increased at the following transition from Ritalin back to placebo. No changes in level occurred at two of the transition points, and an increase in levels occurred at the transition from the baseline phase to Ritalin which does not support the assertion that self-orienting was reduced by the administration of Ritalin.

Methylphenidate did not affect the frequency of Teacher-Pupil Interaction. Figure 37 shows that the mean

Figure 36. Percentage of intervals in which Conversation Initiation and Self-Orienting Behaviors were recorded during classroom behavioral observations of Subject E.

Figure 37. Percentage of intervals in which Teacher-Pupil Interaction and Change in Position were recorded during classroom behavioral observations of Subject E.

number of intervals in which this behavior was coded was comparable for the baseline, methylphenidate, and placebo phases.

The amount of gross motor activity exhibited by Subject E also is graphed in Figure 37. It is not clear if there is a medication effect because Subject E exhibited more gross motor activity when he was on the low dose of Ritalin than at any time during the study. However, Change of Position was recorded just as frequently during the last week when he was on the higher dose of Ritalin as it was during the preceding placebo week. Thus, the findings are inconsistent with respect to the question of whether Ritalin increased the locomotor activity of Subject E. The changes in level tended to support the assertion that Ritalin increased the amount of gross motor activity.

Absence of Behavior was coded less frequently when Subject E was on the low dose of Ritalin than when he was on placebo or no medication (see Figure 38). However, the changes in levels and the higher average of Absence of Behavior when he was on 15 mg Ritalin than when he was on placebo do not support the assertion that Ritalin decreased Absence of Behavior.

Ritalin did not affect the amount of disruptive behavior displayed by Subject E. In fact, he exhibited more

Figure 38. Percentage of intervals in which no problem behaviors (Absence of Behavior) were recorded and mean number of different problem behaviors recorded for each observation interval (Mean Disruptive Behavior) for Subject E.

disruptive behavior when he was on the low dose of Ritalin than at any other time during the study (see Figure 38). The data suggest that the higher dose of Ritalin may have reduced the amount of disruptive behavior, but it was difficult to tell if this was the case because the mean amount of disruptive behavior during the baseline was comparable to his mean score on the high dose of Ritalin. An additional placebo week at the end of the study may have helped clarify the picture. The change in levels at the transition points were not useful in determining if there was a medication effect.

One aggressive behavior was recorded for Subject E during the last week of the study when he was on 15 mg Ritalin. He was put in time out six times for noncompliant, disruptive, or aggressive behavior while he was being observed; once during the baseline week, three times when he was on placebo, and twice when he was on the high dose of methylphenidate.

Conners Parent Questionnaires

The child care worker who was primarily responsible for the supervision of each child filled out a Conners Parent Questionnaire at the end of each week. Since Subjects A, B, C, and D were given their medication at breakfast and at lunch, no medication effects were anticipated because the child care workers supervised the children in the late afternoons and

evenings when the medication had worn off. Subject E was given an additional dose of medication after school, and it was anticipated that the medication would reduce his Conduct Problem and Impulsive-Hyperactive factor scores as well as his score on the Hyperkinesis Index.

Scores on the factors and the Hyperkinesis Index of the Conners Parent Questionnaire are presented in Tables 17 and 18. No large medication effects were evident on any of these measures for Subjects A, B, C, or D, although Subject B's scores on the Conduct Problem and Impulsive-Hyperactive factors tended to be marginally lower during weeks when he was on medication. Subject A's scores on the Impulsive-Hyperactive factor tended to be slightly higher when he was on medication. However, none of these effects were very striking. Contrary to expectation, Subject E did not exhibit an improvement in his behavior as a result of administration of methylphenidate (see Table 17). No medication effects were evident on any of the factors or the Hyperkinesis Index of the Conners Parent Questionnaire. During the baseline week, Subject E's primary child care worker was on vacation, so the head of the residence who was in charge of him rated his behavior. His primary child care worker rated his behavior during the rest of the study. In contrast to the teacher's ratings, the ratings made by his

Table 17

Conners Parent Questionnaire Ratings for Subjects A, C, and E

Subject	Phase									
	Bl	Rit	Rit	Pl	Pl	Rit	Rit	Pl	Pl	Rit 15
Conduct Problem factor										
A	16	8	12	12	14	15	18	13	9	
C	18		19		15		12		10	
E	5	17	17	17	16	18	15	13	16	16
Learning Problem factor										
A	1	2	3	5	1	3	5	3	2	
C	4		3		1		3		3	
E	3	12	8	8	9	7	8	7	9	8
Psychosomatic factor										
A	1	1	0	0	1	0	0	0	2	
C	1		1		3		0		0	
E	0	1	0	0	0	0	0	3	0	0
Impulsive-Hyperactivity factor										
A	4	3	9	5	5	6	7	3	4	
C	10		9		9		8		8	
E	4	12	10	10	11	10	8	8	8	8
Anxiety factor										
A	0	0	1	1	0	0	3	0	1	
C	0		0		0		0		0	
E	0	2	4	4	2	2	2	2	3	4
Hyperkinesis Index										
A	8	6	14	12	9	11	13	8	7	
C	16		13		10		13		13	
E	8	27	21	21	23	19	20	16	22	16

Note. Questionnaires were filled out by the child care worker who was primarily responsible for the supervision of the subject.

Bl = Baseline; Rit = Ritalin; Pl = Placebo; Rit-15 = Ritalin 15mg.

Table 18

Conners Parent Questionnaire Ratings for Subjects B and D

	Phase								
Subject	Bl	Pl	Pl	Rit	Rit	Pl	Pl	Rit	Rit
Conduct Problem factor									
B	9	6	8	7	4	9	9	7	5
D	8	3	8	9	4	5	13	13	6
Learning Problem factor									
B	5	4	4	4	4	5	5	3	2
D	3	2	1	2	1	1	1	1	1
Psychosomatic factor									
B	1	0	0	0	0	0	0	0	0
D	0	0	0	0	0	0	0	0	0
Impulsive-Hyperactivity factor									
B	7	6	5	5	5	7	3	3	1
D	6	5	3	5	2	1	3	3	3
Anxiety factor									
B	3	3	2	3	0	1	1	2	2
D	0	1	1	0	0	0	0	0	0
Hyperkinesis Index									
B	12	8	8	8	9	14	10	5	3
D	10	6	3	7	2	1	5	4	2

Note. Questionnaires were filled out by the child care worker who was primarily responsible for the supervision of the subject. Bl. = Baseline; Rit = Ritalin; Pl = Placebo.

child care worker were remarkably consistent from week to week.

Average ratings across baseline and placebo phases are presented in Table 19. During the course of the study, Subjects A, C, and E exhibited significant amounts of aggressive and disruptive behavior, and their average score on the Conduct Problem factor was over 2.5 standard deviations above the mean. Only Subject E had a mean rating on the Hyperkinesis Index which was greater than 1.5 standard deviations above the mean.

Residence Reports

Daily ratings and frequencies of problem behavior were averaged over 5-day periods for all subjects except Subject C. Ratings and frequencies of problem behavior were averaged across the duration of each experimental phase for him. Data collected on weekends were not included for any subject because they often were gathered by part-time child care workers. Only data collected by the primary child care workers were utilized in this study. However, it should be pointed out that on a couple of occasions, the primary child care worker for a particular child changed because of staff vacations. These changes are noted in the discussion of each child's reports.

All subjects were given the medication twice per day,

Table 19

Average Baseline and Placebo Ratings on Selected Factors of the ConnersParent Questionnaire

Subject	Factor					
	Conduct Problem Factor			Hyperkinesis Index		
	Raw	<u>M</u>	<u>Z</u>	Raw	<u>M</u>	<u>Z</u>
A	64	12.8	+2.82	44	8.8	+0.50
B	41	8.2	+1.30	52	10.4	+0.86
C	43	14.3	+3.31	39	13.0	+1.45
D	37	7.4	+1.06	25	5.0	-0.41
E	67	13.4	+3.01	90	18.0	+2.59

Note. Normative data of Goyette, Conners, and Ulrich (1978) was used to calculate Z scores:

except for Subject E who was given the medication three times per day. By the time the child care workers started to interact with Subjects A, B, C, and D, the medication would have begun to wear off. Thus, it was anticipated that methylphenidate would reduce the amount of disruptive behavior exhibited in residence by Subject E but not for any of the other subjects.

Figure 39 shows that Subject A tended to exhibit more problem behaviors during weeks when he was on methylphenidate than when he was on placebo but not during the baseline week. However, the differences are in the order of 1 more problem behavior per day on medication than on placebo and this difference is of questionable clinical significance. No consistent changes during the course of the study were evident in ratings on the behavioral dimensions for Subject A (see Table 20).

Residence reports for Subject B were not available during week 5 when he was on methylphenidate. Table 21 shows that there were no consistent changes across experimental phases in the ratings of the behavioral dimensions. Subject B exhibited fewer problem behaviors when he was on methylphenidate than when he was on placebo or no medication (see Figure 40).

Ratings on the 5 dimensions of behavior were not filled

Figure 19. Weekly means of total number of problem behaviors reported daily by Subject A's child care worker.

Table 20

Mean Ratings on the Behavioral Dimensions of the Residence Reports forSubject A

	Phase								
Behavioral Dimension	Bl	Rit	Rit	Pl	Pl	Rit	Rit	Pl	Pl
sociable-									
withdrawn	4.5	2.8	2.0	2.0	3.5	4.6	4.8	3.6	2.4
relaxed-									
tense	3.8	1.8	4.0	3.0	5.3	3.0	3.4	3.4	2.0
not demanding-									
demanding	3.0	2.0	2.0	2.0	3.8	2.0	3.2	2.4	1.6
obedient-									
disobedient	4.0	2.3	2.5	2.3	3.5	3.6	4.0	4.2	1.6
attentive--									
distractible	2.0	1.7	4.0	2.3	3.5	2.8	2.0	2.8	2.4

Note. Reports were filled out by the child care worker who was primarily responsible for Subject A. Daily ratings were averaged over 5-day periods. Weekends were not included. Bl = Baseline; Pl = Placebo; Rit = Ritalin.

Table 21

Mean Ratings on the Behavioral Dimensions of the Residence Reports for
Subject B

Behavioral Dimension	Phase							
	Bl	Pl	Pl	Rit	Rit	Pl	Pl	Rit Rit
sociable-								
withdrawn	1.8	3.0	2.5	3.5	-	2.3	2.7	2.0 1.8
relaxed-								
tense	2.8	3.0	2.8	4.0	-	4.3	3.3	3.0 2.0
not demanding-								
demanding	2.0	3.0	3.0	4.0	-	4.7	3.7	2.5 2.0
obedient-								
disobedient	3.0	3.3	2.8	3.5	-	6.3	3.7	3.0 2.3
attentive-								
distractible	2.0	3.0	2.8	4.0	-	6.0	3.7	3.3 2.0

Note. Reports were filled out by the child care worker who was primarily responsible for Subject B. Daily ratings were averaged over 5-day periods. Weekends were not included. Bl = Baseline; Pl = Placebo; Rit = Ritalin.

Figure 40. Weekly means of total number of problem behaviors reported daily by Subject B's child care worker.

out consistently for Subject C. He also exhibited fewer problem behaviors when he was on medication than during the other phases of the study (see Figure 41). These differences were in the order of 1 to 1.5 problem behaviors per day, and no information was available on what type of problem behavior accounted for the difference.

The format of the residence reports was changed after Subject D had been in the study for 6 weeks. Ratings on the 5 behavioral dimensions were not available for him. No differences in the frequencies of problem behavior, verbal aggression, physical aggression, temper tantrums, time out, or physical restraint were apparent.

Residence reports were not available for Subject E for the first 4 weeks of the study. Contrary to expectation, no differences in the frequencies of occurrence of verbal aggression, physical aggression, temper tantrums, time out, or physical restraint were evident as a result of the administration of either 10 mg or 15 mg methylphenidate (see Table 22).

Self-Report Psychiatric Rating Scales

Using the discriminant functions of Beitchman et al. (1985), discriminant scores indicating the probabilities that a child should be classified as a member of the clinical or normal population were calculated with the use of a computer

Figure 41. Mean number of problem behaviors for each experimental phase reported daily, by Subject C's child care worker.

Table 22

Mean Frequencies of Occurrence of Problem Behaviors and Use of Time Out
for Subject E

Behavioral Measures	Phase									
	Bl	Rit	Rit	Pl	Pl	Rit	Rit	Pl	Pl	Rit15
Verbal										
Aggression	-	-	-	-	1.8	0.7	0.6	0	0.6	1.4
Physical										
Aggression	-	-	-	-	0	0	0	0	0.3	0
Temper										
Tantrums	-	-	-	-	0	0	0	0	0	0
Time										
Out	-	-	-	-	0.8	1.3	1.0	0	0.3	0

Note. Behavioral measures were recorded by the child care worker who was primarily responsible for Subject E. Daily records were averaged over 5-day periods. Weekends were not included. Bl = Baseline; Rit = Ritalin; Pl = Placebo; Rit15 = Ritalin 15mg.

program. Cutoffs of $p > 0.50$ for clinical status and $p > 0.60$ for normal status were used. In addition, Z scores on the 8 factors of the scale were calculated with the use of a program which used the normative data collected by Beitchman et al. (1985).

Based on the rating scales filled out during the baseline phase, Subjects A, B, and E were classified as normal, and Subjects C and D were classified as belonging to the clinical population. The baseline ratings are graphed for each of the participants in Figures 42 to 46. None of the classifications changed during the course of the study. That is, none of the boys initially classified as normal were classified later as from the clinical population or vice versa.

Subject A became quite upset during the administration of the baseline Self-Report Psychiatric Rating Scale especially when answering the items concerned with family relations. The baseline rating scale was administered at the end of the baseline testing session. A decision was made not to readminister the self-report scale to Subject A because he did not want to answer the questions, and it was felt that to make him answer would jeopardize his cooperation in performing the cognitive and motor tasks.

Factor scores for Subject B are outlined in Table 23.

Subject A

Figure 42. Children's Self-Report Rating Scale profile for Subject A completed during the baseline phase.

Subject B

227

Figure 43. Children's Self-Report Rating Scale profile for Subject B completed during the baseline phase.

Subject C

Figure 44. Children's Self-Report Rating Scale profile for Subject C completed during the baseline phase.

Subject D

Figure 45. Children's Self-Report Rating Scale profile for Subject D completed during the baseline phase.

Subject E

Figure 46. Children's Self-Report Rating Scale profile for Subject E completed during the baseline phase.

Table 23

Factors Scores on the Self-Report Psychiatric Rating Scale for Subject B

Factor	Phase				
	Baseline	Placebo	Ritalin	Placebo	Ritalin
1. Conduct					
Problems	1.06	0.24	-0.07	0.23	-0.36
2. Lie-					
Immaturity	-0.55	-0.72	-0.72	-0.80	-0.81
3. Positive Self-					
Peer Relations	0.52	0.60	0.53	0.40	0.28
4. Worry	-0.86	-0.09	-0.24	-1.14	-1.35
5. Negative					
Peer Relations	0.97	0.80	0.51	-1.23	0.99
6. Antisocial					
Permissive	-0.74	-0.48	-0.06	-0.60	-0.69
7. Sensitive-					
Emotional	-1.38	-0.97	-1.35	-0.82	-0.30
8. Positive-Family					
Relations	0.10	0.01	0.10	0.11	0.00

His scores on the Conduct Problems and Sensitive-Emotional factors were lower when he was on methylphenidate than when he was on placebo or no medication. A similar but less pronounced pattern was evident in the Worry factor scores. Administration of methylphenidate did not affect his scores on the other factors of the Self-Report Psychiatric Rating Scale. Subject B endorsed the item "I often get into trouble" which loaded on the Conduct Problems factor during the weeks when he was on no medication or placebo, but not when he was on medication. Changes in his responses to other items loading on this factor occurred, but they did not follow a pattern consistent with changes in his medication status. He answered affirmatively to the items "I get too many punishments" and "I cause trouble to my family" during the baseline week, and then negatively in the subsequent weeks. He endorsed the item "Things are all mixed up in my life" for the first three phases of the study, and "I often have fights with kids" for the first 4 phases of the study.

With respect to changes in his responses to items loading on the Worry factor, he endorsed the item "I worry about what is going to happen" for the first three phases of the study, and "I worry about what my parents will say to me" during the second and third phases of the study.

He responded affirmatively to the item "Sometimes even

little things get me mad" during the second, third, and fourth phases of the study, and to the item "Sometimes I get mad at myself" during the first two phases of the experiment. These changes accounted for the differences in his Sensitive-Emotional factor scores.

Large changes also were evident in Subject B's Negative Peer-Relations factor scores (see Table 23). He endorsed the items "Kids laugh at me" and "Kids pick on me" for the first three phases and the item "Other kids boss me around" for the first two phases, and then answered no to these items for the remainder of the experiment.

Subject C exhibited higher scores on the Negative Peer-Relations and Antisocial Permissive factors when he was on medication than when he was on placebo or no medication (see Table 24). However, none of the items which changed showed a consistent medication-related pattern. Subject C answered yes on all phases except the last one to the following items: "Kids pick on me", "Sometimes I think other kids want to beat me up", and "Other kids boss me around". The only time he endorsed the item ~~"It's OK to make a mess"~~ was during the fourth phase when he was on methylphenidate, and the only time he did not endorse the item "Kids laugh at me" was during the baseline phase. All of these items load on the Negative Peer-Relations factor.

Table 24

Factor Scores on the Self-Report Psychiatric Rating Scale for Subject C

Factor	Phase				
	Baseline	Ritalin	Placebo	Ritalin	Placebo
1. Conduct					
Problems	1.94	1.93	1.59	0.58	0.93
2. Lie-					
Immaturity	0.07	0.17	-0.06	1.65	1.34
3. *Positive Self-					
Peer Relations	0.94	0.47	0.76	0.48	0.12.
4. Worry	0.36	-0.29	0.14	-0.62	-0.96
5. Negative					
Peer-Relations	0.80	1.14	0.85	0.92	-0.75
6. Antisocial					
Permissive	-0.37	0.11	0.05	0.73	-0.01
7. Sensitive-					
Emotional	0.12	0.05	-0.03	0.30	-0.11
8. Positive-Family					
Relations	-0.69	0.41	0.39	-0.05	0.77

Changes in the Antisocial Permissive factor scores were accounted for by changes in his responses on the items "It's OK to get angry", "It's OK to tell little lies", and "It's OK to make a mess". The changes in his responses to these items were not consistent with administration or withdrawal of the medication.

Subject C exhibited changes in his Conduct Problems and Lie-Immaturity factor scores after the third experimental phase. These changes were due to changes in his responses to the items "I often get angry at my parents", "I get too many punishments", "I have a bad temper", "I cause trouble to my family", "It's hard for me to wait my turn", and "I do many bad things" which load on the Conduct Problems factor, and to the items "I'll try anything", "I am always happy", "I am always good", "I always tell the truth", and "I am always nice to every one" which load on the Lie-Immaturity factor. He did not endorse these Conduct Problems factor items during either the fourth or fifth experimental phases, in contrast to his responses to them in the first 3 phases. He tended to answer no to the aforementioned Lie-Immaturity factor items during the first 3 phases of the study and then yes during the last 2 phases. It is clear that methylphenidate did not alter his perception of himself or his behavior enough to consistently affect his responses to these items.

Subject D's Z scores on the Lie-Immaturity , Positive Self-Peer Relations, and Positive Family Relations factors, were higher when he was on medication than when he was on placebo but only in the case of the Positive Self-Peer Relations factor were they more positive than the baseline score (see Table 25). His scores on the Sensitive-Emotional factor were lower (more negative) when he was on methylphenidate than when he was on placebo but were comparable to his baseline score.

Subject D tended to respond affirmatively to the items loading on the Lie-Immaturity factor. The changes in his scores on this factor were due to the fact that he sometimes answered no to the following items: "I'll try anything", "I am always happy", "I always tell the truth", "I always do the right thing", and "I always know what to say to people". His responses to these items did not follow a pattern which suggested a medication effect.

Changes in his answers to the items "I have many friends", "I am pretty sure of myself", "I am fun to be with", "I think I am a pretty nice person", and "I am pretty good at most things I do" accounted for the changes in his scores on the Positive Self-Peer Relations factor. None of these changes were consistent with a medication effect.

Subject D tended to answer no to the items loading on the

Table 25

Factor Scores on the Self-Report Psychiatric Rating Scale for Subject D

Factor	Phase				
	Baseline	Placebo	Ritalin	Placebo	Ritalin
1. Conduct					
Problems	-0.64	-0.42	0.75	0.05	0.03
2. Lie-					
Immaturity	2.20	1.09	1.98	1.36	2.28
3. Positive Self-					
Peer Relations	-0.38	-1.42	-0.04	-0.30	0.20
4. Worry	-1.60	-0.75	-0.80	-1.12	-1.09
5. Negative					
Peer Relations	-0.82	-1.04	-1.19	-0.82	-1.03
6. Antisocial-					
Permissive	-0.62	-1.03	-0.74	-0.70	-0.60
7. Sensitive-					
Emotional	-1.00	-0.64	-0.95	-0.52	-1.16
8. Positive-Family					
Relations	0.0	-1.60	0.07	-0.88	-0.02

Sensitive-Emotional factor. On occasion he answered yes to the items "Scarey stories bother me", "Sometimes even little things get me mad", and "I have bad dreams", and this partly accounted for the variability in his Sensitive-Emotional factor scores. Most of the time he answered yes to the item "If I got lost I could get back home". During the second phase of the experiment he answered no to this item; this change also helped explain the variability in his Sensitive-Emotional factor score.

Occasional negative responses to the items "My parents understand me" and "I am important to my family" accounted for the changes in his Positive Family Relations factor scores. These changes were not consistent with the administration or withdrawal of methylphenidate.

No medication effects were noted on any of the factor scores for Subject E (see Table 26). His responses to the items and thus his factor scores tended to be quite stable during the course of the study. His lowest score on the Worry factor occurred when he was on the higher dose of methylphenidate and was accounted for by a change in his usual affirmative response to the item "I am a nervous person". He apparently felt less nervous when he was on the higher dose of medication. After the fourth phase of the experiment, his scores on the Antisocial Permissive factor

Table 26

Factor Scores on the Self-Report Psychiatric Rating Scale for Subject E

Factor	Phase					
	Baseline	Ritalin	Placebo	Ritalin	Placebo	Rit 15
1. Conduct Problems	0.15	-0.31	0.15	0.06	0.10	-0.01
2. Lie-Immaturity	0.20	-0.09	0.32	0.0	-0.04	-0.08
3. Positive Self-Peer Relation	0.36	0.51	0.44	0.37	0.36	0.25
4. Worry	1.22	1.70	1.51	1.07	1.09	0.91
5. Negative Peer-Relations	0.30	0.17	0.25	0.33	0.30	0.23
6. Antisocial-Permissive	1.09	0.82	0.86	0.82	1.41	1.48
7. Sensitive-Emotional	-1.05	-0.71	-1.33	-1.37	-0.81	-0.67
8. Positive-Family Relations	0.50	0.66	0.61	0.74	0.45	0.56

Note. Rit 15 = Ritalin 15 mg.

increased. This was due to a change in his answer to the item "It's OK for kids to bite their fingernails" from no to yes.

Cognitive Tests

Results for the Continuous Performance Test will be presented first, followed by sections on Weingartner's verbal memory task and paired-associate learning.

Continuous Performance Test

Subject A clearly showed a medication-induced decrease in the number of errors of omission that he made (see Figure 47). He made fewer errors when methylphenidate was administered than he did when he was on placebo or no medication. A similar pattern was evident in the number of errors of commission, but there was no change in the number of errors of commission between the second and third testing sessions when he was on methylphenidate and placebo respectively.

Subject B exhibited a favorable response to methylphenidate as indicated by the decrease in the errors of commission during the medication phases compared to his performance during the other phases (see Figure 48). A medication-induced decrease occurred despite his good performance on this test and the fact that there was little room for improvement. Methylphenidate did not improve his

Figure 47. Number of errors of omission and commission on the Continuous Performance Test recorded for Subject A.

Figure 48. Number of errors of omission and commission on the Continuous Performance Test recorded for Subject B.

ability to sustain attention as measured by the number of errors of omission that he made. Figure 48 shows that his medication scores on this measure were lower than his baseline score, but were comparable to his scores when he was on placebo.

Figure 49 shows that Subject C did not exhibit fewer errors of omission when he was on methylphenidate than he did when he was on placebo, but his medication scores were lower than his baseline score. With respect to the number of errors of commission, he exhibited a pattern during the first 4 phases of the study which was consistent with a medication-induced reduction in impulsive responding, but he made fewer errors of commission than expected during the last phase when he was on placebo. ●

Methylphenidate did not reduce the number of errors of omission made by Subject D (see Figure 50). In fact, he made slightly more errors of omission on methylphenidate than he did on placebo, and his best performance occurred during the baseline week. He made fewer errors of commission when he was on medication than he did when he was on placebo, but his average score on the medication phases was higher than his baseline score.

Subject E exhibited a large improvement in his performance on the Continuous Performance Test on the second

Figure 49. Number of errors of omission and commission on the Continuous Performance Test recorded for Subject C.

Figure 50. Number of errors of omission and commission on the Continuous Performance Test recorded for Subject D.

testing session when he was on methylphenidate in comparison to his baseline performance, (see Figure 51). Thereafter, his performance gradually improved and there was no room for improvement when he was given the higher dose of methylphenidate. Thus, it is not clear whether methylphenidate improved his performance on this test due to the large practice effect.

An analysis of the Continuous Performance Test data in terms of signal detection theory was carried out using standard procedures (McNicol, 1972). The hit rate (HR) was calculated by dividing the number of correct responses by 50 which represented the number of target stimuli (B-X pairs) presented. The false alarm rate (FAR) was calculated by dividing the number of errors of commission by the number of unpaired Bs and Xs. This procedure involves the assumption that errors of commission or false alarms are most likely to occur in response to the presentation of the letters B and X when they are not paired with each other but with other letters (Rutschmann, Cornblatt, & Erlenmeyer-Kimling, 1977). Sensitivity (d') is defined as $Z(HR) - Z(FAR)$, and response bias (B) is defined as the ratio of the standardized ordinate of the HR divided by the standardized ordinate of the FAR (i.e., $Y(HR)/Y(FAR)$). By convention, measures of response bias were transformed to natural logarithms.

Figure 51. Number of errors of omission and commission on the Continuous Performance Test recorded for Subject E.

Figures 52 and 53 show that Subjects A, B, and C exhibited increases in perceptual sensitivity (d') as a result of administration of methylphenidate. The d' scores of each of these subjects were higher when they were on methylphenidate than when they were on placebo or no medication. No consistent trend was evident in the response bias scores of Subject A or Subject C (see Figure 54), but Subject B consistently exhibited higher response bias ($\ln B$) scores when he was on methylphenidate than during the other conditions. Subject D did not exhibit a clear trend in his d' scores (see Figure 53), but his response bias scores were more positive when he was on Ritalin compared to his scores obtained under the other conditions which indicates that the medication caused him to adopt a more conservative response strategy (see Figure 55). Subject E's d' scores tended to increase over the course of the study (see Figure 52). There was no evidence for a medication effect on his perceptual sensitivity, but the data suggested that the medication may have induced him to adopt a slightly more conservative response bias (see Figure 54). However, his score on the last placebo test did not follow this pattern.

Weingartner Memory Task

Figure 56 shows that Subject A freely recalled more words when he was on methylphenidate than when he was on placebo or

Figure 52. Perceptual sensitivity (d') scores on the Continuous Performance Test for Subjects A, C and E.

Figure 53. Perceptual sensitivity (d') scores on the Continuous Performance Test for Subjects B and D.

Figure 54. Response bias (In B) scores on the Continuous Performance Test for Subjects A, C and E.

Figure 55. Response Bias (ln B) scores on the Continuous Performance Test for Subjects B and D.

Figure 56. Number of words recalled by Subject A under free recall and cued recall conditions on Weingartner's Memory Task.

no medication. Methylphenidate enhanced his free recall of semantically, but not acoustically, processed words (see Table 27). The same pattern also held for words remembered under cued recall conditions and was accounted for by the fact that he recalled more semantically processed words during the weeks when he was on medication than at any other time. No differences were evident in the number of acoustically processed words remembered under cued recall conditions.

Subject A also exhibited a stimulant-induced facilitation of the total number of semantically processed words remembered under free and cued recall testing conditions. medication effect was not evident on the total number of acoustically processed words recalled (see Table 27).

Subject B freely recalled the most words during the last experimental phase when he was on methylphenidate. He freely recalled the fewest words on the first and third testing sessions when he was on no medication and methylphenidate respectively (see Figure 57). Thus, there was not an overall medication effect on the number of words freely recalled. Subject B tended to remember more words under cued recall conditions when he was on methylphenidate than when he was on placebo or no medication. This tendency was due to an increase in the cued recall of the number of acoustically processed words as a result of the administration of

Table 27

Recall of Semantically and Acoustically Processed Words for Subjects A, C,

and E

Subject	Phase					
	Bl	Rit	Pl	Rit	Pl	Rit15
Free Retrieval Conditions						
A Semantic	7	8	2	7	1	
Acoustic	2	3	3	3	1	
C Semantic	3	3	2	3	2	
Acoustic	2	0	1	1	2	
E Semantic	2	7	7	7	2	9
Acoustic	3	1	1	3	2	2
Cued Retrieval Conditions						
A Semantic	4	9	2	6	4	
Acoustic	4	5	5	2	3	
C Semantic	6	3	2	1	3	
Acoustic	1	0	1	0	2	
E Semantic	3	6	3	1	3	4
Acoustic	4	0	2	4	1	2

e. Bl = Baseline; Rit = Ritalin; Pl = Placebo; Rit15 = Ritalin 15mg.

Figure 57. Number of words recalled by Subject B under free recall and cued recall conditions on Weingartner's Memory Task.

methylphenidate. When the number of acoustically processed words was combined over free and cued recall testing conditions, then the medication-induced facilitation of recall became much clearer (see Table 28). His recall of semantically processed information was quite consistent during the course of the study.

Subject C's free recall of words was not affected by the administration of methylphenidate (see Figure 58). He tended to remember more words under cued recall conditions when he was on placebo than when he was on methylphenidate, but his best performance occurred during the baseline week. The difference in cued recall between medication and placebo conditions was due to a slight tendency for Subject C to recall more acoustically processed words when he was on placebo than when he was on medication. These data suggest that methylphenidate had a slight tendency to impair his recall of acoustically processed information. The negative effects became clearer after the numbers of acoustically processed words recalled were summed over free and cued retrieval testing conditions. Subject C consistently recalled more acoustically processed words on placebo than on methylphenidate (see Table 27).

There was not a medication effect on his recall of semantically processed words. He recalled more semantically

Table 28

Recall of Semantically and Acoustically Processed Words for Subjects B and D

Subject	Phase				
	Bl	Pl	Rit	Pl	Rit
Free Retrieval Conditions					
B Semantic	4	5	3	8	9
Acoustic	2	4	3	2	6
D Semantic	3	3	3	1	0
Acoustic	6	1	0	0	1
Cued Retrieval Conditions					
B Semantic	6	7	5	5	7
Acoustic	1	1	5	2	1
D Semantic	3	1	3	2	1
Acoustic	4	2	0	3	2

Note. Bl = Baseline; Rit = Ritalin; Pl = Placebo.

Figure 58. Number of words recalled by Subject C under free recall and cued recall conditions on Weingartner's Memory Task.

processed words during the baseline testing session than on any other testing session. His motivation to perform this task did not appear to decline after the first testing session. His superior recall of semantically processed words on the baseline test may have been due to chance. In other words, he may have found it easier to semantically process the particular words used on the list in the baseline test.

Subject D did not exhibit a difference between the number of words remembered under free or cued recall conditions when he was on methylphenidate compared to when he was on placebo (see Figure 59). There also was not a difference between medication and placebo conditions in the number of semantically processed words recalled. Subject D did exhibit a slight tendency to recall more acoustically processed words under cued retrieval testing conditions when he was on placebo than when he was on medication (see Table 28). The best performance exhibited by Subject D occurred during the baseline test when he freely recalled more words as well as remembering as many or more semantically and acoustically processed words than on any other test. It is possible that the novelty of the task heightened his interest and motivation, as he appeared to try harder on the baseline testing session than on the other testing sessions.

Subject E tended to recall more words under free recall.

Figure 59. Number of words recalled by Subject D under free recall and cued recall conditions on Weingartner's Memory Task.

conditions when he was on methylphenidate than when he was on placebo or no medication (see Figure 60). Although there was not a difference between the first medication and placebo testing sessions in the number of words freely recalled, he freely recalled 6 more words on the second medication testing session compared to the second placebo testing session, and when the higher dose of methylphenidate was administered his performance improved again. This pattern was not evident in the number of words remembered under cued recall conditions nor was it evident in the number of semantically or acoustically processed words that were recalled under cued retrieval testing conditions. Thus, for Subject E, methylphenidate had a slight tendency to improve his free recall. In addition, methylphenidate tended to enhance his recall of semantically processed words. This effect became clear only after the number of semantically processed words was summed across free and cued recall testing conditions. Subject E tended to recall more semantically processed words when he was on medication than he did on placebo or no medication. However, the pattern was not consistent because the total number of semantically processed words recalled decreased from the first placebo phase to the second methylphenidate phase instead of increasing as expected (see Table 27).

Figure 60. Number of words recalled by Subject E under free recall and cued recall conditions on Weingartner's Memory Task.

In the cued recall procedure, each child was given one word from each pair as a cue and then was asked to remember the other member of the pair. Thus, the maximum number of words that could be recalled in the cued retrieval condition was one-third of the maximum number of words potentially remembered under the free recall condition. The cuing procedure increased the proportion of words recalled regardless of whether the subjects were on methylphenidate, placebo, or no medication (see Figure 61). This trend was evident for each subject under each medication condition.

Most subjects made few intrusion errors which were defined as the recall of words that were not on the lists. However, Subject D exhibited many more intrusion errors than the rest of the subjects. Under free recall conditions, subjects made an average of 4.8 intrusion errors on baseline, 2.4 intrusion errors on placebo, and 3.5 intrusion errors on methylphenidate.

Subjects made a small number of intrusion errors, defined as words recalled that never appeared as stimuli, on free recall and a slightly greater number under cued recall conditions. These data are presented in Figure 62. In addition, none of the subjects exhibited a pattern which suggested that methylphenidate altered the number of intrusions.

Figure 61. Percent of words recalled for all subjects under free recall and cued recall conditions on 'Weingartner' Memory Task.

Figure 62. Number of intrusion errors for all subjects under free recall and cued recall conditions on Weingartner's Memory Task.

Paired-Associate Learning

Subject A exhibited an adverse response to methylphenidate in terms of his performance on the paired-associate learning test. Although his performance while on methylphenidate was only slightly worse than his baseline performance, it was much poorer than his performance while he was on placebo (see Figure 63).

It was not clear whether Subject B exhibited an improvement in his paired-associate performance as a result of the administration of methylphenidate because of the large practice effect which he exhibited (see Figure 64). Over the course of the study, he developed a counting strategy whereby he would count items in the pictures of the stimuli, and this approach provided him with cues for the numerical responses. Thus, there was little room for improvement in his scores on the last three testing sessions. However, it is clear that he did not exhibit an adverse response to methylphenidate.

Figure 63 shows that methylphenidate did not affect the paired-associate performance of Subject C. His scores on the last 4 testing sessions were quite consistent. The improvement in his performance relative to the baseline test may have been due to increased familiarity with the procedure.

The data suggest that Subject D exhibited a favorable

Figure 63. Total number of errors recorded on the Paired-Associate Learning Test for Subjects A, C and E.

4

1.0

1.1

1.25

1.4

1.6

1.8

2.0

2.2

2.5

2.8

3.2

3.6

4.0

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

Figure 64. Total number of errors recorded on the Paired-Associate Learning Test for Subjects B and D.

response to methylphenidate. Although he made slightly more errors on the third test when he was on medication than on the second test when he was on placebo, his performance on the last testing session when he was again on medication was much improved over his placebo performance on the fourth testing session (see Figure 64). He made a total of 27 fewer errors on medication than on placebo. His average performance while on placebo was comparable to his baseline performance.

Ten mg of methylphenidate did not affect Subject E's performance on the paired-associate learning test. The data suggest that the higher dose of methylphenidate slightly impaired his paired-associate performance (see Figure 63). He made 15 errors when he was on 15 mg methylphenidate which was higher than the average of 9 errors that he made when he was on placebo. However, his baseline performance was comparable to his performance on the higher dose of medication.

Psychomotor Tests

Maze Test

Subject A's performance on the Maze Test was improved by methylphenidate. When he performed the test with his right hand, he touched the sides of the maze less frequently, and the total duration of contact was shorter when he was on

methylphenidate than when he was on placebo or no medication (see Figure 65). The medication effect was not as clear when he used his left hand, because there was a slight deterioration in his performance from the third test when he was on placebo to the fourth test when he was on methylphenidate (see Figure 65). However, his performance on the fourth test was better than that on the last test when he was on placebo. Table 29 shows that methylphenidate did not consistently alter the amount of time taken to complete the test.

Regardless of which hand he used, Subject B's performance on the Maze Test was improved by the administration of methylphenidate relative to his performance on placebo in terms of fewer touches of the sides of the maze and shorter duration of contact (see Figure 66). When he used his left hand, his average performance on methylphenidate was better than his baseline performance, but this was not the case when he used his dominant (right) hand. Table 29 shows that his times taken to complete the test were fairly stable during the course of the study.

Subject C exhibited a clear positive response to methylphenidate on the Maze Test when he used his left hand. He touched the sides of the maze less often, and the duration of contact was shorter when he was on methylphenidate than

Figure 65. Total number and duration(s) of contacts recorded on the Maze Test for Subject A.

Table 29

Times Taken to Complete the Maze Test

		Phase				
Subjects						
	Baseline	Ritalin	Placebo	Ritalin	Placebo	(Ritalin 15)
A	43	37	39	42	40	
C	51	53	54		48	
E	33	27	26	24	24	22
	Baseline	Placebo	Ritalin	Placebo	Ritalin	
B	37	34	30	31	29	
D	66	60	62	58	55	

Note. Times are in seconds.

Figure 66. Total number and duration (s) of contacts recorded on the Maze Test for Subject B.

when he was on placebo or no medication (see Figure 67). On the other hand, the data suggest that performance with his right hand was worse on methylphenidate than on placebo (see Figure 67). His average performance with his right hand on medication was better than his baseline performance but was not as good as his average performance on placebo. Subject C's alterations in performance were not accounted for by changes in the amount of time that he took to complete the maze (see Table 29).

Methylphenidate improved the nondominant hand performance of Subject D on the Maze Test. Figure 68 shows that his performance on medication clearly was superior to his baseline performance and to his performance on placebo. The effects on his dominant hand performance were not as clear but they were in the same direction. Methylphenidate did not affect his times taken to complete the test (see Table 29).

Subject E's performance on the Maze Test with his right hand was very good, and there was little room for improvement. He did not exhibit a response to 10 mg methylphenidate, but Figure 69 shows that his best performance occurred when he was on 15 mg methylphenidate. Thus, the data suggest that the higher but not the lower dose of medication improved his right-handed performance. Both

Figure 67. Total number and duration (s) of contacts recorded on the Maze Test for Subject C.

Figure 68. Total number and duration (s) of contacts recorded on the Maze Test for Subject D.

Figure 69. Total number and duration (s) of contacts recorded on the Maze Test for Subject E.

doses of methylphenidate improved his performance with his left hand. Figure 69 shows that he touched the sides of the maze less frequently and the duration of contact was shorter when he was on medication than when he was on placebo or no medication. No changes in his times taken to complete the test were evident during the course of the study (see Table 29).

Handwriting

Handwriting samples were collected during each phase of the study. The boys were asked to copy the same standard paragraph each time (see Appendix K). The criteria of Whalen, Henker, and Finck (1981) were used to score the handwriting samples.

Four specific handwriting dimensions were evaluated: form, spacing, alignment, and uniformity. Two neuropsychological psychometrists experienced in the evaluation of children's handwriting and drawing abilities independently compared each boy's baseline sample with each of his other samples and used 5-point scales to indicate whether the comparison sample was "much worse", "somewhat worse", "the same", "somewhat better", or "much better" than the baseline sample. In addition, they made judgements on the overall comparative quality of each baseline sample with each of the other samples.

Interrater agreement was calculated by dividing the number of agreements by the sum of the number of agreements plus disagreements. The agreement indexes were 0.29 for form, 0.57 for spacing, 0.62 for alignment, 0.52 for uniformity, and 0.57 for the global index. These interrater agreement indexes were much lower than those reported by Whalen, Henker, and Finck (1981). Only 7 out of 105 comparisons made by the raters differed by two points, and none of the comparisons differed by more than two points. Thus, most of the disagreements were by one scale score point, and it was decided to calculate another measure of interrater reliability. Pearson product-moment correlations also were calculated for each of the handwriting dimensions. The values were 0.65 for form, 0.38 for spacing, 0.67 for alignment ($p < .001$), 0.42 for uniformity, and 0.78 for the global index ($p < .001$). Within - subject comparisons were made after averaging the raters' scores. These data are presented in Tables 30 and 31.

Compared to his baseline handwriting sample, Subject A's handwriting was judged to be improved when he was on methylphenidate. His scores on the form and uniformity dimensions as well as the global index were higher when he was on methylphenidate than when he was on placebo (see Table 30). His global index was judged to be "much better" by the

Table 30

Mean Handwriting Ratings for Subjects A, C, and E

Subject	Dimension	Phase			
		Ritalin	Placebo	Ritalin	Placebo
A	Form	4	3.5	3.5	2.5
	Spacing	4	3.5	3	3
	Alignment	3.5	3	3	3
	Uniformity	3.5	3	3	2
	Global Index	4.5	3.5	3.5	2.5
C	Form	3.5	3	3	3.5
	Spacing	3.5	3	4	3.5
	Alignment	3.5	3	3.5	3
	Uniformity	4.5	3	4	4
	Global Index	4	3	3.5	4
E	Form	3.5	2.5	2.5	2
	Spacing	3	3	2.5	2
	Alignment	3	3	2.5	1.5
	Uniformity	3.5	3	2.5	1.5
	Global Index	3	2.5	2	2

Note. All handwriting samples were compared to the baseline sample on a 5-point scale. Samples were judged to be "much worse", "a little worse", "the same", "a little better", or "much better" than the baseline sample. Higher scores indicate better performance.

Table 31

Mean Handwriting Ratings for Subjects B and D

Subject	Dimension	Phase			
		Placebo	Ritalin	Placebo	Ritalin
B	Form	2.5	2.5	2	3
	Spacing	2	2.5	1.5	3
	Alignment	2	2.5	2	3
	Uniformity	2	2	1.5	3
	Global Index	2	2	1	3
D	Form	2.5	3	2.5	2.5
	Spacing	3.5	3	2	4
	Alignment	3.5	4	2.5	4
	Uniformity	3	3	2.5	3
	Global Index	2.5	3.5	2	4

Note. All handwriting samples were compared to the baseline sample on a 5-point scale. Samples were judged to be "much worse", "a little worse", "the same", "a little better", or "much better" than the baseline sample. Higher scores indicate better performance.

first rater and "a little better" by the second rater in the first medication phase and "the same" and "a little better" in the second medication phase. When he was on placebo, his global index score was "the same" or "a little worse" than his baseline score. No clear trends were evident on the spacing and alignment dimensions. The positive medication effects on Subject A's handwriting should be interpreted with caution because there was a tendency for his scores on the form, uniformity, and global dimensions to decrease during the course of the study. Thus, it is possible that methylphenidate did not improve his handwriting but that he exhibited less care and effort in copying the paragraph with the passage of time.

Subject B's scores on the spacing and alignment dimensions were higher when he was on Ritalin than when he was on placebo (see Table 31). However, his medication samples were not better than his baseline sample. There was not a consistent difference between his Ritalin and placebo samples on the form and uniformity dimensions or on the global index. The handwriting sample collected from Subject B during the last phase of the experiment when he was on Ritalin was better than the previous three samples, but it was judged to be the same in quality as his baseline sample.

During the time period when Subject C was on

methylphenidate, his handwriting was rated as better than his placebo and baseline samples on the spacing and alignment dimensions, but there was not a consistent difference between his methylphenidate and placebo samples on the form and uniformity dimensions or on the global index (see Table 30). The positive medication effects on the spacing and alignment dimensions were small; the average difference between the methylphenidate and placebo ratings was half a point.

Subject D's scores on the spacing and alignment dimensions and the global index were higher when he was on Ritalin than when he was on placebo (see Table 31). His Ritalin samples were rated as "the same" or "a little better" than his baseline sample. No medication effects were evident on the form and uniformity dimensions.

Only Subject E's scores on the uniformity dimension clearly revealed a medication effect. His Ritalin scores were higher than his placebo scores, but his Ritalin scores were not substantially better than his baseline sample. The handwriting samples obtained when he was on Ritalin sometimes were rated more highly on the other dimensions than his placebo samples, but the expected pattern of lower placebo scores and higher Ritalin scores did not emerge consistently (see Table 30). Thus, neither 10 nor 15 mg of Ritalin substantially altered Subject E's handwriting.

The data were averaged across phases and individuals yielding a mean Ritalin score and a mean placebo score for each handwriting dimension. The mean Ritalin and placebo scores respectively were: form: 3.2 and 2.7; spacing: 3.3 and 2.7; alignment: 3.3 and 2.7; uniformity: 3.3 and 2.6; and the global index scores were 3.3 and 2.5. These findings indicate that Ritalin slightly improved the boys' handwriting, but the effects were small. The mean Ritalin scores were rated as slightly better on every handwriting dimension than the baseline samples, and they ranged from 0.5 to 0.8 points better than the mean placebo scores.

Group Analyses

Repeated - measures one-way analyses of variance were used to test for the significance of medication effects on each dependent variable. The placebo and methylphenidate scores were averaged for each subject. Consequently, each subject had one baseline score, one placebo score, and one methylphenidate score for each dependent variable, and these scores were used in the analyses. T-tests for correlated means were used to identify which comparisons among means accounted for the significant F ratios.

The mean scores for each condition and the F ratios are presented in Table 32. The F ratios for the Hyperactivity factor $F(2,8) = 4.57, p < .05$ and the Daydreams/Attendance

Table 32

Within Group Analyses of Medication Effects

Dependent Variable	Condition			
	Baseline	Placebo	Ritalin	F
Conners Teacher Questionnaire factors				
Hyperactivity	23.0 (8.3)	25.0 (8.6)	15.7 (9.5)	4.57**
Conduct Problem	10.2 (8.0)	14.8 (7.6)	9.9 (6.7)	2.34
Emotional Overindulgent	8.0 (6.0)	10.3 (4.7)	7.3 (4.5)	<1.0
Anxious-Passive	5.2 (2.2)	3.2 (1.7)	3.8 (2.4)	2.74
Asocial	2.2 (2.9)	2.4 (1.3)	1.6 (0.8)	<1.0
Daydreams/Attendance Problem	3.8 (1.6)	2.8 (1.6)	1.6 (1.8)	13.76***
Hyperkinesis Index	13.8 (5.9)	15.7 (5.3)	9.6 (5.5)	3.67*
Conners Parent Questionnaire factors				
Conduct Problem	11.2 (5.5)	11.1 (3.4)	11.9 (4.8)	<1.0
Learning Problem	3.2 (1.5)	3.9 (2.8)	3.9 (2.8)	<1.0
Psychosomatic	0.6 (0.5)	0.6 (0.6)	0.2 (0.2)	1.63
Impulsive/Hyperactive	6.2 (2.5)	6.1 (2.7)	6.3 (3.0)	<1.0
Anxiety	0.6 (1.3)	1.1 (1.2)	1.1 (1.1)	<1.0
Hyperkinesis Index	11.0 (3.7)	13.2 (10.7)	11.2 (7.0)	<1.0
Weingartner Memory Test				
Free Recall	6.8 (2.0)	5.0 (2.8)	7.2 (4.2)	<1.0
Cued Recall	7.2 (0.4)	5.4 (1.7)	6.1 (3.8)	1.22
Recall of Semantically Processed Words	4.4 (1.5)	3.2 (1.7)	4.2 (2.5)	<1.0
Recall of Acoustically Processed Words	2.8 (1.6)	2.2 (1.1)	1.9 (1.4)	<1.0

Table 32 cont.

Dependent Variable	Baseline	Placebo	Ritalin	F
Paired-Associate Learning				
Number of Errors	31.8 (11.0)	19.5 (12.8)	17.3 (10.0)	2.29
Continuous Performance Task				
Errors of Omission	10.2 (6.6)	6.0 (5.0)	5.5 (5.5)	1.27
Errors of Commission	14.2 (10.0)	9.3 (8.6)	6.4 (7.3)	2.46
d'	1.568 (1.155)	2.596 (1.612)	3.343 (1.538)	3.30*
In B	0.925 (0.157)	1.022 (0.336)	11.023 (16.8)	1.4
Maze Test				
Dominant Hand Counter	20.6 (18.9)	20.4 (17.7)	15.4 (8.6)	<1.0
Dominant Hand Timer	3.10 (4.21)	3.69 (5.43)	1.88 (1.66)	1.00
Nondominant Hand Counter	49.4 (27.5)	49.2 (13.7)	29.1 (15.9)	7.56*
Nondominant Hand Timer	8.20 (8.20)	7.86 (5.85)	4.12 (3.37)	3.95*
Classroom Behavioral Observations				
Interference	11.1 (7.9)	12.2 (8.1)	10.2 (9.8)	<1.0
Conversation Initiation	4.1 (4.0)	3.1 (0.3)	1.1 (0.7)	1.93
Self-Orienting	9.5 (8.8)	4.4 (4.0)	3.0 (2.3)	2.96
Off-Task	22.5 (13.7)	14.8 (4.3)	11.8 (1.7)	2.52
Teacher-Pupil Interaction	29.9 (16.9)	27.2 (9.1)	29.8 (8.6)	<1.0
Change of Position	11.2 (4.7)	11.0 (4.8)	9.1 (1.5)	<1.0
Absence of Behavior	57.7 (13.5)	67.7 (5.7)	72.2 (10.3)	2.27
Mean Disruptive Behavior	63.5 (26.6)	46.0 (10.0)	35.4 (14.3)	2.79

Note. Values are group means and standard deviations are in parentheses.

*p<.10 **p<.05 ***p<.01

Problem factor $F(2,8) = 13.76$, $p < .01$ of the Conners Teacher Questionnaire were significant. The methylphenidate scores were significantly lower than the placebo scores for both of these measures (Hyperactivity factor: $t(4) = 3.68$, $p < .05$; Daydreams/Attendance Problem factor: $t(4) = 4.30$, $p < .05$), and the methylphenidate score was significantly lower than the baseline measure for the Daydreams/Attendance Problem factor ($t(4) = 4.46$, $p < .05$). The baseline and placebo scores were not significantly different (Hyperactivity factor: $t(4) = 0.62$; Daydreams/Attendance Problem factor $t(4) = 2.03$). The Hyperkinesis Index scores of the Conners Teacher Questionnaire approached significance ($F(2,8) = 3.67$, $p < .10$). The methylphenidate score was much lower than the baseline and placebo scores.

The difference among the mean scores for the measure of perceptual sensitivity, d' , approached significance ($F(2,8) = 3.30$, $p < .10$). The methylphenidate score was much higher than the scores for the other conditions.

There was a significant difference among the Nondominant Hand Counter scores ($F(2,8) = 7.56$, $p < .05$), and the difference among the Nondominant Hand Timer scores approached significance ($F(2,8) = 3.95$, $p < .10$). Methylphenidate improved the subjects' performances resulting in significantly fewer contacts with the sides of the maze

(methylphenidate-placebo: $t(4) = 4.82, p < .01$;
methylphenidate-baseline: $t(4) = 3.34, p < .05$) and a tendency
for a shorter total duration of contact. There was not a
significant difference between the baseline and placebo
Nondominant Hand Counter scores ($t(4) = .03$).

None of the other comparisons approached statistical
significance.

Side Effects

Side Effects Questionnaire

The potential side effects of methylphenidate are grouped into 4 areas on the Parent-Teacher Side Effects Questionnaire. The first area represents behavioral side effects and the latter 3 areas represent potential physical complaints (see Appendix L). Within each area scores were totalled. Results of the questionnaires filled out by the teachers are presented in Tables 33 and 34, and by the child care workers in Tables 35 and 36.

The subjects reported few physical complaints during the course of the study and those which did occur were not reported specifically during the periods of time when methylphenidate was administered. No reductions in the dosage of methylphenidate due to physical or behavioral complaints were necessary. Subject D's mother was concerned because he had two nosebleeds during the weekend preceding

Table 33

Scale Scores on the Teacher Side Effects Questionnaire for SubjectsA, C, and E

Subject	Phase									
	Bl	Rit	Rit	Pl	Pl	Rit	Rit	Pl	Pl	Rit 15
Behavioral Side Effects										
A	11	6	9	14	15	4 ^a	4	9	6	
C	8		16		16		4		11	
E	13	14	17	12	24	16	25	21	23	23
Physical Complaints										
A	0	0	1	2	1	0 ^a	0	0	1	
C	7		10		11		6		1	
E	0	0	0	0	0	0	0	0	0	1
Infrequent Physical Complaints										
A	4	3	6	6	8	1 ^a	1	3	0	
C	1		5		3		2		10	
E	0	0	1	1	6	5	10	8	7	3

Note. Bl = Baseline; Rit = Ritalin; Pl = Placebo; Rit 15 = Ritalin 15 mg.

^a At this point, a new teacher started to complete the questionnaires.

Table 34

Scale Scores on the Teacher Side Effects Questionnaire for Subjects B and D

Subject	Phase							
	B1	Pl	Pl	Rit	Rit	Pl	Pl	Rit Rit
Behavioral Side Effects								
B	4	2	3	4	3	0 ^a	7	3 1
D	4	3	7	5	7.5	17	12	2 6
Physical Complaints								
B	1	2	0	0	3	0 ^a	0	0 0
D	0	0	0	0	0	0	0	0 3
Infrequent Physical Complaints								
B	0	0	1	0	0	0 ^a	3	1 0
D	0	0	0	0	0	0	0	0 0

Note. B1 = Baseline; Rit = Ritalin; Pl = Placebo; Rit 15 = Ritalin 15 mg.

^a At this point, a new teacher started to complete the questionnaires.

Table 35

Scale Scores on the Parent Side Effects Questionnaire for Subjects A, C, and E

Subject	Phase									
	B1	Rit	Rit	Pl	Pl	Rit	Rit	Pl	Pl	Rit 15
Behavioral Side Effects										
A	2	4	5	17	6	8	17	6	16	
C	6		5		5		3		6	
E	7	25	20	20	26	26	24	16	24	24
Physical Complaints										
A	1	0	0	0	2	0	0	0	2	
C	1		1		4		1		0	
E	0	1	0	0	0	1	0	0	0	0
Infrequent Physical Complaints										
A	1	2	3	2	3	2	5	5	4	
C	2		0		0		1		0	
E	0	0	0	0	0	0	2	0	2	0
Anorexia, Insomnia and Enuresis										
A	0	2	1:5	-	1	1	1	0	0	
C	1		1		1		2		1	
E	0	4	-	-	-	-	-	-	-	-

Note. Questionnaires were completed by the child care worker who was primarily responsible for the supervision of the subject.

B1 = Baseline; Rit = Ritalin; Pl = Placebo; Rit 15 = Ritalin 15 mg.

Table 36

Scale Scores on the Parent Side Effects Questionnaire for Subjects B and D

Subject	Phase								
	B1	Pl	Pl	Rit	Rit	Pl	Pl	Rit	Rit
Behavioral Side Effects									
B	8	8	8	10	5.5	12	16	9	4
D	4	3	4	7	2	4	10	7	1
Physical Complaints									
B	0	0	0	0	0	0	0	0	0
D	0	0	0	0	0	0	0	0	1
Infrequent Physical Complaints									
B	0	0	0	0	0	0	0	0	0
D	0	0	0	0	0	0	0	0	0
Anorexia, Insomnia and Enuresis									
B	2	0	0	2	0	-	0	-	0
D	0	0	-	0	-	-	-	-	-

Note. Questionnaires were completed by the child care worker who was primarily responsible for the supervision of the subject.

B1 = Baseline; Rit = Ritalin; Pl = Placebo.

week 4. Her concerns were allayed during a meeting between the principal investigator, Subject D's primary therapist, and the mother in which it was explained that this was an unlikely side effect of the medication.

With respect to the physical complaints noticed by the teachers, Subject A earned moderately high scores on weeks 3, 4, and 5 but he was on placebo during weeks 4 and 5 (see Table 33). During this time, the teachers thought that he was biting his fingernails and playing with himself more than usual. Subjects B and D did not exhibit any significant physical complaints according to their teachers. During the first four phases of the study, Subject C experienced stomachaches, headaches, muscle aches, and a dry mouth but these symptoms were reported as frequently during the placebo and baseline phases as during the methylphenidate phases. Subject E apparently exhibited more eye twitches and tics and picked at his skin more often during weeks 5 to 9 than during other weeks, but these side effects were not produced by the administration of methylphenidate because they occurred with the same intensity and frequency while he was on placebo.

It was expected that child care workers would not report many physical complaints because the medication would have worn off by the time they started to work with the subjects (except for Subject E). Nevertheless, they were asked to

fill out the Parent-Teacher Side Effects Questionnaire in case persisting or rebound effects occurred.

Subject A exhibited few physical complaints according to his child care worker (see Table 35). During the last four weeks of the study, he bit his fingernails and played with himself more than during the first part of the study. He was on placebo for 2 of these last 4 weeks. No significant physical complaints were observed by the child care workers in charge of subjects B, C, D, and E (see Tables 35 and 36).

With respect to the behavioral side effects on the Parent-Teacher Side Effects Questionnaire as perceived by the teachers, Subject A clearly exhibited a reduction in these behaviors when he was on methylphenidate (see Table 33). His teachers thought that he was less crabby, jittery, restless, worried, and anxious during the weeks when he was on medication than during the other weeks. Subject B did not exhibit any changes in the frequency and intensity of these behaviors during the course of the study (see Table 34). The average number of behavioral side effects exhibited by Subject C was less when he was on methylphenidate than when he was on placebo but it was comparable to his baseline score (see Table 33). The difference was accounted for by his low score on the fourth phase of the study when he was on methylphenidate. His teacher thought that he was less

crabby, jittery, restless, anxious, tired, and drowsy during this time period. Subject D's score on the measure of behavioral side effects was highest during weeks 6 and 7 when he was on placebo (see Table 34). His teacher regarded him as more crabby, jittery, restless, tearful, and whiny during these weeks than at any other time during the study. Subject E did not exhibit an alteration in the frequency and intensity of behavioral side effects as a consequence of the administration of methylphenidate. However, his scores on this measure tended to rise as the study progressed (see Table 33). His teachers thought that he was more crabby, jittery, restless, worried, and anxious during the last half of the study than during the first half of the study.

On the Parent-Teacher Side Effects Questionnaires filled out by the child care workers, Subject A showed a fair amount of variability during the study. His behavioral side effects score was elevated on weeks 4 and 9 when he was on placebo and on week 7 when he was on methylphenidate (see Table 35). He was perceived by his child care worker as being more worried, anxious, jittery, and restless during these weeks than at other times. These behaviors obviously were not due to the administration of methylphenidate. Table 36 shows that Subject B's scores on the measure of behavioral side

effects were fairly consistent except for weeks 6 and 7 when he was on placebo and his scores were higher than usual. His primary child care worker thought he was unusually worried and anxious during these 2 weeks. The behavioral side effects scores for Subjects C and D were stable during the course of the study, and there were not any changes in these scores as a result of the administration of methylphenidate (see Tables 35 and 36). Subject E had a good baseline week in which his child care worker perceived him as being less crabby, jittery, restless, anxious, fearful, and dull than during the rest of the study. The rest of his scores were fairly consistent except for week 8 when he was on placebo (see Table 35). During this week, he was regarded as less worried, fearful, anxious, and tearful than in the weeks preceding and following this week.

Heart Rate

Heart rate data in beats per minute are presented in Table 37. Subject A's heart rate was lower when he was on methylphenidate than when he was on placebo, but his mean medication score was comparable to his baseline score. Methylphenidate did not alter Subject B's heart rate. Subject C's results were very much like those of Subject A; his heart rate was slightly depressed on medication relative to his rate on placebo, and his average medication rate was

Table 37

Heart Rate

Subject	Phase				
	Baseline	Ritalin	Placebo	Ritalin	Placebo
A	80	88	90	76	82
C	88	82	90	92	96
E	84	90	82	86	88
	Baseline	Placebo	Ritalin	Placebo	Ritalin
B	88	84	80	80	92
D	84	80	84	86	80

Note. The values represent beats per minute.

very similar to his baseline rate. Methylphenidate did not alter the heart rate of Subject D or Subject E. These results provide additional support for the results of the behavioral questionnaires which showed that the subjects tolerated the medication very well and reported few complaints that were specifically linked to the administration of the medication. None of the subjects experienced tachycardia which occasionally has been reported following the administration of stimulants.

CHAPTER IV

Discussion

This study has demonstrated that methylphenidate has a variety of cognitive and behavioral effects on conduct disordered children. Medication effects on behavioral measures, cognitive tests, and psychomotor tests will be reviewed first, and then a general discussion section will follow. A global interpretation of the results and their importance will be presented in the general discussion section. As well, the methodological and theoretical importance of this study will be reviewed. Results will be integrated with previous findings throughout the discussion.

Behavioral Measures

Conners Teacher and Parent Questionnaires

Subjects A and C exhibited clear behavioral responses to methylphenidate as demonstrated by their relatively low medication scores on the Conduct Disorder, Emotional Overindulgent, and Hyperactivity factors as well as their low scores on the Hyperkinesis Index of the Conners Teacher Questionnaire. The Hyperactivity factor score and the Hyperkinesis Index for Subject B were lower when he was on methylphenidate than when he was on placebo or no medication, but the changes in his Conduct Disorder and Emotional

Overindulgent factor scores were less clear. The changes in these four measures for Subject D were suggestive of a medication effect because his scores during the last two weeks that he was on methylphenidate were lower than the previous two weeks when he was on placebo. The absence of a medication effect in the first half of the study indicates that the results should only be regarded as suggestive. Subject E's classroom behavior, as perceived by his teachers, was not affected by methylphenidate.

With the exception of Subject E, none of the subjects were expected to show a change in their Conners Parent Questionnaire factor scores as a result of the administration of Ritalin because the last dose was given at noon and would have been largely worn off by the time the child care workers started to interact with the children. Subject E was given the medication three times a day, and his behavior in the residence was judged to have been unaltered by Ritalin. Thus, the child care worker agreed with the teachers that methylphenidate did not affect Subject E's behavior.

The reductions in hyperactivity, inattentiveness, impulsivity, emotional lability, and disruptiveness reported by the teachers are consistent with the work of Eisenberg et al. (1963). They found that dextroamphetamine reduced teachers' ratings of institutionalized delinquent boys on a prototype of the Conners Teacher Questionnaire. Maletzky (1974) found that dextroamphetamine reduced parents' and teachers' ratings of their delinquent teenage boys on

the Conduct Problem and Sociability factors of the Conners Teacher Questionnaire. For some unexplained reason Maletzky averaged scores on the Conduct Problem and Sociability factors when analyzing the results. Lower scores on the Conduct Problem factor reflect an improvement in behavior in terms of reduced aggressiveness, disruptiveness, and disobedience whereas lower scores on the Sociability factor reflect improved peer relations. It is possible that changes in one of these factors might have accounted for the results.

However, separate factor scores were not reported. This study is noteworthy because it is one of the few stimulant medication studies which reported group as well as individual data. Ratings for two of the fourteen subjects were unchanged by dextroamphetamine indicating that the treatment was ineffective for them.

The results of this study are not directly comparable with the findings of Eisenberg and co-workers or Maletzky because they used delinquents as subjects. Groups of children adjudicated as delinquents probably include some who would not be diagnosed as having a psychiatric disorder as well as others who would be given another diagnosis instead of or in addition to a diagnosis of conduct disorder. Despite these differences in subject population, the reductions in disruptiveness, noncompliance, and aggressiveness on the teacher rating scales are similar.

On the other hand the results are not consistent with the results of Conners, Kramer, Rothschild, Schwartz, and Stone (1971).

They reported that methylphenidate did not affect cottage parents' or teachers' ratings of symptoms of delinquent boys. They administered 10 mg of methylphenidate twice a day to each subject, and thus differences in dosage were not responsible for the discrepant findings. They used a relatively less powerful between-groups design and their subjects exhibited low predrug parent ratings. There was little room for improvement in this measure. Apparently, many of the subjects were institutionalized for practical reasons such as a shortage of suitable foster home placements, and their symptoms may have reflected temporary mild situational adjustment problems more than severe psychopathology as in the case of the symptoms exhibited by the boys in this study.

Taylor (1983) examined the effects of methylphenidate on children diagnosed as having a conduct disorder according to the ICD-9 diagnostic classification system. However, only nine of his subjects were conduct disordered but not hyperactive. He also found that methylphenidate reduced scores on the Hyperactivity factor of the Conners Teacher Questionnaire. No medication effects were evident on the Conduct Problem factor of the Conners Teacher Questionnaire. The reason for the discrepancy between his negative results and the positive findings reported in this study is not clear, but there was a great deal of variability in the teachers' ratings of conduct problems in Taylor's study, and this may have obscured any medication effects.

Taylor (1983) also reported that Ritalin reduced parent hyperactivity ratings but not parent defiance ratings. These latter scales were based on items contained in a standardized psychiatric interview (Rutter & Brown, 1966). Presumably Taylor administered the medication more than twice per day or on weekends and holidays because the parents were able to detect medication effects. However, the schedule of medication administration as well as some essential information on data analysis is lacking in this preliminary report. This latter point will be commented on further in the discussion of the cognitive effects of methylphenidate.

Teacher Reports

The analysis of teacher frequency counts of problem behaviors and ratings on the behavioral dimensions was not planned because the principal investigator was unaware Child Study Center staff collected this information. Despite the incompleteness of the data set and the change in format of the reports during the study, a decision was made to analyze this data because it provided, along with classroom behavioral observations, a complementary view of the boys' classroom behavior to that provided by the Conners Teacher Questionnaires.

Methylphenidate produced clear behavioral changes in Subject A according to the teacher ratings of the behavioral dimensions. He was more sociable, relaxed, obedient, attentive, and less demanding

when he was on medication. These findings are in agreement with the dramatic improvement in his behavior as reflected by changes in his factor scores on the Conners Teacher Questionnaire and several target behaviors of the observational code. Thus, it was surprising that no medication effects were apparent on the frequency of problem behaviors. One wonders if the teachers were accurate recorders of the number of problem behaviors exhibited by Subject A. The teachers did not record these problem behaviors immediately after they occurred but waited until recess or lunch. Thus, it is possible that they missed some of the problem behaviors that he exhibited. This appears to be the most parsimonious explanation for the discrepant findings.

Subject C clearly exhibited a reduction in problem behaviors during the methylphenidate phases which is consistent with the reduction in the Conduct Disorder, Hyperactivity, and Emotional Overindulgent factor scores on the Conners Teacher Questionnaire. However, no medication effects were evident on the teacher report ratings of the following behavioral dimensions: sociable-withdrawn, relaxed-tense, not demanding-demanding, obedient-disobedient, and attentive-distractible. Prior to the study, it was expected that Subject C would be less demanding, more obedient, and more attentive during the medication phases. However, he was able to work independently throughout the experiment which would account for the negative findings on the first measure. No explanation is readily

available for the lack of effects on the ratings of obedience and attentiveness. Methylphenidate did not make Subject C seem more withdrawn or tense, effects which might have been possible although unlikely.

No medication effects were apparent on the Teacher Reports for Subjects B and D, but the data sets for these subjects were incomplete. Methylphenidate did not reduce the frequency of verbal aggression, physical aggression, or acts of defiance exhibited by Subject E. In addition, time out and physical restraint were used no less frequently in the methylphenidate phases than in the placebo phases. These negative findings are consistent with the absence of medication effects on the other measures of classroom behavior.

Classroom Behavioral Observations

Most of the point-by-point agreement ratios for occurrences of the target behaviors fell below the 80% level of agreement which is a commonly used cutoff point for acceptable levels of interobserver agreement. The exceptions were the ratios for Teacher-Pupil Interaction and Absence of Behavior both of which exceeded the 80% agreement level. In part, the low interobserver agreement ratios were due to the low frequencies of occurrence of the target behaviors. The boys were in small classrooms, and the teacher-pupil ratio usually was about 5 to 1. A child care worker also was present in every class, and their primary job was to enforce

discipline using behavior modification techniques. Thus, the children generally were well controlled and exhibited few disruptive behaviors. Point-by-point agreement ratios also were calculated for nonoccurrences of the target behaviors, and all of the agreement levels were over 90%, with the exception of the Ratio for Absence of Behavior which was 82.8%. However, given the high base rate for the nonoccurrence of the target behaviors, it is likely that these agreement ratios were high partly as a result of chance (Kazdin, 1982). Thus, kappa correlations (Cohen, 1965) were calculated because this statistic provides an estimate of agreement corrected for chance (Kazdin, 1982). Relatively high overall correlations were obtained for Teacher-Pupil Interaction, Change of Position, and Absence of Behavior, while moderately high correlations were obtained for Interference, Conversation Initiation, Self-Orienting, Off-Task, and Mean Disruptive Behavior. Unacceptable levels of agreement were obtained for Vocalization and Day-Dreaming and incidents of non-compliance and aggression occurred too infrequently during interrater reliability checks to provide meaningful correlations. These findings indicate that confidence can be placed in the results for Teacher-Pupil Interaction, Change of Position, and Absence of Behavior, while the results for target behaviors whose kappa correlations ranged from 0.61 to 0.72 should be interpreted with caution.

In addition to the low frequencies of occurrence of some of the target behaviors, the interobserver reliabilities were lowered by the complexity of the behavioral code in conjunction with the relative inexperience of the raters who assisted in the reliability checks. Unfortunately the rater who started the study was unable to participate in reliability checks during the latter part of the study. This necessitated the training of a new rater. The interobserver reliabilities might have been higher if the raters who assisted in reliability checks had been involved in data collection as well as reliability checks. They failed to detect some target behaviors likely as a result of their relative inexperience. For example, the boys in the study were well behaved for various periods of time, and then they engaged in a burst of disruptive behavior. This burst often consisted of a number of disruptive behaviors in a given interval. The raters who conducted reliability checks recorded some of the target behaviors, but the principal investigator tended to record more behaviors during these bursts which lowered the interobserver reliabilities. It would have been preferable if all of the raters had been involved in data collection, as well as reliability checks.

Despite the less than impressive interrater reliabilities for some of the target behaviors and the moderate levels of daily variability, medication effects were demonstrated for each subject in the study. Whether methylphenidate affected the frequency of

occurrence of the target behaviors primarily was determined by examining the changes in means across phases. The changes in level, the discontinuity of performance between the end of one phase and the beginning of the next phase, were less useful in determining medication effects because of the day-to-day variability in performance which tended to obscure changes in level.

Methylphenidate reduced the amount of disruptive behavior exhibited by Subject A. The summary category of Mean Disruptive Behavior was reduced as a result of decreased amounts of interference, activity, and off-task behavior during the methylphenidate phases. The slight reduction in the number of intervals in which Conversation Initiation was coded also contributed to the overall decrease in disruptive behavior. There was a slight increase in the number of intervals in which Absence of Behavior was scored. Positive interactions between Subject A and his teachers also occurred more frequently when he was taking methylphenidate than when he was taking placebo or no medication. The stimulant-induced increase in Teacher-Pupil Interaction may have been related to the decrease in disruptive behavior. That is, the teachers may have been more favorably inclined to interact with Subject A because he was less disruptive.

Subject B was on task more and he engaged in fewer self-orienting behaviors during the methylphenidate phases. A slight reduction in conversation initiation also was evident. He

interfered with classroom functioning less during the last methylphenidate phase than the preceding placebo phase, but since there was not a decline in interference between the first placebo and methylphenidate phases, the data provides weak evidence for a medication effect. The summary category of Mean Disruptive Behavior was coded less frequently when Subject B was taking methylphenidate than when he was not taking any medication, and there was a decrease in overall disruptiveness each time he was switched from placebo to methylphenidate. Changes in Absence of Behavior followed a reciprocal pattern to the changes in Mean Disruptive Behavior: Methylphenidate increased the amount of this target behavior, and Absence of Behavior increased each time Subject B changed from a placebo to a methylphenidate phase.

The change in classrooms also affected Subject B's behavior. Several disruptive behaviors including Interference, Off-Task, Conversation Initiation, Self-Orienting, and Change of Position decreased in the second placebo phase compared to the first placebo phase. Some of the decreases in these target behaviors were marginal (e.g., Conversation Initiation, Interference, Change of Position) whereas the other declines were larger. The summary category of Mean Disruptive Behavior also decreased whereas Absence of Behavior increased between the first and second placebo phases. The changes in target behaviors resulting from the switch in classrooms may have acted to obscure medication effects. For

example, the amount of Mean Disruptive Behavior did not increase between the first methylphenidate and second placebo phases, and the number of intervals in which Absence of Behavior was scored did not decrease after Subject B was switched from methylphenidate to placebo. Subject B was in a smaller classroom at the Child Study Center and the staff was able to watch him more closely. Thus, it is suggested that the environment and methylphenidate produced similar changes in these target behaviors, and that the effects of methylphenidate would have been clearer if the change in environment had not occurred.

Subject C's classroom behavior largely was unaffected by the administration of methylphenidate. There was a stimulant-induced reduction in activity, and a slight tendency for Subject C to exhibit less inappropriate behavior when he was taking methylphenidate than when he was taking placebo or no medication.

The effects of methylphenidate on Subject D's classroom behavior also were minimal. He interfered with classroom functioning less when he was on methylphenidate than he was on placebo, but his methylphenidate and baseline mean scores were similar. There may also have been stimulant-induced reductions in disruptiveness and number of conversations initiated, but the data only were suggestive because of the failure to find the expected increase in these target behaviors after methylphenidate was withdrawn. In

addition, he engaged in more self-orienting behavior when he was on medication.

Both doses of methylphenidate decreased the number of intervals in which Self-Orienting was coded for Subject E, but the effects were small. A similar pattern emerged with respect to Conversation Initiation, but the higher dose of Ritalin had negligible effects on this target behavior. Subject E was more active when he was on the low dose of methylphenidate than when he was on placebo or no medication. His activity level on the higher dose of methylphenidate was similar to his activity level in the preceding placebo phase. No medication effects were apparent on the remaining target behaviors. Thus, there was little evidence which suggested that methylphenidate altered the classroom behavior of Subject E.

Studies which have used this classroom observational code or its variations have shown that it is reliable and can be used to distinguish hyperactive from normal children (Abikoff et al., 1977, 1980) especially in formal classroom settings (Jacob et al., 1978). This code has been used in studies which have evaluated the effectiveness of behavior therapy (Abikoff & Gittelman, 1984; Gittelman-Klein et al., 1976) and methylphenidate (Gittleman-Klein et al., 1976) in the treatment of hyperactive children. Gittelman-Klein et al. (1976) found that methylphenidate reduced scores on an index of disruptive behavior consisting of Interference, Off-Task, and Gross Motor Activity which is consistent with

the medication effects on some of the boys in this study. The results of this study extend their work by demonstrating that this behavioral observational code can be used to detect stimulant medication effects in conduct disordered boys.

The changes in the Conners Teacher Questionnaire scores generally were consistent with the changes in the behavioral observational code. Subjects A and B exhibited reductions in disruptive, non-compliant, and hyperactive behavior as reflected by decreases in the Conduct Disorder, Emotional Overindulgent, and Hyperactivity factor scores as well as the Hyperactivity Index and reductions in the categories of the behavioral code reflecting these behaviors. However, Subject B did not exhibit a reduced gross-motor activity level as measured by the Change of Position category on methylphenidate. Thus, the change in his Hyperactivity factor score might have reflected improvements in attention. The decreased amount of Off-Task behavior and the increase in Absence of Behavior supports this interpretation. Only slight medication effects on the Conners Teacher Questionnaire and the behavior observational code were apparent for Subjects D and E. Methylphenidate reduced the activity level of Subject C as indicated by the reduction in Change of Position scores and the Hyperactivity factor score and Hyperkinesis Index. Absence of Behavior increased when Subject C was on medication indicating that he appeared to be on task and was not engaging in disruptive behavior. This finding is consistent

with the stimulant-induced decreases in his Conduct Disorder and Emotional Overindulgent factor scores. However, given the size of the changes and the effects on several factor scores of the Conners Teacher Questionnaire, one might have expected more numerous positive changes in the target behaviors comprising the behavioral code. A possible explanation for the discrepancy is that his teacher had a greater opportunity to observe Subject C's behavior in several different settings. It might be the case that the stimulant-induced changes in Subject C's behavior were more apparent and salient during less structured classroom activities, at lunch time or during recess, than they were during structured classroom periods when the behavioral observations were conducted.

Residence Reports

The principal investigator only became aware that residence reports on each boy were kept after the study had begun. Thus, their use in the study was not planned, and the principal investigator had no control over the change in format of the reports, and the missing data for some of the subjects. However, since this data was available, it was decided to make use of it.

No medication effects were apparent on the adjective ratings for Subjects A and B. This data was not available for the rest of the subjects. Frequency counts of problem behaviors were lower for Subjects B and C and slightly higher for Subject A during the

methylphenidate phases than the placebo or baseline phases. These findings suggest that the positive behavioral effects for Subjects B and C carried over into the late afternoon and possibly early evening. The reduction in problem behaviors for Subjects B and C is consistent with the decrease in disruptive behavior noted on the Conners Teacher Questionnaire but not with the absence of effects on the Conners Parent Questionnaires filled out by the child care workers. Subject A apparently exhibited a slight rebound effect because more problem behaviors were recorded during the medication phases than the placebo phases. No medication effects were reported for Subjects D and E which is consistent with the negative findings obtained with the Conners Parent and Teacher Questionnaires. Since the medication was given to Subject E three times per day, these data provide additional evidence for the lack of medication effects on his behavior.

Self-Report Psychiatric Rating Scales

Two of five boys were classified correctly as clinical cases using the discriminant function of Beitchman et al. (1985). The percentage of correctly classified cases was similar to the specificity reported in Study II of their paper (45%). Beitchman et al. (1985) conducted post-hoc analyses designed to increase the classification accuracy of their rating scale. By altering the cutoff points for the classification decision and by selecting cases

about which the psychiatrists were certain of the presence or absence of psychopathology, the specificity and sensitivity were improved considerably. However, since this was a post-hoc analysis, no data on the validity of these new cut-offs were collected. Thus, only their original cut-offs were used in this study.

It is interesting that three of the boys were classified as normal using this self-report measure. Beitchman et al. (1985) tested a heterogeneous group of psychiatric inpatients and outpatients and did not provide separate information on the classification rates for conduct disordered children. It would be interesting to compare conduct disordered children's responses with those of other diagnostic groups. If conduct disordered children have low levels of self-knowledge or are prone to give socially desirable responses, then they would be incorrectly classified as normal. If so, this could have important implications for treatment. A conduct disordered child who has limited self-awareness and denies that he or she has any problems would not be a good candidate for individual psychotherapy. It may well be that this type of treatment is most beneficial for anxious conduct disordered children who recognize that they have problems and want help in solving them (Rutter & Giller, 1983). Thus, Beitchman's Self-Report Psychiatric Rating Scale might be useful as a screening

instrument to help select conduct disordered children who are good candidates for individual psychotherapy.

At first glance, it appears as if methylphenidate altered the responses of Subjects B, C, and D on the Self-Report Psychiatric Rating Scale. However, the factors that were affected were different for each subject, and an item analysis revealed that there were few consistent changes across medication conditions in the responses of the subjects to individual questions. These findings suggest that methylphenidate did not affect their responses to the items of this questionnaire. This can be interpreted as a positive finding since the item "sometimes even little things make me cry" should be capable of detecting the dysphoria that sometimes occurs as a side effect of stimulant therapy. It should also be mentioned that no dysphoria was recorded on the side effects questionnaire. A plausible explanation for the changes in a few of the factor scores during the course of the study is that they merely reflect variability in the boys' answers. This interpretation is consistent with the moderately high short-term stabilities for the factor scores reported by Beitchman et al. (1985).

Cognitive Tests

Continuous Performance Test

Methylphenidate facilitated the performance of some of the conduct disordered boys on the Continuous Performance Test. Subject A made fewer errors of omission when he was on methylphenidate than when he was on placebo or no medication. Subjects A, B, and D made fewer errors of commission when they were on medication than when they were on placebo. Subject C's performance on these dependent measures was unaffected by methylphenidate. It was not clear whether the medication altered Subject E's performance because he exhibited a practice effect and obtained perfect scores on the last three test administrations.

Methylphenidate increased the perceptual sensitivity (d') of Subjects A, B, and C. Subject B and D's scores on a measure of response bias ($\ln B$) increased when they were on methylphenidate reflecting their adoption of a more conservative response criterion. There also was a slight tendency for Subject E to adopt a less risky response criterion while he was on methylphenidate but there was not a difference between his $\ln B$ scores on the last methylphenidate and placebo phases.

These results are consistent with previous reports that stimulants improve the vigilance performance of hyperactive children (e.g., Conners, 1972; Rapoport, Buchsbaum et al., 1980; Sykes

et al., 1971, 1972; Werry et al., 1980). Although there have been reports that methylphenidate facilitated the vigilance performance of a heterogeneous group of hyperactive and aggressive children (Kupietz & Balka, 1976; Yepes, Balka, Winsberg, & Bialer, 1977), this is the first report that methylphenidate improved the vigilance of some conduct disordered boys. Taylor (1983) found that methylphenidate did not alter the number of errors made by purely conduct disordered boys on an attention test scale. Although the Continuous Performance Test was one of the tasks that he used, he summed scores from widely disparate tests such as the Continuous Performance Test and a paired-associate learning test and only presented the summed scores. Thus, it could not be discerned if methylphenidate altered performance on any of the individual tests.

It is not known if conduct disordered children have deficits in their ability to sustain attention compared to normal children, but the fact that Conduct Problem factor scores on the Conners Teacher Questionnaire were not correlated with errors of omission or commission for a group of hospitalized psychiatric inpatients (Klee & Garfinkel, 1983) suggests that conduct disordered children may not have vigilance deficits. The findings in this report, then, are compatible with those of Rapoport, Buchsbaum et al. (1980) who showed that methylphenidate improved the vigilance performance of normal children. In other words, level of initial performance on this test was not predictive of a stimulant-induced improvement in performance.

Sostek et al. (1980) conducted an analysis of their Continuous Performance Test data in terms of signal detection theory. Dextroamphetamine increased $\ln B$ for young (aged 6-9) hyperactive and normal children but not for the older (aged 10-12) groups. The medication increased perceptual sensitivity for hyperactive and normal children regardless of age. Methylphenidate improved the performance of some conduct disordered boys by increasing their attention (d') and/or by altering motivational factors (response bias or $\ln B$). Stimulant-induced changes in one parameter did not necessarily accompany changes in the other parameter which is consistent with the signal detection theory assumption of independence of d' and $\ln B$ (McNicol, 1972). These findings further demonstrate the usefulness of distinguishing perceptual sensitivity and response bias components of vigilance performance in studies of children with psychopathological disorders (cf. Nuechterlein, 1983). Further work in this area should determine whether there are differences among hyperactive, conduct disordered, and normal children in these parameters, and whether there are differential rates of vigilance decrements over time (cf. Nuechterlein, 1983).

Weingartner Memory Task

Subject A remembered more words under both free and cued recall conditions when he was on methylphenidate than when he was on placebo or no medication. Methylphenidate facilitated the recall of

semantically processed words on both memory test conditions, but did not alter his recall of acoustically processed words. Subject B remembered slightly more words under cued recall testing conditions, but there was not a clear enhancement of the recall of semantically or acoustically processed words under these test conditions. However, methylphenidate enhanced his total recall of acoustically processed words. The total number of words recalled by Subject C under free and cued recall testing conditions was not affected by methylphenidate. However, he recalled more acoustically processed words under both free and cued testing conditions when he was on placebo. Thus, methylphenidate had a slight tendency to impair his recall of acoustically processed words. Subject D recalled slightly fewer acoustically processed words under cued retrieval testing conditions when he was on Ritalin compared to his baseline and placebo performance. However, no medication effects were apparent on the recall of acoustically processed words under free recall testing conditions or on the total recall of acoustically processed words. A pattern suggestive of a stimulant-induced enhancement of free recall was apparent in the test results of Subject E. He freely recalled more words during the second methylphenidate phase and on the 15 mg dose of medication than he did on placebo. However, there was no difference between the first methylphenidate and placebo tests in words freely recalled. Methylphenidate enhanced Subject E's recall of semantically processed words. The

medication effects only became clear after the number of semantically processed words were summed across free and cued recall testing conditions.

These findings extend the work of Weingartner et al. (1980) who found that dextroamphetamine enhanced cognition in both normal and hyperactive children. These findings suggest that a stimulant-induced facilitation in performance is not limited to low level routine tasks (Burns et al., 1967; Laties & Weiss, 1967), but also is evident in at least some complex information processing tasks. Weingartner et al. (1980) found that dextroamphetamine primarily enhanced free recall rather than cued recall. Methylphenidate did not appear to preferentially alter either free or cued recall in these conduct disordered boys. The subjects recalled more semantically processed words than acoustically processed words (summed over free and cued recall testing conditions) and methylphenidate facilitated the recall of semantically processed words. On the other hand, methylphenidate tended not to facilitate the recall of acoustically processed words. Thus, the pattern of performance exhibited by the conduct disordered boys was more like that of the normal children than the hyperactives in the Weingartner et al. (1980) study. Normal children recalled significantly more semantically processed words than acoustically processed words. The means fell in the same direction for hyperactive children but the difference was not

significant. Dextroamphetamine primarily enhanced normal children's recall of semantically processed words, and hyperactive children's recall of acoustically processed words. It is possible that conduct disordered children process information in a manner which is more similar to the cognitive style of normal than hyperactive children. In fact, this task may turn out to be a useful way of helping to distinguish between conduct disordered and hyperactive children. However, before this assertion can be evaluated, these findings need to be replicated using a larger sample of conduct disordered children. In addition, the results for these two groups of children should be directly compared in the same study.

Paired-Associate Learning

In contrast to the positive medication effects obtained on the other cognitive tests, there was little evidence for a stimulant-induced facilitation of performance on the paired-associate learning test. Subject A's performance clearly was affected adversely by methylphenidate. Subject B exhibited a practice effect on this test, and consequently the effects of the medication could not be discerned. Methylphenidate did not enhance or impair the paired-associate performance of Subjects C and E. Subject D's best performance by far occurred during the last phase when he was on methylphenidate. However, there was almost no change in his performance the first time he was switched from placebo to

methylphenidate. Taken together, these results indicate that methylphenidate did not improve the paired-associate performance of these conduct disordered boys.

These negative results are surprising given the well-documented sensitivity of the paired-associate test in detecting the cognitive effects of stimulants in hyperactive children (e.g. Kinsbourne et al., 1979; Swanson & Kinsbourne, 1976, 1979; Swanson et al., 1978). It cannot be argued that the conduct disordered boys were nonresponders since they exhibited favorable behavioral and cognitive responses in varying degrees. Swanson et al. (1979) found that methylphenidate improved the vigilance of hyperactive children who were classified as adverse responders because methylphenidate impaired their paired-associate performance. Thus, it is clear that a discrepancy can occur between the results on a paired-associate test and the Continuous Performance Test. This clearly was the case for Subject A. The relationships between performance on the paired-associate learning test and the other cognitive tests used in this study have not been explored by other investigators. It is possible that the other subjects might have responded favorably, in terms of their paired-associate performance, if the dose of methylphenidate had been increased. Nevertheless, these findings illustrate the problems one encounters when using a single test to determine responsiveness to stimulant medications.

Swanson and Kinsbourne (1979) reported that 30 to 40% of children referred because of symptoms of hyperactivity responded adversely to stimulant medication on the basis of their performance on the paired-associate learning task used in this study.

Additional research is needed to determine if conduct disordered children respond favorably to stimulants as defined by changes in their performance on the paired-associate test, and if so, whether the percentages of favorable and adverse responders are the same as those for hyperactive children. At the present time, there is no compelling reason to believe that the percentages of favorable and adverse responders for these two diagnostic groups would be different.

Psychomotor Tests

Maze Test

The Maze Test previously had been shown to be sensitive to stimulant medication effects. Knights and Hinton (1969) and Werry et al. (1980) reported that methylphenidate reduced the duration of contact between the stylus and the edge of the channel, but the number of contacts was unaltered. Barkley (1977) found that the number and duration of contacts were decreased by Ritalin when the subjects used their nondominant hands, but not when they used their

dominant hands. All of these studies examined medication effects in hyperactive children or children with learning problems.

The results of this study are consistent with these earlier reports. All of the conduct disordered boys exhibited medication effects on their nondominant hand performance, and both the duration and number of contacts were reduced by methylphenidate. Medication effects on dominant hand performance were more variable. Subject A and B's dominant hand performance were improved by methylphenidate, Subject C's was worsened, and Subject E's was unaffected. The results for Subject D were suggestive of a positive medication effect, but the expected pattern of results did not occur throughout the entire experiment. The group analyses also showed that the medication had a greater effect on the boys' nondominant hand performance than on their dominant hand performance. That is, the methylphenidate-placebo differences on these dependent measures were larger for the nondominant hand performances.

Barkley (1977) attributed the improvement in maze performance to an improvement in his hyperactive subjects' ability to concentrate. If this was the case, then one wonders why only nondominant hand performance was improved significantly. He found that dominant hand methylphenidate scores were lower than the placebo scores, but the differences failed to reach statistical significance. Methylphenidate also improved conduct disordered boys' nondominant hand performance on the Maze Test more than their

dominant hand performance. It may be that stimulants directly affect motor control and that nondominant hand performance was more affected than dominant hand performance because the subjects were not as practised in using their nondominant hands in performing a fine motor coordination task like the Maze Test. In other words, there was more room for improvement when they were using their relatively clumsy nondominant hands.

Handwriting

An anecdotal report indicated that methylphenidate improved the handwriting of some hyperactive children (Schain & Reynard, 1975). Lerer and co-workers (Lerer, Artner, & Lerer, 1979; Lerer, Lerer, & Artner, 1977) found that methylphenidate improved the handwriting of approximately half of their samples of children with minimal brain dysfunction who had "severe handwriting deficits." Improvement occurred in all of the handwriting deficit areas examined. Methylphenidate positively affected organization and legibility of material, consistency of letter size, placement of letters on lines, and spacing of words. Erasures and omission of letters were less

frequent. In addition, the children even exhibited fewer letter reversals or inversions after treatment with methylphenidate.

Whalen, Henker, and Finck (1981) found that the handwriting of hyperactive boys who received placebo first and then methylphenidate improved whereas it deteriorated slightly in those hyperactive boys who received the medications in the reverse order. Whalen et al. (1981) described the positive changes in the methylphenidate-placebo group as being substantial, but the mean difference in the overall score was 3.75 units. The overall performance index was calculated by summing scores on the four specific handwriting dimensions (form, spacing, alignment, and uniformity) which were each rated on a 5-point scale. Data were not presented for the individual handwriting dimensions, but the mean difference might represent about a one point change on each of the dimensions. In other words, the handwriting samples may have been rated as "somewhat better" instead of "the same." Thus, one wonders if these minor changes on each of the dimensions led to a statistically significant improvement on the overall performance index which was clinically insignificant.

It was not clear whether methylphenidate improved Subject A's handwriting because his scores gradually declined during the course of the study. Subject B's scores on the spacing and alignment dimensions were higher when he was on methylphenidate than when he was on placebo. His methylphenidate scores were comparable to his

baseline score. These findings indicate that methylphenidate improved his handwriting in terms of more appropriate spacing between letters, words, and sentences and alignment of sentences in a straight line. Methylphenidate improved the spacing and consistency or uniformity of the handwriting samples produced by Subjects C and D. Subject E's handwriting consistency also was improved by the medication.

A group comparison suggests that methylphenidate improved the handwriting of the conduct disordered boys on each of the dimensions and on the global index. However, methylphenidate-placebo differences were of smaller magnitude than those reported by Whalen, Henker, and Finck (1981). Thus, it is unlikely that these small improvements are of clinical significance. Nevertheless, these findings do not preclude the possibility that methylphenidate may improve the handwriting of some conduct disordered boys.

General Discussion

This study is important because it demonstrates that single-case experimental designs can be successfully used in the scientific evaluation of treatments for the individual patient. This was not surprising given the extensive use of this research methodology in determining the efficacy of behavioral treatments. Single-case designs have been tied so closely to the experimental

and applied analysis of behavior that a few authors even have gone so far as to define behavior therapy in terms of this methodology (e.g., Yates, 1970). However, this is a mistake since use of these designs should not be restricted to a particular theoretical approach (Kazdin, 1982). Rather, this methodology can be used to evaluate a variety of treatments, and the importance of this study lies in the fact that this methodology was used in the context of a human psychopharmacological experiment. This is important because of the infrequent use of this methodology outside of the behavior modification area, and the general lack of awareness on the part of many researchers and clinicians of the usefulness of this methodology.

Single-case designs are useful because they offer a scientifically rigorous approach to the evaluation of treatments and are capable of ruling out alternative explanations for the results. They provide a flexible approach to evaluation which is consistent with the practical realities of clinical practice in hospitals and clinics where the bulk of treatment is carried out (Kazdin, 1983). Thus a scientist-practitioner can individually tailor an intervention to the case on which he is working. This provides an alternative to reliance on conclusions drawn from group research about the average response of patients that are difficult to apply to the individual. From this viewpoint, single-case research is seen as a complement to other methodological approaches

such as between-groups research and meta-analysis which address questions at different levels of analysis (Kazdin, 1982).

Single-case experimental designs particularly are well suited to the evaluation of stimulant medication effects because of the short onsets of action and short half-lives of these medications (Cantwell & Carlson, 1978; Gualtieri, Hicks, Patrick, Schroeder, & Breese, 1984). Thus, one would expect immediate effects after the administration of clinically effective doses and little or no carryover effects across phases of the single-case experiment.

This study is clinically important because it is one of the first demonstrations of the efficacy of methylphenidate in the treatment of some conduct disordered boys. Subjects A and C exhibited clear favorable cognitive and behavioral responses to methylphenidate, and a decision was made to maintain both subjects on the medication after the study was concluded. It should be recalled that Subject A was taking methylphenidate prior to participating in the study, and the results of this study confirmed the clinical impressions of his physician and psychologist who thought that he was a favorable responder. Subject B also exhibited a favorable behavioral response, and a positive response on some of the cognitive and motor tests (e.g., Continuous Performance Task-errors of commission, Weingartner Memory Task-cued recall, Maze Test). However, his recent behavior was acceptable in the Child Study Center school and residence, and a decision about whether to

prescribe methylphenidate was deferred. Subjects D and E exhibited a few scattered positive findings, but the effects were not consistent enough to clinically label them as favorable responders. Subject E was taking methylphenidate prior to the commencement of the study. Unbeknownst to the principal investigator, his dose recently had been increased from 10 mg tid to 15 mg at breakfast and lunch and 10 mg in the evening. On the last week of the study he was tested on 15 mg methylphenidate and the data did not strongly support the contention that he was a favorable responder. A more detailed analysis of his cognitive and behavioral responses to the higher dose could not be carried out because his primary clinician refused permission for the administration of placebo during the following week. His primary clinician and teachers were not convinced that he was a nonresponder and a decision was made to continue to prescribe the medication. Subject E clearly was a difficult boy to manage. He occasionally had aggressive outbursts which were difficult to control and often were triggered by minor provocations. These outbursts occurred regardless of whether he was taking methylphenidate or placebo.

There are few studies which have examined the behavioral effects of methylphenidate on conduct disordered children or delinquents. Favorable behavioral changes have been detected with the use of rating scales (e.g., Eisenberg et al., 1963; Maletzky, 1974; Taylor, 1983), but negative results also have been reported

(Conners et al., 1971). In addition, this study clearly demonstrated that methylphenidate resulted in favorable cognitive changes in terms of improved ability to sustain attention, to inhibit impulsive responding, and to recall words on a verbal memory task. The conduct disordered boys' fine motor coordination also was improved.

These findings are important since it is not widely recognized that stimulants are useful adjuncts in the treatment of conduct disordered boys. In fact, Campbell, Cohen, and Small (1982) claimed that stimulants were ineffective in the treatment of conduct disorders, and they advocated the use of lithium carbonate and to a lesser extent haloperidol (Campbell et al., 1984; Platt, Campbell, Green, & Grega, 1984) in the treatment of undersocialized aggressive children. It is important to point out the efficacy of methylphenidate because these two alternative medications are associated with serious side effects such as tardive dyskinesia in the case of haloperidol (Campbell, Grega, Green, & Bennett, 1983) and possible renal or thyroid toxic reactions in the case of lithium carbonate (Jenner, 1979; Reisberg & Gershon, 1979). There definitely is a need for more information on the long-term safety of these two alternative medications in the treatment of children.

Compared to these medications, the side effects associated with the use of stimulants are relatively benign. In addition, haloperidol produced negative cognitive effects on conduct disordered children

(Platt et al., 1984). It would be interesting to compare the relative efficacy of these medications in the treatment of conduct disordered children, but at the present time it would seem prudent for physicians considering pharmacotherapy to try methylphenidate first.

Conduct disordered children are notoriously resistant to treatment. Individual psychotherapy, case work, group counselling, family therapy, and community-based interventions generally are of little value in the treatment of these children (Patterson, 1980; Rutter & Giller, 1983; Shamsie, 1981). Behavioral approaches to the treatment of aggression in children are useful (Fehrenbach & Thelen, 1982; Frankel & Simmons, 1985; Rutter & Giller, 1983), especially the parent-training program devised by Patterson and co-workers (Fleischman, 1981; Patterson, 1974, 1980). However, there often is a problem with lack of generalization to the classroom, and as Pelham and Murphy (1985) have pointed out, many parents drop out of the behavioral treatment programs or fail to adequately implement the treatment. For example, in one of the Oregon studies over 60% of the families terminated treatment before their therapist considered them ready for discharge (Patterson, 1980). In particular, low socioeconomic status single-parent mothers who are socially isolated have difficulty implementing and maintaining behavioral programs (Firestone & Witt, 1982). Since ineffective supervision and discipline as well as psychosocial disadvantage are

correlates of conduct disorders (e.g., Rutter & Giller, 1983), the evidence suggests that the parents who have an increased likelihood of having a conduct disordered child and who are experiencing psychosocial stressors are the very ones who have difficulty following through on behavioral programs. Thus, given the ineffectiveness of most treatments for conduct disordered children, the limitations of behavior therapy, and the poor prognosis for conduct disordered children (e.g., Robins, 1966, 1979), it is evident that alternative forms of therapy such as treatment with stimulant medication should be considered.

However, it is important to point out that stimulant therapy is not without limitations. Only about 70 percent of hyperactive children show a beneficial response to stimulant medication (Barkley, 1977). It is not known whether the percentage of favorable responders will turn out to be the same for conduct disordered children, but the results of this study show that not all conduct disordered children respond to methylphenidate. Furthermore, some children exhibit side effects to the medication which is why most physicians now typically prescribe them only during school hours. Presumably this reduces complaints of insomnia and the likelihood of growth suppressant effects. Lack of adherence to the stimulant medication regimen is an important but rarely mentioned limitation (Firestone, 1982). Many families will not consider the use of medication in the treatment of their child's

behavior problems, and a significant minority of families will discontinue the medication without telling their physicians (Firestone, 1982). Another limitation of stimulant therapy is that the medication may not be sufficient to normalize the behavior of children. For example, when moderate dosages of stimulants are used, ratings of behavior may be improved, but the scores may remain well above the mean for the normative data (Sprague & Sleator, 1977). A more serious limitation is that stimulants may not appreciably alter the long-term outcome in certain areas for hyperactive children. For example, young hyperactive adults who had been treated for three years with stimulants when they were between 6 and 12 years of age had poorer educational attainment, fewer vocational plans, and spent more time unemployed than controls (Hechtman, Weiss, & Perlman, 1984). They also tended to have more psychiatric hospitalizations and a higher incidence of personality disorders than controls. However, serious psychiatric conditions such as psychosis were rare. On the other hand, stimulant-treated hyperactives had fewer car accidents, stole less in elementary school, saw their childhood as more positive, and had better social skills and higher self-esteem than untreated hyperactives. These findings need to be replicated, but they suggest that stimulant therapy may be useful in preventing the development of a negative self-image possibly by decreasing the frequency of negative

sanctions that the hyperactives received as children (Hechtman, Weiss, & Perlman, 1984).

Given these limitations, it seems clear that stimulant therapy should be used only as an adjunct in the treatment of conduct disordered children. It is possible that a multimodality treatment package, such as the one successfully used by Satterfield, Satterfield, and Cantwell (1979, 1980, 1981) to treat attention deficit disordered children, will turn out to be the most useful approach to treating aggressive and antisocial children. In this approach, treatment is individualized and may include individual and group psychotherapy for the child, academic remediation, individual and group psychotherapy for the parents, family therapy, and stimulant medication. Unfortunately, it is not known which components of the treatment package are essential and which, if any, are superfluous. It would be quite useful to compare the relative efficacy of individualized treatment packages with and without the inclusion of stimulant medication in the treatment of attention deficit disordered or conduct disordered children. Another approach would be to compare the efficacy of the individualized treatment package with that of the combination of stimulant medication and behavior modification. It is possible that a multimodality treatment package may be more costly and difficult to implement than a behavioral-pharmacological combination, but not more effective (cf. Pelham & Bender, 1982). Thus, it is clear that combinations of

stimulant medication plus behavioral or cognitive-behavioral treatments should be investigated as well (Hinshaw, Henker, & Whalen, 1984).

Finally, this study is theoretically important because it provides suggestive evidence for a similarity in the responses of conduct disordered and attention deficit disordered children to methylphenidate. However, the evidence is only suggestive because the responses of these two groups of children were not directly compared in the same study. Since Taylor (1983) found that methylphenidate did not affect conduct disordered children's composite performance on a variety of cognitive tests, it would be extremely interesting to compare and contrast the cognitive responses of conduct disordered children, hyperactive or attention deficit disordered children, and children who satisfy the diagnostic criteria for both of these disorders in the same study. The behavioral responses of the groups should be studied as well. Based on the results obtained in this study and the literature on the effects of stimulants on hyperactive children, we would predict that there would be few differences among the groups. There is a possibility that only the attention deficit disordered children would exhibit a favorable response on a paired-associate learning test. However, this seems unlikely given the lack of a convincing explanation for why this should be the case. A more likely possibility is that the groups would differ in their performances on

Weingartner's Memory Task. The conduct disordered children in this study recalled more semantically processed words than acoustically processed words under placebo conditions and demonstrated a greater methylphenidate-induced increase in the recall of semantically processed words. Their pattern of performance was similar to that exhibited by the normal children in the Weingartner et al. (1980) study. On the other hand, the hyperactive children in that study freely recalled an equal number of semantically and acoustically processed words and exhibited a marked amphetamine-related increase in the recall of acoustically processed words. Weingartner et al. (1980) suggested that hyperactive children have an immature information processing style because they encode information less effectively than normal children and use cognitive strategies which are seemingly characteristic of younger normal children. The findings in this study provide indirect and preliminary evidence for the assertion that conduct disordered children have a more mature information processing style than hyperactive children. Further research is needed to verify this assertion.

In addition to the possible subtle differences in the ways in which hyperactive and conduct disordered children respond to stimulants, there may be subtle differences in their responses to other treatments. For example, Abikoff and Gittelman (1984) found that behavior therapy normalized the amount of aggression exhibited by hyperactive children, but the core symptoms of attention,

activity, and impulsivity were not normalized. Abikoff and Gittleman (1984) did not attempt to provide an explanation for the differential effectiveness of their behavior therapy program on various target behaviors. One wonders if a standardized behavioral treatment would be more effective in the treatment of conduct disordered than hyperactive children.

Response to treatment, etiological factors, prognosis or natural history, and variables other than the diagnostic criteria used to define these psychopathological disorders are all potentially useful in distinguishing between hyperactive and conduct disordered children. As far as etiological factors are concerned, researchers have concentrated on biological variables in the causation of hyperactivity (Rapoport & Ferguson, 1981; Ross & Ross, 1982), and psychosocial variables in the case of conduct disorders (Offord & Waters, 1983; Rutter & Giller, 1983).

Biological factors such as prenatal and perinatal complications, soft neurological signs, minor physical anomalies, and motor development have not proved to be useful in distinguishing between hyperactive and conduct disordered children (McGee, Williams, & Silva, 1984a, 1984b; Sandberg et al., 1980). This is perhaps not surprising given the nonspecific relationship between biological factors and hyperactivity (Ferguson & Rapoport, 1983; Rapoport & Ferguson, 1981).

Psychosocial factors including socioeconomic status, family size, presence of a broken home, overcrowding, maternal mental distress, attitudes toward child rearing, and a questionnaire measure of family functioning were not capable of distinguishing between hyperactive and conduct disordered children (McGee et al., 1984b; Sandberg et al., 1980). Many of these factors are relatively crude, and it is likely that if children falling into these groups are to be distinguished on the basis of psychosocial variables, then more sensitive measures such as observations of parent-child interactions or an examination of parental psychiatric histories will have to be used. For example, conduct disordered boys tend to have parents with personality disorder and alcoholism, while hyperactive boys do not (Stewart et al., 1980). Furthermore, hyperactive and hyperactive-aggressive boys who had a biological parent who had a psychiatric diagnosis in the antisocial spectrum were more likely to show conduct disturbance and to have siblings with a conduct disorder than those boys who had a negative family history for a psychiatric disorder in the antisocial spectrum (August & Stewart, 1983). These findings suggest that groups of hyperactive and conduct disordered children can be distinguished on the basis of parental psychiatric history.

Further research is needed to determine whether these groups of children have different styles of interaction with their parents (cf. Patterson, 1980). It is known that mothers of hyperactive boys

have a more intrusive and controlling style of interaction with their sons than mothers of normal boys (Cunningham & Barkley, 1979). This style of interaction appears to be somewhat similar to the coercive parent-child interactions that occur in families containing a conduct disordered child (Patterson, 1976). Thus it would be useful to compare and contrast the interactions of hyperactive and conduct disordered children in structured laboratory settings as well as in more natural settings. Furthermore, administration of psychopharmacological substances will be useful in studying the reciprocal influences of parent-child interactions (Barkley, 1981), teacher-child interactions, and peer interactions. For example, it is possible that methylphenidate may reduce the frequency of coercive parent-child interactions engaged in by conduct disordered children thereby normalizing this aspect of their behavior.

Follow-up studies have shown that many hyperactive and conduct disordered children experience difficulties in several areas of functioning in adolescence and adulthood (Milich & Loney, 1979; Robins, 1966, 1978; Thorley, 1984). Although most of these studies should be interpreted cautiously because of methodological deficiencies (Milich & Loney, 1979; Thorley, 1984), several tentative conclusions can be reached. Hyperactive children continue to have academic difficulties and poor peer relations in adolescence (e.g., Minde et al., 1972; Weiss, Minde, Werry, Douglas, & Nemeth,

1971) and young adulthood (Hechtman, Weiss, & Perlman, 1984). Furthermore, they appear to be at risk for exhibiting antisocial behavior (Satterfield, Hoppe, & Schell, 1982). The core symptoms seem to persist, and they have an elevated incidence of personality disorder of the immature and impulsive type (Hechtman, Weiss, & Perlman, 1984; Weiss et al., 1979). Given these problems, it is not surprising that they are reported to have low self-esteem (Weiss, Minde, Werry, Douglas, & Nemeth, 1971).

Generally speaking, follow-up studies of conduct disordered children have found that they also have difficulties in many of these areas of functioning. It is not clear whether they also are at risk for developing a personality disorder of the immature-independent type. The prognosis for conduct disordered children is poorer than the prognosis for any other childhood psychiatric disorder with the exception of childhood psychosis (Robins, 1979). A sizeable minority exhibit serious and wide-ranging disturbances such as sociopathy, criminality, alcoholism, drug abuse, marital disruption, poor work record, poor health, and financial dependency (Robins, 1966, 1979). The general trend in the literature, then, is that conduct disordered children tend to have a poorer outcome than hyperactive children. However, it is important to point out that no follow-up study has compared the outcomes for these two childhood disorders. As Thorley (1984) pointed out, a major methodological weakness of many of the

follow-up studies of hyperactive children was that they failed to use psychiatric control groups. Thus, it is not entirely clear whether the hyperactive-normal differences at follow-up are specifically a consequence of hyperactivity or reflect externalizing psychiatric problems in general.

August, Stewart, and Holmes (1983) conducted a four-year follow-up of hyperactive boys with and without associated conduct disorder. The core symptoms of inattention and impulsivity remained relatively stable over time. Although August et al. (1983) claimed that the hyperactive boys were less overactive than at referral, they did not carry out a statistical analysis to support this contention. There was not a difference between the groups in ratings of overactivity at follow-up. The purely hyperactive boys showed little evidence of aggressive or antisocial behavior at follow-up, whereas the hyperactive-unsocialized aggressive boys continued to have conduct disturbance. They were more likely to be described by their mothers in a structured psychiatric interview as noncompliant, physically and verbally aggressive, cruel, and vengeful. They also tended to use drugs and alcohol more frequently. Thirty-seven per cent were given the DSM-III diagnosis of conduct disorder whereas none of the purely hyperactive boys met the diagnostic criteria for this disorder. At the time of follow-up, they were just entering their teenage years. Thus, it

would be quite useful to continue to monitor their progress in order to see if these trends persist.

Other investigators also have found that the level of aggression of hyperactive children was significantly related to outcome in adolescence and young adulthood. Weiss, Minde, Werry, Douglas, and Nemeth (1971) found that ratings of aggression at referral were significantly related to antisocial outcome at follow-up. Minde et al. (1972) reported that ratings of aggression and Conduct Disorder factor scores on the Peterson-Quay Behavior Problem Checklist were significant predictors of outcome at follow-up. Initial ratings of aggression at time of referral were related to adult outcome measures of educational achievement, police involvement, and nonmedical drug use (Hechtman, Weiss, Perlman, & Amsel, 1984). However, these authors contended that it was a symptom complex of aggression, emotional instability, and low frustration tolerance rather than any particular variable which was important in predicting adult outcome.

Work carried out by a group of investigators at the University of Iowa also supports the contention that the aggressive behavior of hyperactive children is associated with adolescent outcome. Ratings on an Aggression factor, which reflected control deficits, negative affect, and aggressive interpersonal behavior (Loney et al., 1978), were related to ratings of symptomatology at follow-up (Loney

et al., 1980). On the other hand, a factor reflecting hyperactive behavior was not a significant predictor of adolescent outcome. Since all of the children were hyperactive, it is possible that there was little for this symptom condition to predict because of the limited variability in the Hyperactivity factor scores (Thorley, 1984). Thus, it would be interesting to extend the findings of these studies by looking at the predictors of behavior at follow-up in purely hyperactive and conduct disordered children, as well as in a group of children satisfying the diagnostic criteria for both conditions.

Taken together, the results suggest that the prognosis for conduct disordered children is worse than that for hyperactive children. Furthermore, the level of aggression in hyperactive children is a ~~significant~~ predictor of adolescent outcome. Since no study has compared directly the outcome for hyperactive and conduct disordered children, these conclusions are tentative. Nevertheless, they offer a promising way of validating these two childhood disorders.

The usefulness of distinguishing between conduct disordered and hyperactive children also would be demonstrated by determining if they each make independent contributions to our understanding of concurrent functioning. In other words, do they differ on variables other than the diagnostic criteria used to define the groups. Boys participating in the Dunedin Multidisciplinary Child Development

Longitudinal Study were divided into aggressive, hyperactive, aggressive-hyperactive, and nonaggressive-nonhyperactive groups on the basis of rating scale criteria (McGee et al., 1984a). The aggressive-hyperactive boys were rated by their parents and teachers as showing more serious behavioral problems and were found to have a higher frequency of specific reading retardation. However, the rate of reading retardation was not significantly different between the aggressive boys and the nonaggressive-nonhyperactive boys. Thus, these findings do not provide consistent support for the association between aggressiveness and reading retardation (Sturge, 1982). Only 2 of 21 aggressive boys were identified by both their parent and teacher whereas 33 percent of hyperactive children were characterized as having a pervasive problem. These findings suggest that aggressive behavior may be more situation-specific than hyperactive behavior. The aggressive boys also were relatively well behaved during a psychometric assessment.

Both hyperactive groups exhibited relative cognitive deficits compared to the remainder of the sample. They had lower Performance IQs as well as lower scores on the Burt Reading Test and a measure of verbal expression. A 2-year follow-up of both hyperactive groups showed poor verbal skills as reflected in lower reading and spelling ability. They also had a more negative perception of their ability in school subjects.

Anthropometric data also distinguished the groups. The hyperactive boys had smaller mid-upper arm circumference, triceps, fat fold, and body-mass index than the other groups (McGee, Birkbeck, & Silva, 1985). It is possible that hyperactive boys are leaner as a consequence of their activity level. If this is the case, then anthropometric differences merely are secondary to the behavioral criteria used to distinguish the groups.

Another area of concurrent functioning that has been investigated is the peer relationships of aggressive and nonaggressive hyperactive children. Fernham and Bender (1982) used teacher ratings on a questionnaire developed by O'Leary and Steen (1982) to subdivide hyperactive boys into 4 subgroups on the basis of their scores on the Hyperactive and Aggressive factors. Peer relationships were assessed with the use of the Pupil Evaluation Inventory (Pekarik, Prinz, Liebert, Weintraub, & Neale, 1976), a sociometric questionnaire administered to all children in each subject's classroom. Boys who scored above the median on either the Hyperactive or Aggressive factors were reported by their peers to engage in teacher-disturbing behaviors. Boys rated high on the Hyperactive factor were rated highest on items which seem to reflect the core symptoms of the syndrome. On the other hand, the high aggressives were rated highest on items involving getting into trouble, showing off, and being rude to the teacher. The boys who scored high on the Aggressive factor also were rated highest on

items reflecting verbal and physical aggression as well as teasing and annoying behaviors. Given these findings, it was not surprising that boys with high levels of aggression were disliked by their peers. However, extreme hyperactive behavior also resulted in unpopularity, but it was not clear why this was the case. The authors suggested that future research should use sociometric instruments containing more items relevant to the hyperactive behavioral domain.

Milich, Landau, Kilby, and Whitten (1982) examined the relationships between peer perceptions of preschoolers and the dimensions of hyperactivity and aggression in boys. Teacher ratings and peer nominations of either hyperactive or aggressive behavior were associated with peer rejection. Peer nominations of hyperactive, but not aggressive, behavior were positively and significantly correlated with peer nominations of popularity. These findings suggest that the hyperactivity and aggression behavioral dimensions were associated differentially with peer status.

Since poor peer relationships reflect current interpersonal problems and are predictive of future maladjustment (Milich & Landau, 1982), it is clear that additional research should be conducted on the peer relationships of hyperactive and conduct disordered children. The previously cited studies focused on the peer relationships of boys with externalizing behavior disorders. There was a striking lack of information on the peer relationships

of hyperactive and conduct disordered girls. It is possible that both hyperactive and aggressive boys are rejected by their peers, but for different reasons. If this is the case, then this would be an additional reason for continuing to distinguish between children with these disorders.

There are several areas of concurrent functioning such as cognitive abilities, academic skills, situational specificity of the behavior problems, and peer relationships which deserve additional investigation. Some of the studies in this area have examined measures in hyperactive and hyperactive-aggressive boys, and future work would benefit from the inclusion of purely conduct disordered boys. Girls who satisfy the diagnostic criteria for these disorders should be studied as well. Another area that needs to be investigated is the familial interaction patterns of these diagnostic groups. Do hyperactive children, like conduct disordered children, engage in coercive styles of interaction with their parents and siblings in natural settings? What are the implications of these familial interaction patterns for treatment and long-term prognosis?

Measures of concurrent functioning, etiological factors especially family histories of psychiatric problems, possible differential responsiveness to behavior modification, and prognosis, all appear to be useful in distinguishing between hyperactive and conduct disordered children.

The results of this study showed that methylphenidate was effective in the short-term treatment of some conduct disordered boys. This was demonstrated with the use of a single-case reversal design, an experimental design which deserves more emphasis from researchers and clinicians. Methylphenidate reduced their disruptive, uncooperative, emotionally labile, inattentive, impulsive, and restless classroom behavior. These effects were detected with the use of a standardized teacher rating scale, teacher reports, and classroom behavioral observations. The medication also enhanced the boys' performance on cognitive tests of ability to sustain attention and inhibit impulsive responding and verbal memory. Measures of fine motor coordination and handwriting also were improved when the boys were taking methylphenidate. The results suggest that there likely is a great deal of similarity in the response patterns of hyperactive and conduct disordered children to stimulant medication. However, the findings of this study also provide indirect and suggestive evidence for possible subtle differences in the ways in which hyperactive and conduct disordered children respond to methylphenidate. Additional research on the mnemonic processes and paired-associate learning performance of these groups of children is warranted.

Thus, it is clear that much future research on the validity of distinguishing between these disorders is needed before the evidence can be regarded as compelling. Given the many promising leads for

future research, it would seem premature and possibly counterproductive to conclude that hyperactivity is a form of conduct disorder (Sandberg, 1985). Subject heterogeneity has slowed the rate of progress and made interpretation of results difficult in the childhood psychopathological literature. There is a strong trend for researchers to subdivide hyperactive children into groups according to various characteristics (cf. Cantwell, 1984).

Investigators should continue to group hyperactive children according to their level of aggression, and they would be wise to use a similar approach to subcategorize conduct disordered children in order to form more homogeneous groups as was done in this study.

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Appendix A

Infancy, Childhood, or Adolescence Disorders 45

B. Signs of hyperactivity are no longer present; but other signs of the illness have persisted to the present without periods of remission, as evidenced by signs of both attentional deficits and impulsivity (e.g., difficulty organizing work and completing tasks, difficulty concentrating, being easily distracted, making sudden decisions without thought of the consequences).

C. The symptoms of inattention and impulsivity result in some impairment in social or occupational functioning.

D. Not due to Schizophrenia, Affective Disorder, Severe or Profound Mental Retardation, or Schizotypal or Borderline Personality Disorders.

CONDUCT DISORDER

The essential feature is a repetitive and persistent pattern of conduct in which either the basic rights of others or major age-appropriate societal norms or rules are violated. The conduct is more serious than the ordinary mischief and pranks of children and adolescents.

Four specific subtypes are included: Undersocialized, Aggressive; Undersocialized, Nonaggressive; Socialized, Aggressive; and Socialized, Nonaggressive. These subtypes are based on the presence or absence of adequate social bonds and the presence or absence of a pattern of aggressive antisocial behavior. The validity of these diagnostic subtypes within the category of Conduct Disorder is controversial. Some investigators believe that a more useful distinction would be on the basis of the variety, frequency, and seriousness of the antisocial behavior rather than the type of disturbance, whereas others believe that the Undersocialized and Socialized types represent distinct disorders.

The *Undersocialized* types are characterized by a failure to establish a normal degree of affection, empathy, or bond with others. Peer relationships are generally lacking, although the youngster may have superficial relationships with other youngsters. Characteristically the child does not extend himself or herself for others unless there is an obvious immediate advantage. Egocentrism is shown by readiness to manipulate others for favors without any effort to reciprocate. There is generally a lack of concern for the feelings, wishes, and well-being of others, as shown by callous behavior. Appropriate feelings of guilt or remorse are generally absent. Such a child may readily inform on his or her companions and try to place blame on them.

The *Socialized* types show evidence of social attachment to others, but may be similarly callous or manipulative toward persons to whom they are not attached and lack guilt when these "outsiders" are made to suffer.

The *Aggressive* types are characterized by a repetitive and persistent pattern of aggressive conduct in which the rights of others are violated, by either physical violence against persons, or thefts outside the home involving confrontation with a victim. The physical violence may take the form of rape, snugging, assault, or, in rare cases, homicide. In some cases, the physical violence may be

46 Diagnostic Categories

directed against parents. Thefts outside the home may involve extortion, purse-snatching, or holdup of a store.

The *Nonaggressive* types are characterized by the *absence* of physical violence against persons and of robbery outside the home involving confrontation with a victim. However, there is a persistent pattern of conduct in conflict with norms for their age, which may take the form of: chronic violations of a variety of important rules that are reasonable and age-appropriate for the child at home or at school, such as persistent truancy and substance abuse; running away from home overnight while living in the parental home; persistent serious lying in and out of the home; vandalism or fire-setting; or stealing (not involving confrontation of a victim).

Associated features. (all four types). Difficulties at home and in the community are common. Frequently there is precocious sexual activity, which may be aggressive or submissive, depending on subtype. The child typically blames others for his or her difficulties and feels unfairly treated and mistrustful of others. Self-esteem is usually low, though the individual may project an image of "toughness." Unusually early smoking, drinking, and other substance use are also common. Poor frustration tolerance, irritability, temper outbursts, and provocative recklessness are often present. Academic achievement is frequently below the level expected on the basis of intelligence and age. Attentional difficulties are common, and may justify the additional diagnosis of Attention Deficit Disorder. One or more Specific Developmental Disorders may be present.

In the *Socialized* types, sometimes there is membership in a gang and the antisocial behavior may be limited to gang activities.

Age at onset. Onset is usually prepubertal for the *Undersocialized* type and pubertal or postpubertal for the *Socialized* types.

Course. The course is variable, mild forms frequently showing improvement over time and severe forms tending to be chronic. Some individuals may continue their antisocial behavior and generally poor social functioning into adulthood, particularly the *Undersocialized*, *Aggressive* type, and thus qualify for the diagnosis of Antisocial Personality Disorder. Others may display adequate social functioning but persist in illegal activity, and may be considered to have Adult Antisocial Behavior (V Code). Finally, many achieve reasonable social and occupational adjustment as adults, particularly the *Socialized*, *Nonaggressive* type.

Impairment. The degree of impairment varies from mild to severe. It may preclude attendance in the ordinary school classroom or living at home or in a foster home. When antisocial behavior is extreme, institutionalization, with its temporary loss of autonomy, may be necessary.

Complications. Complications include school suspension, legal difficulties, Substance Use Disorders, venereal diseases, unwanted pregnancy, high rate of

Infancy, Childhood, or Adolescence Disorders 47

physical injury from accidents, fights, along with retaliation by victims, and suicidal behavior.

Predisposing factors. Attention Deficit Disorder, parental rejection, inconsistent management with harsh discipline, early institutional living, frequent shifting of parent figures (foster parents, relatives, or stepparents), and being an illegitimate only child may predispose to the development of the Under-socialized type. Large family size, association with a delinquent subgroup, and an absent father or a father with Alcohol Dependence may predispose to the development of the Socialized type.

Prevalence. The disorder is common, particularly the Socialized, Nonaggressive and the Undersocialized, Aggressive types.

Sex ratio. The disorder is far more common among boys than among girls, the ratios ranging from 4:1 to 12:1. The only exception may be the Undersocialized, Nonaggressive type, which may be equally common in both sexes.

Familial pattern. The disorder is more common in children of adults with Antisocial Personality Disorder and Alcohol Dependence than in the general population.

Differential diagnosis. Isolated acts of antisocial behavior do not justify a diagnosis of Conduct Disorder and may be coded as Childhood or Adolescent Antisocial Behavior (V Codes). The behavior qualifies for a diagnosis of Conduct Disorder only if the antisocial behavior represents a repetitive and persistent pattern. When such a pattern exists there will usually be obvious impairment in social and school functioning that frequently will not be present when the antisocial behavior represents an isolated act.

In Oppositional Disorder there are some of the features that are present in Conduct Disorder, such as disobedience and opposition to authority figures. However, the basic rights of others and major age-appropriate societal norms or rules are not violated as they are in Conduct Disorder.

Attention Deficit Disorder and Specific Developmental Disorder are common associated diagnoses, and should also be noted when present.

312.00 Conduct Disorder, Undersocialized, Aggressive

Diagnostic criteria

A. A repetitive and persistent pattern of aggressive conduct in which the basic rights of others are violated, as manifested by either of the following:

- (1) physical violence against persons or property (not to defend someone else or oneself), e.g., vandalism, rape, breaking and entering, fire-setting, mugging, assault

48 Diagnostic Categories

(2) thefts outside the home involving confrontation with the victim (e.g., extortion, purse-snatching, armed robbery)

B. Failure to establish a normal degree of affection, empathy, or bond with others as evidenced by *no more than one* of the following indications of social attachment:

- (1) has one or more peer-group friendships that have lasted over six months
- (2) extends himself or herself for others even when no immediate advantage is likely
- (3) apparently feels guilt or remorse when such a reaction is appropriate (not just when caught or in difficulty)
- (4) avoids blaming or informing on companions
- (5) shares concern for the welfare of friends or companions

C. Duration of pattern of aggressive conduct of at least six months.

D. If 18 or older, does not meet the criteria for Antisocial Personality Disorder.

312.10 Conduct Disorder, Undersocialized, Nonaggressive

Diagnostic criteria

A. A repetitive and persistent pattern of nonaggressive conduct in which either the basic rights of others or major age-appropriate societal norms or rules are violated, as manifested by any of the following:

- (1) chronic violations of a variety of important rules (that are reasonable and age-appropriate for the child) at home or at school (e.g., persistent truancy, substance abuse)
- (2) repeated running away from home overnight
- (3) persistent serious lying in and out of the home
- (4) stealing not involving confrontation with a victim

B. Failure to establish a normal degree of affection, empathy, or bond with others as evidenced by *no more than one* of the following indications of social attachment:

- (1) has one or more peer-group friendships that have lasted over six months
- (2) extends himself or herself for others even when no immediate advantage is likely
- (3) apparently feels guilt or remorse when such a reaction is appropriate (not just when caught or in difficulty)
- (4) avoids blaming or informing on companions
- (5) shows concern for the welfare of friends or companions

C. Duration of pattern of nonaggressive conduct of at least six months.

D. If 18 or older, does not meet the criteria for Antisocial Personality Disorder.

312.23 Conduct Disorder, Socialized, Aggressive

Diagnostic criteria

A. A repetitive and persistent pattern of aggressive conduct in which the basic rights of others are violated, as manifested by either of the following:

- (1) physical violence against persons or property (not to defend someone else or oneself), e.g., vandalism, rape, breaking and entering, fire-setting, mugging, assault
- (2) thefts outside the home involving confrontation with a victim (e.g., extortion, purse-snatching, armed robbery)

B. Evidence of social attachment to others as indicated by at least two of the following behavior patterns:

- (1) has one or more peer-group friendships that have lasted over six months
- (2) extends himself or herself for others even when no immediate advantage is likely
- (3) apparently feels guilt or remorse when such a reaction is appropriate (not just when caught or in difficulty)
- (4) avoids blaming or informing on companions
- (5) shows concern for the welfare of friends or companions

C. Duration of pattern of aggressive conduct of at least six months.

D. If 18 or older, does not meet the criteria for Antisocial Personality Disorder.

312.21 Conduct Disorder, Socialized, Nonaggressive

Diagnostic criteria

A. A repetitive and persistent pattern of nonaggressive conduct in which either the basic rights of others or major age-appropriate societal norms or rules are violated, as manifested by any of the following:

- (1) chronic violations of a variety of important rules (that are reasonable and age-appropriate for the child) at home or at school (e.g., persistent truancy, substance abuse)
- (2) repeated running away from home overnight
- (3) persistent serious lying in and out of the home
- (4) stealing not involving confrontation with a victim

50 Diagnostic Categories

B. Evidence of social attachment to others, as indicated by at least two of the following behavior patterns:

- (1) has one or more peer-group friendships that have lasted over six months
- (2) extends himself or herself for others even when no immediate advantage is likely
- (3) apparently feels guilt or remorse when such a reaction is appropriate (not just when caught or in difficulty)
- (4) avoids blaming or informing on companions
- (5) shows concern for the welfare of friends or companions

C. Duration of pattern of nonaggressive conduct of at least six months.

D. If 18 or older, does not meet the criteria for Antisocial Personality Disorder.

312.90 Atypical Conduct Disorder

This is a residual category for illnesses in which the predominant disturbance involves a pattern of conduct in which there is violation of either the basic rights of others or major age-appropriate societal norms or rules but which cannot be classified as one of the specified subtypes of Conduct Disorder.

ANXIETY DISORDERS OF CHILDHOOD OR ADOLESCENCE

This subclass includes three disorders in which anxiety is the predominant clinical feature. In the first two categories, Separation Anxiety Disorder and Avoidant Disorder of Childhood or Adolescence, the anxiety is focused on specific situations. In the third category, Overanxious Disorder, the anxiety is generalized to a variety of situations.

309.21 Separation Anxiety Disorder

The essential feature is a clinical picture in which the predominant disturbance is excessive anxiety on separation from major attachment figures or from home or other familiar surroundings. When separation occurs, the child may experience anxiety to the point of panic. The reaction is beyond that expected at the child's developmental level.

Children with Separation Anxiety Disorder are uncomfortable when they travel independently away from the house or from familiar areas. They may refuse to visit or sleep at friends' homes, to go on errands, or to attend camp or school.* They may be unable to stay in a room by themselves, and may display clinging behavior, staying close to the parent, "shadowing" the parent around the house. Physical complaints, such as stomachaches, headaches, nausea, and vomiting, are common when separation is anticipated or occurs.

* School refusal is often inaccurately referred to as "school phobia." However, not all school refusal is due to separation anxiety. When separation anxiety accounts for school refusal, the child experiences difficulty being separated from home or family for a variety of purposes, school attendance being only one of them. In a true school phobia, the child fears the school situation, whether or not he or she is accompanied by the parent.

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CHILD BEHAVIOUR CHECKLIST FOR AGES 4-16

Please contact: R. M. Achenbach
University of Vermont
Burlington, VT 05405

IV. Listed below are descriptive terms of behavior. Place a check mark in the column which best describes this child. ANSWER ALL ITEMS.

Observation	Degree of Activity			
	Not at all	Just a little	Pretty much	Very much
CLASSROOM BEHAVIOR				
1. Constantly fidgeting				
2. Hums and makes other odd noises				
3. Demands must be met immediately—easily frustrated				
4. Coordination poor				
5. Restless or overactive				
6. Excitable, impulsive				
7. Inattentive, easily distracted				
8. Fails to finish things he starts—short attention span				
9. Overly sensitive				
10. Overly serious or sad				
11. Daydreams				
12. Sullen or sulky				
13. Cries often and easily				
14. Disturbs other children				
15. Quarrelsome				
16. Mood changes quickly and drastically				
17. Acts "smart"				
18. Destructive				
19. Steals				
20. Lies				
21. Temper outbursts, explosive and unpredictable behavior				
GROUP PARTICIPATION				
22. Isolates himself from other children				
23. Appears to be unaccepted by group				
24. Appears to be easily led				
25. No sense of fair play				
26. Appears to lack leadership				
27. Does not get along with opposite sex				
28. Does not get along with same sex				
29. Teases other children or interferes with their activities				
ATTITUDE TOWARD AUTHORITY				
30. Submissive				
31. Defiant				
32. Impudent				
33. Shy				
34. Fearful				
35. Excessive demands for teacher's attention				
36. Stubborn				
37. Overly anxious to please				
38. Uncooperative				
39. Attendance problem				

UNIVERSITÉ D'OTTAWA

UNIVERSITY OF OTTAWA

May, 1984

Dear Parent:

Research findings to date indicate that methylphenidate (Ritalin) is effective in helping some, but not all hyperactive children and children with behavior problems. It is important to find out what the characteristics are of children who respond favorably to this medication. We are planning to conduct a study in collaboration with Dr. Curtis on the behavioral and cognitive effects of methylphenidate. We would like to conduct a medication trial on your son. Dr. Curtis will provide medical care for your son during this study. This assessment will take place at the Child Study Centre, University of Ottawa. The evaluation will take nine weeks to complete, and your son will follow his normal school routine during most of this period. However, we will ask him to perform some learning and memory tests during this study and he will miss about one hour of school per week. Over this time period your son will be given a trial on a low dose of methylphenidate and a placebo (a sugar pill). No serious side effects result from administration of low doses of this medication. The most commonly reported side effects are loss of appetite, headaches, and difficulty falling asleep. They occur in a minority of individuals and they may disappear after the patient has been on the medication for a few days. If you have questions about whether your son is experiencing any side effects, feel free to contact Mr. Bawden (733-6588), or Dr. Firestone or Dr. Curtis at the Child Study Centre (231-2249).

We will ask your son's teachers, child care workers, and parents to assess his behavior with the use of questionnaires. This information, when combined with the results of the learning and memory tests, will allow us to determine if your son responds favorably to the medication. If he responds favorably, then his impulsive and disruptive behavior will be reduced, and his ability to concentrate on his schoolwork will be improved. Not only will your son benefit, but his family and classmates also should benefit. On the other hand, if we find that your son does not respond to the medication, and if there is still time in the school year, then we will give him a trial on a slightly higher dose of Ritalin. If he does not respond to this dose, then Dr. Curtis will recommend that he not continue on the medication. All of the information that we collect will be kept confidential, but we will be available to discuss the results with you.

Your cooperation in this study is appreciated. If you would like additional information about the study, we will be available for an evening meeting to discuss the study with the parents.

Sincerely,

Phil Firestone, Ph.D.
Director, Child Study Centre

Harry Bawden, M.A.
Centre d'étude de l'enfant
École de psychologie

10 McDougall Lane
K1N 6N5

Child Study Centre
School of Psychology

I have read the above request for my son to participate in a clinical study on the behavioral and cognitive effects of methylphenidate.

I give permission for my son to participate. _____

I do not give permission for my son to participate. _____

I would like to attend an evening meeting to find out more about the study. _____

Child's Name: _____ (please print)

Name of Parent or Guardian: _____ (please print)

Date: _____ Signature: _____

Relationship to Child: _____

RESEARCH

BEHAVIOR REVIEW

Child's Name _____

Age _____

Sex _____

Adopted _____

Seen as: Outpt. _____ Inpt. _____

Informant's Name _____

Relation to Child _____

SES: Ma _____ Fa _____

Interviewer _____

Date _____

TREATMENT

(Ask specifically about head injuries, broken bones, burns, and swallowing poisons.)

2. Did you ever take him to an MD for help with nervousness, sleep problems, or any other kind of psychological problem before he went to school? Did an MD ever give him medicine for anything like that, sedative/ tranquilizer?

MD/TREATMENT

(Ask specifically about colic/sleep problems in first year)

3. Is the child currently on medication? Yes No . If yes, specify

Now I'd like to ask you questions about his behavior in the past year.

1. When you ask your child to do something

does he always do it	() most of the time	() hardly ever
----------------------	----------------------	-----------------
2. In disciplining your child

do you seldom need to	() scolding usually works	() have you tried everything and found that nothing works--you just can't discipline him
-----------------------	----------------------------	---
3. Is your child

less active and energetic than most	() about average	() much more active, never tired, super energetic
-------------------------------------	-------------------	--
4. Is your child generally

quiet	() about as noisy as average	() very loud and rowdy
-------	-------------------------------	-------------------------
5. Can your child stay with the same project or activity

for an unusually long time	() about average	() only for the shortest time
----------------------------	-------------------	--------------------------------
6. How is your child about finishing projects such as jobs, chores

very good	() about average	() It is a real problem
-----------	-------------------	--------------------------
7. How does your child like school

very much	() about average	() dislikes it
-----------	-------------------	-----------------
- 7a. Recent change in school work

Improvement	() none	() decline
-------------	----------	-------------
8. Is your child

patient, always able to wait	() will wait about as long as most children	() impatient, always in a hurry
------------------------------	--	----------------------------------

9. Does your child plan ahead and think about doing things () act about average () do things on the spur of the moment and gets into trouble ()
10. Is your child very careful and cautious () about average () reckless, gets into dangerous situations ()
11. How is your child's temper slow, hardly ever gets mad () about average () quick tempered and irritable ()
12. How often does your child have tantrums () once in a while () often ()
13. How much does it take to get your child upset () about like other kids () easily upset ()
- 13a. How often does he cry hardly ever () average () often, more than other kids ()
14. How about getting excited he is usually calm () like other kids () easily gets wound up and silly, especially around other kids ()
15. How about fighting will he avoid fights, and not stand up for himself () he is like other kids, some fights () gets into a lot of fights, quarrelsome ()
16. Have you noticed any sexual behavior none at all () he is about as interested as other boys his age () he seems to be much more interested than other kids, lots of dirty talk ()

17. Is he fairly independent ☐ tends to cling to mother, ☐ always has been unusually independent, not afraid to do anything on his own ☐ about like other kids ☐
18. Most kids have some fears, what about your son ☐ he has unusual fears, too intense, too many ☐ not afraid of anything, never has been ☐ about like other kids ☐
19. Is he a worrier ☐ he worries a lot ☐ never seems to worry or care about anything ☐ about like average kids ☐
20. How about sleep problems ☐ no difficulties ☐ often has nightmares, trouble getting to sleep ☐
85. Is your child still wetting the bed ☐ no ☐ yes ☐
- 20a. How about recent appetite ☐ poor, finicky ☐ average ☐ too good ☐
21. Are there times when he gets sick at his stomach, abdominal pains, for example, does not want to eat in the morning ☐ no ☐ this happens when he is worried about something ☐
22. Does he ever get nervous, tense, or shaky ☐ never ☐ sometimes ☐ quite often ☐
23. How about complaining of aches and pains ☐ he often seems to have some pain or something wrong, a hypochondriac ☐ not more than most kids ☐ never ☐

24. How is his general opinion of himself
generally low, thinks he is inferior to other kids
() about average () cocky, never any doubt he can do things ()
25. How about his general mood
quite often unhappy or depressed
() about average () unusually happy ()
26. What does he think about how people treat him
seems to think people are down on him, has a chip on the shoulder attitude
() about average () confident everybody likes him ()
27. Does he have friends
he is unpopular, no friends
() has about as many as other kids () very popular, lots of friends ()
- 27a. Has he lost interest in, stayed away from friends lately
no
() yes ()
28. How much attention does he seem to need
gets along with very little
() about average () wants more than everybody else, has to be center of attention ()
29. How does he react to losing or falling at a game
doesn't care about winning
() like other kids () has to win; would stop a game or cheat rather than lose ()
30. In a group of children how does he get along
does whatever they tell him
() just like any other kid () tends to get into arguments and quarrels ()

31. Again in a group of kids, when playing, will he share things () like other kids () unable to share, grabs toys away from children ()
32. What is his general attitude towards adults () about average () sassy and disrespectful to parents and other adults ()
33. Does he use bad language towards adults () like other kids () he curses parents and other adults ()
34. When you would like something done () about average () resistant, negative or does the opposite ()
35. Is your child () about average () cannot rely on him, generally irresponsible ()
36. If a parent or sibling is hurt or in trouble, how does your child react () he is like other kids () he never seems to care, only thinks of himself ()
37. How does he react if he does something wrong () he is very sorry and ashamed () he generally is sorry, like an ordinary kid () never admits being wrong, never sorry or guilty, denies guilt ()
38. What are his friends like () ordinary kids () he definitely goes with the wrong group ()
39. When does he come in the evenings () he stays out with the other neighborhood kids () he stays out late, won't follow the rules ()

40. How truthful is he
always () sometimes he'll try to () he lles most of the ()
get out of trouble () time
41. Can you leave money
laying around the house he'll never touch it () he might take some, but () he often takes money from ()
he generally tells me () purses, money banks, etc. ()
42. When you take the
children to the store he'll never take any- () once or twice he has () he is always taking ()
thing without asking () taken something () things from the store ()
or other kids ()
43. Does he play with
matches and fire never interested () has played with () plays with fire a lot, has ()
matches a bit () set some dangerous fires ()
44. How well does he care
for his own things and he takes very good () sometimes he takes () he damages things often, ()
other people's care of them () put them back to- () sometimes out of mean- ()
gether () ness ()
45. Have you had complaints
of rock throwing, broken never had complaints () like other kids () many complaints ()
windows, or any form of vandalism
46. Has your child physically
attacked parents, he has never attacked () like other kids () several times ()
teachers or other adults an adult
47. When your child doesn't
get his own way (with he easily accepts the () vengeful, often hurts ()
adults or children) disappointment or () someone or damages ()
frustration () like other kids () property to get back at ()
people ()

48. How does your child respond to children or animals younger and weaker than himself
 plays kindly, gently, never hurts them ☐ like other kids ☐ bully, is cruel and mean ☐
49. How does your child react to unfamiliar situations? .
 e.g. new school, move to new neighborhood, trying out a new activity
 (riding bike, swimming, etc.)
 confident and self-assured ☐ after initial stress will adapt like most kids ☐ leery, anxious, resistant to new experiences ☐
50. How does your child react to pain and/or stress
 (dentist, shot, visit to emergency room, training for a strenuous sport)
 never appears to be upset, bothered ☐ like other kids ☐ very fearful, resistive unable to cope ☐
51. When a disagreement arises between your son and you (or your spouse) how does he behave
 he's quiet, timid, doesn't state his opinion ☐ like other kids (some back talk) ☐ loudly argues and shouts with parents ☐
78. How does your child react when friends or neighbors get hurt, have problems, trouble
 he expresses concern and goes out of his way to help out ☐ he is like other kids ☐ he never seems to care, doesn't express concern; thinks only of himself ☐
79. Is he included in group activities with school or neighborhood friends
 usually included ☐ frequently left out ☐

80. Does he seem to make friends ☐ has problems making friends ☐
81. Does he have trouble keeping friends ☐ definitely a problem ☐
82. When your child has free time--after school, evenings or weekends, does he prefer ☐ both kinds of activities ☐ doing things by himself, a loner ☐
83. If your child and one of his friends got into trouble together would he ☐ would take the consequences himself would not tell on his friend voluntarily ☐ voluntarily tell on his friend to lessen the consequences for himself ☐
84. Does your child ☐ keep quiet around other kids, rather not attract attention ☐ show off a lot in front of other children, try to impress them ☐
52. Has he ever skipped classes or played hooky? ☐
53. Has he ever drunk liquor without your permission? ☐
54. Has he tried drugs other than marijuana? ☐
55. Has he smoked marijuana frequently? ☐

56. Has he stayed away from home overnight without permission?
57. Has he run away from home?
58. Has he been in any trouble with the police?
59. Has he had to visit an officer of the juvenile court?
60. Has he had to go to a hearing before a juvenile court judge?
61. Has he been in a house of detention or a jail?
62. If he gets into trouble, is it generally by himself or with a bunch of boys?
63. Has he ever threatened suicide, started to harm himself?

63a. Behaviors of concern (trouble) annoyance to parents:

a) Define:

b) How long present:

2

65. How many—times have you been married?

1 () 2 () 3 ()

more than 3 ()

none ()

67. How long have you been married to your present spouse?

1- 5 years () 15 - 20 years ()

5-10 years () more than 20 ()

10-15 years ()

69. How frequently do you quarrel?

always fighting
about something ()

average; like
other people ()

never quarrel about
anything ()

70. Have these conflicts ever led to physical action against each other ?
the children?

Yes ()

No ()

Yes ()

No ()

72. Have you ever been separated from your spouse because of conflicts? Yes () No () For how long —

73. Have there ever been any periods in which your son has been separated from you and/or your spouse? Yes () No ()

For how long? _____

What were the circumstances?

74. Who cared for him?

Mother ()

Father ()

Relatives _____

()

Foster home ()

Other _____

()

UNIVERSITÉ D'OTTAWA

UNIVERSITY OF OTTAWA

May, 1984

Dear Parent:

We would like your permission to ask you questions about your son's behavior. This information will help us to determine if your son might benefit from a trial of stimulant medication. All information that we collect will be kept confidential. The interview contains questions about the age of onset of your son's behavior problems, emotional and behavioral symptoms present in the past year, your major concerns about your son's behavior, and parent-child separations. In addition, there are a few questions about the quality of your marriage.

I have read the above request for me to be interviewed about my son's behavior.

I give permission for the interview to be conducted. _____

I do not wish to be interviewed. _____

Child's Name: _____ (please print)

Name of Parent or Guardian: _____ (please print)

Relationship to Child: _____

Date: _____

Signature: _____

Appendix C

The Classroom Behavioral Observational Code

Category	Definition	Includes	Excludes
Interference	A general measure of disruptiveness.	Calling out, interruption of others during work periods, and clowning.	Cooperation with peers in completion of task.
Conversation Initiation	Initiations of conversation from one child to another.	Child verbally interrupts another child.	Target child responds to conversation but did not initiate it.
Vocalization	Conversations which continue for one full interval.	Child engaged in conversation for full interval.	Conversation or attention to conversation ceases during interval.
Non-Compliance	Child fails to follow instructions from teacher, either directly to child or to class as a whole.	Child answers back to teacher in response to her command.	
Aggression	Behaviors that are verbally or physically threatening or abusive to others.	Verbal and physical aggression, destruction of others' materials, derogatory teasing and bossing other children.	Play fighting.
Self-Orienting	Repetitive behaviors that are potentially irritating to teacher or class.	Biting or pencil, tapping, banging, or fiddling with objects.	

Category	Definition	Includes	Excludes
Teacher-Pupil Interaction	One-to-one interaction with the teacher.	Child converses with teacher, touches teacher, goes to her desk.	Child goes to teacher's desk when she is not there.
Off-Task	Attention to stimuli other than the assigned work.	Doing a task other than the assigned one.	Child begins another task after assigned task completed.
Day-Dreaming	Not visibly attending to any environmental stimuli.	Child stares off into space without attending to objects or people.	Child attends to verbal interaction or object. Off-Task.
Change of Position	Gross motor behavior.	Child out of seat without teacher's permission. None of child's weight supported by chair.	Retrieval of an accidentally dropped object. Minor motor movements.
Absence of Behavior	No inappropriate behaviors as defined by most of the above categories.		Teacher-Pupil Interaction
Mean Disruptive Behavior	Number of disruptive behaviors observed divided by the number of observation intervals.		Teacher-Pupil Interaction

Parent's Questionnaire

Name of Child _____

Date _____

Please answer all questions. Beside *each* item below, indicate the degree of the problem by a check mark (✓)

	Not at all	Just a little	Pretty much	Very much
1. Picks at things (nails, fingers, hair, clothing)				
2. Sassy to grown-ups.				
3. Problems with making or keeping friends.				
4. Excitable, impulsive.				
5. Wants to run things.				
6. Sucks or chews (thumb; clothing; blankets).				
7. Cries easily or often.				
8. Carries a chip on his shoulder.				
9. Daydreams.				
10. Difficulty in learning.				
11. Restless in the "squirmy" sense.				
12. Fearful (of new situations; new people or places; going to school).				
13. Restless, always up and on the go.				
14. Destructive.				
15. Tells lies or stories that aren't true.				
16. Shy.				
17. Gets into more trouble than others same age.				
18. Speaks differently from others same age (baby talk; stuttering; hard to understand).				
19. Denies mistakes or blames others.				
20. Quarrelsome.				
21. Pouts and sulks.				
22. Steals.				
23. Disobedient or obeys but resentfully.				
24. Worries more than others (about being alone; illness or death).				

25. Fails to finish things.				
26. Feelings easily hurt.				
27. Bullies others.				
28. Unable to stop a repetitive activity.				
29. Cruel.				
30. Childish or immature (wants help he shouldn't need; clings; needs constant reassurance).				
31. Distractibility or attention span a problem.				
32. Headaches.				
33. Mood changes quickly and drastically.				
34. Doesn't like or doesn't follow rules or restrictions.				
35. Fights constantly.				
36. Doesn't get along well with brothers or sisters.				
37. Easily frustrated in efforts.				
38. Disturbs other children.				
39. Basically an unhappy child.				
40. Problems with eating (poor appetite; up between bites).				
41. Stomach aches.				
42. Problems with sleep (can't fall asleep; up too early; up in the night).				
43. Other aches and pains.				
44. Vomiting or nausea.				
45. Feels cheated in family circle.				
46. Boasts and brags.				
47. Lets self be pushed around.				
48. Bowel problems (frequently loose; irregular habits; constipation).				

FIGURE 3.4. The 48-item version of the Conners Parent Symptom Questionnaire. (Reprinted by permission of C. K. Conners.)

NAME OF CHILD: _____ DATE: _____ AGE: _____

BOY OR GIRL: _____ SCHOOL: _____ GRADE: _____

This is a list of questions that tell how children feel. Your answers will help us understand more about children.

Please read these questions one at a time. Fill in the circle under the YES if you think the question is true. If you think the question is not true, fill in the circle under the NO. Do not fill in a circle under the YES and the NO for the same question. Remember, this is not a test and there are no right or wrong answers.

In this example:

	YES	NO
IT SNOWS IN WINTER	0	0

The circle under the YES should be blackened in.

IF YOU HAVE NO QUESTIONS, PLEASE TURN THE PAGE AND BEGIN.

.....

[illegible]

	YES	NO
1. IT'S OK FOR KIDS TO DATE THEIR FINGERNAILS -----	0	0
2. KIDS LAUGH AT ME -----	0	0
3. IT'S OK TO GET ANGRY -----	0	0
4. I HAVE MANY FRIENDS -----	0	0
5. MY FAMILY IS PROUD OF ME -----	0	0
6. I OFTEN GET ANGRY AT MY PARENTS -----	0	0
7. WHEN I NEED HELP MY PARENTS HELP ME -----	0	0
8. I'LL TRY ANYTHING -----	0	0
9. I FEEL SOMEONE WILL TELL ME I AM DOING THINGS WRONG -----	0	0
10. MY PARENTS UNDERSTAND ME -----	0	0
11. I AM ALWAYS HAPPY -----	0	0
12. KIDS PICK ON ME -----	0	0
13. THINGS ARE ALL MIXED UP IN MY LIFE -----	0	0
14. I LIKE EVERYONE I KNOW -----	0	0
15. IT'S OK TO TELL LITTLE LIES -----	0	0
16. I AM IMPORTANT TO MY FAMILY -----	0	0
17. IT'S OK TO YELL AT YOUR PARENTS SOMETIMES -----	0	0
18. MOST KIDS I KNOW LIKE ME -----	0	0
19. I WORRY ABOUT WHAT OTHER PEOPLE WILL THINK ABOUT ME -----	0	0
20. SOMEONE SICKENED OTHER ME -----	0	0
21. I AM PARTLY SOME OF MYSELF -----	0	0
22. SOMETIMES I THINK OTHER KIDS WANT TO BEAT ME UP -----	0	0
23. I WORRY ABOUT WHAT MY PARENTS WILL SAY TO ME -----	0	0
24. I AM AS GOOD AS THE NEXT DAY -----	0	0
25. I DON'T THINK IT'S GOING TO HAPPEN -----	0	0
26. I AM A SERIOUS PERSON -----	0	0
27. I GET TOO MANY PUNISHMENTS -----	0	0

- 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100
29. I HAVE A BAD TEMPER ----- YES NO
0 0
30. I AM ALWAYS GOOD ----- 0 0
31. KIDS CALL ME NAMES ----- 0 0
32. IT'S OK TO MAKE A MESS ----- 0 0
33. I THINK I AM A PRETTY NICE PERSON ----- 0 0
34. I CAUSE TROUBLE TO MY FAMILY ----- 0 0
35. SOMETIMES EVEN LITTLE THINGS GET ME MAD ----- 0 0
36. I ALWAYS TELL THE TRUTH ----- 0 0
37. I OFTEN GET INTO TROUBLE ----- 0 0
38. I AM ALWAYS NICE TO EVERYONE ----- 0 0
39. I OFTEN HAVE FIGHTS WITH KIDS ----- 0 0
40. I GET NERVOUS WHEN THE TEACHER CALLS ON ME ----- 0 0
41. IT IS HARD FOR ME TO WAIT MY TURN ----- 0 0
42. IT'S HARD FOR ME TO KEEP MY MIND ON ANYTHING ----- 0 0
43. WHEN I GO TO BED AT NIGHT I WORRY ----- 0 0
44. I DO MANY BAD THINGS ----- 0 0
45. IT'S OK TO SHOW OFF ----- 0 0
46. I ALWAYS DO THE RIGHT THING ----- 0 0
47. SOMETIMES EVEN LITTLE THINGS MAKE ME CRY ----- 0 0
48. OTHER KIDS BOSS ME AROUND ----- 0 0
49. IF I GET LOST I COULD GET BACK HOME ----- 0 0
50. MY FRIENDS EXPECT TOO MUCH FROM ME ----- 0 0
51. I AM AFRAID OF THE DARK ----- 0 0
52. I HAVE BAD DREAMS ----- 0 0
53. I DON'T KNOW WHAT TO SAY TO PEOPLE ----- 0 0
54. SOMETIMES I GET MAD AT MYSELF ----- 0 0
55. I AM REALLY GOOD AT MOST THINGS I DO ----- 0 0

FORM COMPLETED BY: _____

4164

RELATIONSHIP: _____

SWANSON, J.

THE PARENT-TEACHER SIDE EFFECTS QUESTIONNAIRE

HSC November 2, 1979

When medication is used, side effects sometimes occur. If some of the side effects listed below occur, please indicate which ones occurred and how severe they were. If other side effects occur, please write them in the space provided.

1. During the past week, did this child seem overly: Not at All Just a Little Pretty Much Very Much

Crabby, Touchy

Whiny

Worried

Fearful

Anxious

Withdrawn

Dull

Drowsy

Tearful

Tired

Jittery

Restless

2. During the past week, was this child bothered by:

Stomachache

Headaches

Muscle ache

Vomiting

Rash

Weakness

Dry Mouth

Fainting

3. During the past week, did this child have problems with:

Eye twitches

Tics (frequent muscle jerks)

Biting fingernails

Repetitive tongue movements

Picking (at skin or clothes)

Distortion of vision

Other: _____

Comments _____

4. Parents (please turn over)

(Parents only)

4. <u>During the past week, did</u> <u>this child experience:</u>	<u>Not at All</u>	<u>Just a Little</u>	<u>Pretty Much</u>	<u>Very Much</u>
Anorexia (lack of appetite)	==	==	==	==
Insomnia (sleeplessness)	==	==	==	==
Enuresis (bed wetting)	==	==	==	==

Appendix K

The German Shepherd

The German Shepherd dog is also called the police dog. He is very intelligent and can be trained to do almost any job well. He is famous for his work with the police and the Army. He has sound nerves and is not gun-shy.

Many German Shepherds have been trained as Seeing Eye dogs. These dogs guide their blind masters through busy streets and protect them from danger. A Seeing Eye dog is so intelligent that he will sometimes disobey his master if he recognizes a danger his master cannot see.

END

FIN

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