# MINIMAL BRAIN DYSFUNCTION WITH HYPERACTIVITY: A COMPARISON OF THE BEHAVIORAL AND COGNITIVE EFFECTS OF PHARMACOLOGICAL AND BEHAVIORAL TREATMENTS

by

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ABSTRACT

Title of Thesis: Minimal Brain Dysfunction with Hyperactivity: A Comparison of the Behavioral and Cognitive Effects of Pharmacological and Behavioral Treatments

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It was the aim of the study: to compare the behavioral and cognitive effects of pharmacological and behavioral therapies in the short-term, clinical treatment of minimal brain dysfunction; and, to compare the behavioral and cognitive effects of stimulant (methylphenidate) and antidepressant (imipramine) drugs in the short-term, clinical treatment of minimal brain dysfunction.

Twenty-nine boys, ranging in age from 6 through 12 years, with the diagnosis of minimal brain dysfunction with hyperactivity, were randomly assigned to three treatment groups: imipramine, methylphenidate, or behavior modification. The total time of treatment for each child was 6 weeks.

For subjects within the imipramine and methylphenidate groups, medication dosage was individually titrated by a child psychiatrist. (Range: 75 - 150 mg/daily of imipramine, 10 - 30 mg/daily of methylphenidate.)

Parents of subjects within the behavior modification group individually met with an experimenter 1 hour per week. Behavioral principles were discussed, problem behaviors

targeted, and behavioral programs devised for implementation during the treatment period.

Subjects assigned to behavior modification were also individually seen once weekly. The first part of a session focused on behavioral control, following the method of behavior rehearsal. Working from problem areas targeted by parents, the subjects and experimenter discussed specific encounters, and then reenacted these incidents, rehearsing alternative, adaptive behaviors. The second part of a session was devoted to cognitive control, with training in self-directed verbal commands instituted. On tasks of trail making, matching pictures, and embedded figures, subjects verbally cued themselves to delay and to consider requirements before attempting a solution, with reinforcement contingent upon responses correct on initial trial.

For all groups, prior to and following treatment, behavioral and cognitive measures were obtained: parents completed a behavior rating scale, the Parent's Questionnaire; teachers completed the School Report, assessing behavior and academic achievement; and subjects were administered a battery of psychological tests which included the Wechsler Intelligence Scale for Children, Wide Range Achievement Test, Porteus Maze Test, Bender Gestalt Test, Developmental Test of Visual-Motor Integration, and Draw-A-Person.

Analysis of the data from teachers' global ratings of behavior indicated the superiority of pharmacological

treatment in comparison with behavioral treatment. Within the cognitive area, based on teachers' global ratings of academic achievement and the Porteus Maze Test, pharmacological treatment was again shown superior. Isolating specific group effects, contributing to the major portion of the variance between pharmacological and behavioral treatments was the superiority of methylphenidate to behavior modification. Further research was felt necessary concerning the therapeutic comparability or lack of comparability of imipramine and behavior modification treatments.

Between imipramine and methylphenidate treatments, based on teachers' ratings of hyperactivity and global ratings of both behavior and academic achievement, differential effects, in favor of methylphenidate, were suggested. Thus, the comparability of imipramine and methylphenidate treatments in terms of both behavioral and cognitive effects was felt to be in question.

Results were discussed in terms of the bounds of the design, procedure, and measurements. Qualifications were noted concerning statistical power, Type I error, the relative rather than absolute efficacy of the treatments, and the validity of the measurements.

Application and research implications were presented. The need for continued research into the application of behavioral programs with MBD children, both independent of and in conjunction with pharmacological treatment, was

stressed, with suggestions provided as to the clinic-based and, to a limited extent, school-based implementation of such programs.

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# INTRODUCTION

Writing in the 1902 edition of the British journal Lancet, a physician, Dr. G. F. Still, described an "abnormal" condition of childhood, a condition that he termed a "defect in moral control." It was a condition characterized by restless and fidgety movements, emotional lability, aggressive behavior, and the presence of physical stigmata. It most frequently affected boys, occurring apart from any general impairment of intellect, and without evidence of physical disease or environmental impoverishment.

In retrospect, the condition described bears a marked similarity to the syndrome today most commonly known as minimal brain dysfunction (MBD) or hyperactivity.

As defined by a task force under the sponsorship of the United States Public Health Service, the syndrome of minimal brain dysfunction refers to:

> children of near average, average, or above average general intelligence with certain learning or behavioral disabilities ranging from mild to severe, which are associated with deviations of function of the central nervous system (Clements, 1966, p. 9).

While the above definition includes direct reference to neurologic functioning, in actuality the question of etiology is far from answered, with postulates of causality ranging from the exclusively organic to those of a psychogenic nature.

The child with minimal brain dysfunction is described as manifesting a variety of behavioral, cognitive, and neurological symptoms, with no one sign pathognomonic. There are, however, certain symptoms which are repeatedly cited in the literature, and these in order of frequency are:

1. Hyperactivity.
2. Perceptual-motor impairments.
3. Emotional lability.
4. General coordination deficits.
5. Disorders of attention (short attention span, distractibility, perseveration).
6. Impulsivity.
7. Disorders of memory and thinking.
8. Specific learning disabilities:
    a. Reading.
    b. Arithmetic.
    c. Writing.
    d. Spelling.
9. Disorders of speech and hearing.
10. Equivocal neurological signs and electroencephalographic irregularities (Clements, 1966, p. 13).

Depending on the author, it is generally estimated that from 3 to 10% of primary school-aged children warrant the diagnosis of minimal brain dysfunction. It is also estimated that minimal brain dysfunction accounts for about 40% of the children referred to mental health clinics because of behavioral disturbances (Lipman, 1971), and possibly 80% of

the problems of which certain schools complain (Huessy & Gendron, 1970).

The prognosis for the syndrome was originally thought to be benign, with the difficulties disappearing around the onset of adolescence. This early view has since been revised, and MBD children are now considered to be at risk in terms of their later behavioral and cognitive functioning. Thus, given the estimates of prevalence and the prognostic implications, preventing and minimizing the effects of minimal brain dysfunction have become major health concerns.

The literatures of education, neurology, pediatrics, psychiatry, and psychology abound with articles on the treatment of the MBD syndrome. While each of the disciplines offers its unique treatment perspective, it is pharmacology which currently occupies the front line of therapy. Dating back to Bradley's (1937) work with benzedrine, pharmacological treatment has grown to the point at which it is estimated that some 300,000 children are now receiving medication (Wiens & Anderson, 1971).

Recent literature reviews report that of the drugs typically employed in the treatment of minimal brain dysfunction, central nervous system stimulants are preferable. There are, however, reservations with regard to the use of stimulants. Foremost are the effects of the medication on physical development, side effects of treatment, and concerns of addiction potential. There have been a few reported studies suggesting the usefulness of tricyclic antidepressant drugs in

treatment, but as yet the effectiveness of these agents has not been directly compared with that of the stimulants.

As search for alternative pharmacological treatment continues, there is also need for the development of effective non-drug treatments. Questions remain as to the long-term influence of medication; also there are some children who are nonresponders to pharmacological treatment, and other instances when medical or parental prohibition precludes drug treatment. The behavior modification literature reports non-drug treatment of behavioral and cognitive problems associated with minimal brain dysfunction. However, there have been no direct comparisons of the behavioral and pharmacological therapies in clinical treatment.

It is thus the aim of the present study: 1. to compare the behavioral and cognitive effects of pharmacological and behavioral therapies in the short-term, clinical treatment of minimal brain dysfunction; and 2. to compare the behavioral and cognitive effects of a stimulant drug, methylphenidate (trade name Ritalin) and an antidepressant drug, imipramine (trade name Tofranil) in the short-term, clinical treatment of minimal brain dysfunction.

Following this introductory section, the dissertation is divided into five chapters. The first chapter provides a description of minimal brain dysfunction, surveying the areas of terminology, symptomatology, prevalence, etiology, and prognosis. In the second chapter, treatment is discussed, with the review primarily considering three approaches,

stimulant and antidepressant drug therapy, and behavior modification. In the final three chapters, the methodology, results, and discussion, respectively, of the present study are presented.

As discussed in Chapter 1, terminology is an issue within the literature, with one of the primary areas of conflict concerning the use of the terms "minimal brain dysfunction" and "hyperactivity." For purposes of consistency, the author has chosen to retain the "minimal brain dysfunction" terminology except in the presentation of the behavioral treatment literature, or unless a specific behavioral dimension such as activity level or attention span is under consideration. In the description of the sample, Chapter 3, the medical diagnosis is specifically designated as "minimal brain dysfunction with hyperactivity," emphasizing activity level as being one of the primary selection criteria.

# CHAPTER 1

# REVIEW OF THE LITERATURE - I: DESCRIPTION OF MINIMAL BRAIN DYSFUNCTION

## Diagnostic Issues

In an area fraught with conceptual disparities and empirical inconsistencies, it is perhaps not surprising that even the legitimacy of the minimal brain dysfunction diagnosis is a subject for debate.

There is concern that the minimal brain dysfunction label has become a wastebasket diagnosis, a label assigned arbitrarily whenever a child manifests any significant psychological symptom, fails to learn, or just generally fails to meet the expectations of his parents and/or teachers (Paine, 1968; Schwartz, Pizzo, & McKee, 1971; Twitchell, 1971). There are those who fear that the diagnosis may be applied to the bored but bright child, or to the child who cannot or will not comply with the unnatural demands of educational institutions to be still and silent (Gallagher, 1970).

Fish (1971), in reviewing the literature on brain disorders in children, found that minimal brain dysfunction and hyperactivity, once regarded as nonspecific disorders, have now replaced diagnosis. Several investigators have indicated that the assignment of diagnostic status to minimal brain dysfunction is premature for basic issues await

clarification. Quantitatively and qualitatively, data on the various facets of "normal" child development are lacking (Moore & Welcher, 1971). The possibility of socioeconomic and ethnic variability of symptoms has not been explored (Werry, 1968a). It is not known if various cognitive difficulties thought to be peculiar to the MBD child are characteristic of a wider spectrum of psychologically disturbed children (Werry, Weiss, Douglas, & Martin, 1966).

Assuming that the normal-abnormal line can be drawn for individual behaviors, it is still unclear what behaviors are the defining parameters of the MBD child. As Wender (1971) asks, is the hyperactive and distractible child without a learning disability to be considered as MBD? Denhoff, Davids and Hawkins (1971) reported that ratings of hyperactivity by teachers and parents did not correlate significantly. In diagnosis, then, by whose criteria is the determination of minimal brain dysfunction to be made?

Although basic diagnostic issues may still be in question, Keogh (1971) writes that parents and professionals do know an MBD child when they see him. Empirical support for this contention comes from several sources. Stewart (1970) found that as reported by parents, MBD and control children did differ significantly on behavioral questionnaires, while Campbell, Douglas, and Morgenstern (1971) reported significant differences based on classroom observation. Conners (1970) and Werry, Minde, Guzman, Weiss, Dogan, and Hoy (1972) have been successful in differentiating groups of MBD and

neurotic children. In longitudinal observations covering 10 years, hyperactivity per se has been shown to be a stable behavioral dimension (Battle & Lacey, 1972).

Given that the behaviors associated with the MBD child, behaviors such as hyperactivity, distractibility, and lability, are recognizable, troublesome, and apparently incompatible with school demands (Schrager & Lindy, 1970), a question remains as to the "elevation" of these behaviors to the status of a syndrome. In other words, with the seemingly disparate clinical pictures often presented by MBD children, is there, in fact, justification in grouping these children together, justification in assigning to all the diagnosis of minimal brain dysfunction?

As noted by Campbell et al. (1971), it has been assumed, without empirical evidence, that behavioral, cognitive, and neurological symptoms covary. However, a factor analytic study by Werry (1968b) sampling 103 children diagnosed as MBD found 10 basically unrelated dysfunctions; and each dysfunction tended to be comprised mainly of measures from only one source, such as psychological, neurological, or psychiatric data.

Expressing the views of those who oppose the syndrome approach, Twitchell (1971) suggests that given the ill-defined concept of minimal brain dysfunction and its essentially unrelated parameters, it would be wise to abandon labeling and concentrate on the problems of the individual child. Advocates of the syndrome approach do not dispute

these criticisms, but nonetheless do contend there is value in the syndrome concept. Rather than stressing the heterogeneity underlying the minimal brain dysfunction concept, these authors have chosen to emphasize the clustering of certain symptoms (Clements, 1966; Wender, 1971). Kaspar, Millichap, Backus, Child, and Schulman (1971) found that although behavioral correlates were not convergent, they were parallel, with the setting and nature of the stimulus materials being central to the syndrome concept. Thus, activity and distractibility did correlate significantly among structured tasks of visual or auditory functioning, but not necessarily between these areas.

Also in defense of the syndrome status of minimal brain dysfunction, research and treatment considerations are offered. Given the somewhat unwieldy nature of the subject matter, the minimal brain dysfunction label is felt to focus research, and also to orient the clinician to the multi-treatment needs of these children (Katz, 1972; Lesser (1970).

## Terminology

Along with questions as to the existence of the MBD child and the MBD syndrome, the subject of terminology is also conflicted. At present, the terms "minimal brain dysfunction" and "hyperactivity" appear to have gained the widest acceptance. It may be noted that in addition to these two, at least 38 other terms, such as "minimal brain damage," "cerebral damage," "hyperkinesis," and "learning disability," used to describe the syndrome and its various subcategories

have been identified (Clements, 1966).

"Minimal brain dysfunction," in contrast to "hyperactivity" or other of the terms stressing behavioral aspects, has the advantage of emphasizing the multiple developmental dysfunctions of the syndrome (Fish, 1969) rather than a single symptom which need not in fact be present (Huessy, 1967). Also, it is felt that use of the term, in emphasizing the organic hypothesis, may tend to make the parents more understanding of the child, and may also ameliorate parental guilt (Clements & Peters, 1962).

Those citing objections to the "minimal brain dysfunction" terminology indicate that, to begin with, the problem itself is certainly not "minimal," and that in another sense, there has been to pathological documentation to warrant an organic interpretation of "minimal." Likewise, without anatomical identification, "brain" and "dysfunction" are terms used without justification (Cruickshank, 1972; Friedman, 1969). "Hyperactivity," a descriptive term, has the advantage of bypassing the etiologic question (Eisenberg, 1972; Marwit & Stenner, 1972). Furthermore, "minimal brain dysfunction" is seen as having little diagnostic value, being devoid of educational or psychological implications (Friedman, 1969). The emphasis on organicity, the argument continued, serves only to produce a therapeutic nihilism and to allow the public schools to exclude children so labeled (Werry, 1968a).

At face value, the terminology issue may appear just a question of semantics. There are authors, however, who

place semantic disparity at the core of the many inconsistencies found in the literature. While "minimal brain dysfunction" and "hyperactivity" are not considered mutually exclusive, they reject their synonymity, hypothesizing that contradictions in research are artifacts created by applying the same terms to vastly different groups of children (Birch & Bortner, 1968; Fish, 1971).

Whether this be or not, in most of the literature the usage of the terms, unless otherwise specified, is essentially synonymous. For example, Wender (1971), favoring "minimal brain dysfunction," recognizes hyperactivity as a salient attribute of most MBD children. Werry and his associates (Werry, 1968b; Werry et al., 1966), preferring "hyperactivity," indicate that as most of their subjects have associated behavioral, cognitive, and neurological disorders, it is reasonable to conclude that the majority do not differ from those elsewhere described as MBD.

## Symptomatology

As indicated in the above discussions of diagnosis and terminology, the actual parameters of minimal brain dysfunction continue to be in question. A number of generalizations have been made concerning behavior and cognitive functioning, generalizations which are frequently offered without empirical support, and which are at times contradictory. Millichap (1968) writes that the heightened motor activity of the MBD child is usually confirmed without difficulty in the clinician's office, whereas Stewart (1970) and Wiens and

Anderson (1971) indicate that when under tension or in strange situations, activity may be subdued, and thus no behavioral symptoms may be apparent upon interview. Clements and Peters (1962) rely on patterns of subtest scatter on the WISC and other "organic" indicators in the psychological test battery in their diagnosis. Paine (1968) finds psychological test irregularities among the most impressive findings. Conners (1967), however, cites the myth of patterns, stating that no battery of psychological tests is, at present, adequately standardized to insure discrimination of minimal brain dysfunction from psychogenic or cultural deficits.

Behaviorally, based on parent and teacher report, MBD and normal children have been differentiated on dimensions such as activity, anxiety, distractibility, aggression, and social adjustment (Conners, 1970a; Weiss, Minde, Werry, Douglas, & Nemeth, 1971). Most of the observational data, however, relate specifically to hyperactive behavior.

In defining hyperactivity, the distinction has been made between quantitative (total amount of movement) and qualitative (situational appropriateness and structure of movement) dimensions (Werry, 1968a). Based on actometer recordings, both Pope (1970) and Kaspar et al. (1971) found no difference in the total motor activity of MBD and control children in free play situations. Pope, however, did report that the MBD subjects traversed more grid areas, spent a greater amount of time uninvolved with any toy, and made a

greater number of contacts with the toys, each of a shorter duration, than the control group.

In contrast to the undirected situation of free play, Pope (1970) found that when given instructions to refrain from movement, the activity level of the MBD subjects was greater than that of the control group. Kaspar et al. (1971) also reported this difference given the structured situation of psychological testing. Sykes, Douglas, Weiss, and Minde (1971), measuring activity by seat cushions, likewise found that MBD children were more restless than controls during a testing session, and that restlessness, while increasing in both groups during a second session, had increased at a faster rate for the MBD subjects.

Observation would thus seem to indicate, as Kaspar et al. (1971) conclude, that the effect of minimal brain dysfunction is not to increase the amount of activity the child generates in a free situation, but rather to make it more difficult for him to reduce his activity level when such reduction is expected or required, pointing to a deficiency in control or inhibitory processes.

While there appears to be at least verbal agreement concerning the behavioral difficulties of the MBD child, the subject of cognitive functioning is somewhat conflicted and inconsistent. The terms "minimal brain dysfunction" and "learning disability" have at times been used synonymously (Tarnopol, 1971), but their identity is not necessarily supported on the basis of the traditional psychological test battery.

Various studies attest to the superiority of control in comparison with MBD children on a number of standard measures of intellectual, academic, and perceptual-motor functioning. The specific nature of these differences is not, however, consistent across studies. For example, Stevens, Boydstun, Dykman, Peters, and Sinton (1967) reported that MBD and control groups differed significantly, in favor of the latter, on the WISC Verbal and Full Scale scores, while Wikler, Dixon, and Parker (1970) indicated that Performance and Full Scale scores were lower in their MBD subjects.

A study by Palkes and Stewart (1972) reported that MBD and control groups differed significantly on intelligence, achievement, and perceptual tests, all differences in favor of the control children. However, when scores were adjusted for Full Scale intelligence, neither achievement nor perceptual tests distinguished between the two groups significantly. It was concluded that while MBD children may perform less well on tests of intelligence, they do learn at a normal rate for their measured intelligence, and thus doubt is cast on the assumptions of underachievement and perceptual-motor handicap in this group.

Rather than a difference in intellectual ability or specific cognitive skills, Campbell et al. (1971) hypothesized that the general style or approach to problem solving of MBD children may pervade and be sufficient to explain their poorer performance. Comparing MBD and control samples on the

cognitive dimensions of reflection-impulsivity, constricted-flexible control, field dependence-independence, and automatization, they found that:

> the hyperactive child is more likely to respond impulsively without evaluating the response possibilities. . . . is less apt to monitor his behaviour and inhibit incorrect responses. . . . tends to be more easily drawn by the most obvious and compelling aspects of the stimulus field. . . . (and) when the task requires rapid response rates, he is slower than the normal child . . . (p. 65).

The view of a global rather than specific cognitive deficit has been expressed by several other investigators, with both stages of information processing (acquisition and decision making) cited in explanation of such global deficit.

At the stage of input, it is hypothesized that attentional defects disrupt the accurate acquisition of information. Freibergs and Douglas (1969) found that MBD in comparison with control children did more poorly on a concept attainment task under conditions of partial reinforcement; however, there was no difference between groups under continuous reinforcement. The authors suggested that continuous reinforcement counters distractibility and restlessness, increases motivation, and thus draws attention to the task for MBD subjects. Keogh (1971), in reviewing this study, offers an alternative explanation, considering that continuous reinforcement may not only serve to increase attention, but also to reduce the number of possible hypotheses to be dealt with in problem solving.

Sykes et al. (1971) hypothesized that the greater number

of errors of omission of their MBD subjects in comparison with the control on a continuous performance test indicated an impairment in sustained attention. Since the difference between groups in both errors of omission and commission was greater at a slower interval of presentation, it was also suggested that on a decision making dimension, MBD children are more prone to impulsive responding, while the normal child evaluates each stimulus and thus inhibits incorrect responses.

Whatever the cognitive deficit of the MBD child, specific or global, input or central processing, there is still the question of whether such deficit is the direct or indirect result of minimal brain dysfunction. Does the behavioral constellation of minimal brain dysfunction, especially hyperactivity and distractibility, disrupt cognitive functioning? Or are the difficulties in learning more directly the result of independent cognitive disorders (Keogh, 1971; Werry, 1968a)?

Werry (1968a) comments that:

> it is possible to hypothesize that the hyperactive child as ordinarily seen with his combination of learning and other behavioral difficulties represents a pseudosyndrome, the result of selective screening. . . . Such a question is, however, largely academic, since, from the point of view of the clinician, the average hyperactive child in trouble can be expected to have associated learning and behavioral disorders (p. 585).

Keogh (1971) concludes that it seems safe to say that MBD children often have learning problems. However, neither the particular educational skills affected nor the specific

mechanisms responsible have been verified. Thus, one cannot conclude that all MBD children will be learning disabled, and any assumption of cognitive impairment must be established independently.

## Prevalence

Generally, the rates of prevalence for minimal brain dysfunction are largely impressionistic, with estimates ranging between 3 - 10% of the grade school population (Lipman, 1971; Paine, 1968). The variability in rates is attributable in part to differences in diagnostic criteria, and also to differences in the children targeted. For example, Conrad, Dworkin, Shai, and Tobiessen (1971) place the prevalence at 3 - 5% for middle class children, and 10% for lower class children. Stewart (1970) estimated that 4% of suburban grade school children meet the criteria, while Huessy and Gendron (1970) report that for inner city slum school populations, impressions run as high as 40% of the students.

Based on clinical referral rates, the ratio of boys to girls ranges from estimates of 4 or 5:1 (Huessy, 1967; Lipman, 1971), to as high as 9 or 10:1 (Werry, 1968a); Wiens & Anderson, 1971).

## Etiology

In the early 1920s, following an encephalitis epidemic, clinicians recognized a postencephalitic behavior disorder in those children who had recovered from the acute phase of the illness. Behavioral sequelae included hyperkinetic and restless activity, emotional lability, disobedience,

quarrelsome and abusive behaviors, and a decline in academic performance (Ebaugh, 1923). Given the similarity of these symptoms to those of the MBD child, it is perhaps not surprising that theories of organic etiology dominate the minimal brain dysfunction literature.

The list of organic considerations is extensive, ranging from hypotheses of structural damage or dysfunction to explanations entailing more subtle biochemical variations. Circumstances of genetic transmission, random intrauterine variation, pre- and paranatal trauma, and other factors presently unknown, have all been cited as plausible events leading to innate dysfunctions, constitutional variability, or maturational delay (Lesser, 1970; Lipman, 1971; Millichap & Fowler, 1967; Wender, 1971).

Since there has been no pathological documentation of brain damage or dysfunction, neither diffuse nor localized, theories of organic etiology are inferential, stemming mainly from the neurological status of MBD children.

In a study of MBD and control subjects by Stewart, Pitts, Craig, and Dieruf (1966), no significant difference was found in medical history suggestive of probable brain injury. The authors concluded, however, that the prevalence of delayed speech development, current speech problems, poor coordination, and strabismus in MBD children suggests that brain dysfunction rather than primarily psychological factors is often the basis for the syndrome.

In a study by Werry et al. (1972), again, no difference was

found in medical history (birth records), nor in major neurological signs or EEG recordings of MBD and control subjects. However, an excess of neurological soft signs was reported in MBD subjects as compared to both normal and neurotic children.

Boydstun, Ackerman, Stevens, Clements, Peters, and Dykman (1968) compared the physiological levels (heart rate, muscle reaction, and skin resistance) of MBD and control children during a tone discrimination task. The groups did not differ in the resting state, but the controls were more physiologically reactive during training. It was hypothesized that deficiencies related to cortical arousal structures could explain the performance of the MBD group.

Dykman, Walls, Suzuki, Ackerman and Peters (1970) compared the performance of hyperactive, hypoactive, normoactive samples on a telegraph pressing task. The authors concluded that the slower response times and greater error scores of the hyper- and hypoactive groups, suggesting slower information processing, were supportive of the Boydstun et al. (1968) theory of defective cortical arousal. They added that while the evidence warranted neurological interpretation, a primary organic explanation was not necessarily indicated for neural maturation also depends upon experience, and thus neurological status can plausibly be viewed as a reactive rather than causal state.

Huessy and Gendron (1970), in studying the stability of the behavioral constellation of minimal brain dysfunction,

found that the constellation was stable in only 1/3 to 1/2 of the group originally so identified; furthermore, other children who had not shown symptoms previously were 2 1/2 years later reported to be hyperactive. The authors concluded that, based on the instability of the behavioral constellation, a purely organic hypothesis appears untenable.

In a discussion of the psychogenic ("reactive to environmental or inner neurotic stress") determinants of minimal brain dysfunction, Wender (1971, p. 48) considers two possible subgroupings, a purely reactive form and a privation-produced form. In support of reactive etiology he finds evidence from clinical reports that hyperactivity can be increased by increasing psychological stress, and in turn, decreased by decreasing such stress. Both human and animal studies have also indicated that early environmental deprivation can generate MBD-like characteristics such as heightened activity and impaired cognitive functioning. However, since not all children subjected to psychological and environmental stress or interpersonal privation develop MBD behavior patterns, Wender suggests that biological predisposing characteristics must exist, and interact in some manner with psychogenic determinants.

Battle and Lacey (1972), in a nonclinical longitudinal study, did report, in contrast to Huessy and Gendron (1970), hyperactivity to be a relatively stable dimension over 10 years, but also found that on the basis of observational and interview data, mothers of high activity children were

critical, disapproving, and severe in punishment. They concluded that from the earliest years, hyperactivity is negatively received by the mother, and thus parental and environmental factors may possibly exacerbate the condition.

At present, organic, psychogenic, and interactional hypotheses all remain unestablished. The prevailing view, however, does hold that although obscure, etiology is most plausibly organic (Weiss et al., 1971).

## Prognosis

In their landmark article, Laufer and Denhoff (1957) commented that minimal brain dysfunction was a situation which in the course of the normal maturational process was overcome. The place of treatment, therefore, was to prevent the development of psychological consequences prior to that point. Writing at a later date, Paine (1968) held a somewhat similar position, stating the long-range prognosis to be relatively favorable, with adult adjustment basically satisfactory.

With the publication of a retrospective study by Menkes, Rowe, and Menkes (1967), the complacency regarding prognosis was tempered. From child psychiatry records dating back 14 - 27 years, the authors were able to contact 14 of the 18 subjects adjudged to meet the criteria for minimal brain dysfunction. At the time of original referral, treatment of this group had varied, ranging from a single clinic visit to ongoing counseling support for a period of 7 years. None of the subjects had received pharmacological therapy. Follow-up

information obtained from clinical interview, telephone contact, or parental report revealed that of the 14 subjects: 4 were institutionalized with a psychiatric diagnosis; 2 were considered retarded and were residing with their families; 8 were self-supporting, but of these 8, 4 had at some point been hospitalized or incarcerated; of the 11 subjects the authors were able to interview clinically, 8 still had evidence of neurological dysfunction. The authors themselves cautioned in regard to conclusions that, in addition to the small size of the sample, the findings could reflect diagnostic errors of inclusion rather than the natural history of the syndrome.

Suggesting that minimal brain dysfunction may be the precursor of adult psychiatric disorders are other retrospective studies. Quitkin and Klein (1969), sampling adolescent and young adult psychiatric patients, found that a case history of childhood hyperactivity was a strong predictor of adult "impulsive-destructive" disorder. A different childhood pattern was reconstructed for an "awkward-withdrawn" group. Rochford, Detre, Tucker, and Harrow (1970), studying hospitalized and day patients, found that a significantly greater percentage of neurological abnormality was found in the patient group as compared with control subjects, and that, in turn, neurological findings were more often present in patients with histories of behavioral and psychological difficulties associated with minimal brain dysfunction.

Retrospective studies, and especially those without control

data, are of inconclusive prognostic value at best. Within the past few years, longitudinal studies have begun to be available.

Stewart (1970) presented 5 year follow-up data on 45 teenagers who previously had been diagnosed as MBD. In interviews with parents, it was reported that of the 45: 5 were more or less free from the original symptoms; 26 were somewhat improved; and 14 were not improved or worse. Most subjects were still reported to be restless, with poor concentration, school performance, and self-esteem. In fact, there was felt to be an increase in impatience, irritability, antisocial behavior, and resistance to discipline. Interviews with the teenagers revealed that many found it hard to study and were not interested in school. The author, while noting the need for a control group, did feel that compared with baselines from other studies, normal teenagers do not have the extent of the problems manifested by his sample. Although Stewart did not indicate what, if any, treatment this sample had received, in another article (Mendelson, Johnson, & Stewart, 1971) follow-up data was presented on 83 teenagers, 92% of whom had received stimulant drugs, and most of whose parents had received counseling. This sample did presumably include the 45 subjects from the 1970 study, and reached essentially the same conclusions.

A 5 year follow-up evaluation of MBD children, with control data, has recently been published in a series of articles (Cohen, Weiss, & Minde, 1972; Minde, Lewin, Weiss,

Lavigueur, Douglas, & Sykes, 1971; Weiss et al., 1971). All 64 subjects had previously received some form of drug treatment—dextroamphetamine, methylphenidate, or chlorpromazine. In addition, 15% had participated in remedial programs in addition to regular schooling, and 10% of the families had received counseling. Based on parents' and teachers' reports and classroom observation, it was found that hyperactivity, per se, although still present in 30% of the sample to some extent, was no longer the chief complaint. Other major handicaps did persist, however. Parents listed distractibility as a major concern, with social adjustment and low self-esteem also frequently noted. From teachers' ratings, it was found that MBD and control subjects did differ significantly, with difficulties in restlessness, concentration, and aggression, although somewhat diminished with age, still remaining. Academically, only 20% of the MBD group had not repeated a grade. Even when the effect of intelligence was controlled, their achievement was inferior to the control subjects. On psychological testing, there were significant differences in intellectual functioning, evenness of cognitive profiles, and in cognitive style.

In summarizing the state of prognostic research, Eisenberg (1972) emphasizes that to date, no careful follow-up of a comprehensively and continuously treated group has been reported. Until such data are available, it is not known if the negative prognostic implications found in the literature are the necessary consequences of the basic syndrome.

## Summary

Of basic issue is the legitimacy of the minimal brain dysfunction diagnosis itself. There is concern that the label has become a wastebasket diagnosis, assigned arbitrarily whenever a child deviates from the expected norm. The opposing view holds that parents and professionals do know an MBD child when they see him, and that empirically, MBD, neurotic, and normal children have been found to differ significantly.

As with diagnosis, the issue of terminology is also conflicted. Currently, the terms "minimal brain dysfunction" and "hyperactivity" have gained the widest acceptance, with benefits cited regarding the use of each. While the usage of the terms in the literature is essentially synonymous, semantic disparity is hypothesized by some to be at the core of the many inconsistencies found in research.

With regard to behavioral symptomatology, based on parent and teacher report, MBD and normal children have been distinguished on dimensions such as activity, anxiety, distractibility, aggression, and social adjustment. Most of the observational data, however, relate specifically to hyperactive behavior, and seem to indicate that the effect of minimal brain dysfunction is not to increase a child's activity in a free situation, but rather to make it more difficult for him to reduce activity when such reduction is required.

Concerning the cognitive symptomatology of MBD children,

assumptions of underachievement and perceptual-motor handicap have been challenged. Rather than a difference in specific cognitive skills, some authors have hypothesized deficits in the MBD child's global approach to problem solving. It is concluded that MBD children often have learning problems; however, the particular skills or mechanisms involved await verification, and thus, any assumption of cognitive impairment must be established independently.

Prevalence rates for minimal brain dysfunction are largely impressionistic, with estimates ranging between 3 - 10% of grade school children, with the ratio of boys to girls placed at 4:1 to as high as 10:1. Variability in rates is partly attributable to differences in diagnostic criteria, and also to differences in the populations targeted.

The list of etiologic considerations for minimal brain dysfunction is extensive, with postulates of causality ranging from the exclusively organic to those of a psychogenic nature. While there has been no pathological documentation of brain damage or dysfunction, the prevailing view, based on the neurological status of MBD children, does hold that etiology is most plausibly organic.

On the basis of retrospective and recently available follow-up studies, MBD children have been found to be at risk in terms of behavioral and cognitive development. However, to date, data based on a comprehensively and continuously treated group are not available, and thus it is

still not known if negative prognostic implications are the necessary consequences of the basic syndrome.

# CHAPTER 2

## REVIEW OF THE LITERATURE - II: TREATMENT OF MINIMAL BRAIN DYSFUNCTION

Treatment recommendations for the MBD child and/or his family include:

> Special school, special class, or additional training within a regular class. . . .
>
> Medication by the pediatrician, neurologist, or by the clinic psychiatrist. . . .
>
> Developmental optometric training - for visual evaluation and visual-motor training in areas of deficit. . . .
>
> Individual or group counseling or psychotherapy for the child when indicated. . . .
>
> Parents join appropriate associations. . . .
>
> Recreational programs including specific gross and fine visual-motor activities. . . .
>
> Parent counseling groups (Millman, 1970, pp. 95-96).

A consideration of each modality is beyond the scope of this review, the focus of which is limited to the pharmacological, stimulant and antidepressant drugs in particular, and behavioral treatment approaches. Regarding the remaining approaches, for purposes of this review, suffice it to say that currently the empirical evidence necessary to accept or reject specific programs is limited (Fine, 1970), with the greatest amount of success of any one method frequently reported by the proponents of that method (Reed, 1971).

## Pharmacological Treatment

It is estimated that 300,000 MBD children are currently receiving medication, with stimulant drugs being the prescription for 200,000 of these (Wiens & Anderson, 1971). Another group of drugs, the phenothiazines, have been reported useful in treatment. However, most studies show the phenothiazines inferior to the stimulants, finding clinical reports of improvement mixed, and the laboratory reports indicating, if anything, a slight deterioration in cognitive functioning (Wender, 1971; Werry, 1968a, 1970). A group of drugs definitely contradicted are the barbituates as they serve to aggravate the syndrome, making the child even more hyperactive and disorganized (Wender, 1971; Werry, 1968a).

### Stimulant Drug Treatment

Summary statements of the effectiveness of stimulant drugs are somewhat discrepant, with effectiveness estimates generally placed somewhere between 1/2 - 2/3 improvement (Department of Health, Education, and Welfare, 1971), or 2/3 - 3/4 improvement (Eisenberg, 1972) of children treated. In a literature review, Millichap and Fowler (1967) reported wide differences from study to study in percentage improvement. Surveying six studies with methylphenidate, improvement ranged from 70 to 90%, deterioration from 0 to 1% of the cases, with the combined rates being 83% improved and 1% worse. In nine studies with amphetamines, improvement rates ranged from 40 to 100%, deterioration from

3 to 30%, with combined rates of 69% improved and 11% worse. Based on efficacy and toxicity, the authors conclude methylphenidate to be of choice, a view similarly held by a number of investigators.

As a point of comparison, it may be noted that placebo improvement is typically reported at approximately 33%, although depending on the measure used, rates as high as 67% have been reported (Knights & Hinton, 1969).

Approaches to the study of the behavioral and cognitive effects of methylphenidate may be divided into two, the clinical method and the laboratory method. In the clinic, dosage is typically individually determined for each subject and medication is administered by the parent over a period of 4 - 12 weeks. Pretreatment and posttreatment measurements include parents' and teachers' ratings and a standard battery of psychological tests. The laboratory method, in contrast, generally employs a fixed, single dosage administered by staff. Testing occurs at a predetermined interval following ingestion, and measurements are usually more atomistic, being obtained from automated instrumentation or direct observational procedures (Werry, 1970).

Both clinical and laboratory studies have been more consistent in finding evidence of positive behavioral in contrast to cognitive change. In controlled investigations of methylphenidate and placebo treatments, Weiss, Minde, Douglas, Werry, and Sykes (1971) found methylphenidate to be superior based on parents' global ratings of behavioral

improvement, and Sprague and Christensen (1972) reported significant differences based on teachers' ratings of conduct, distractibility, and hyperactivity. Similarly, based on parents' and teachers' ratings, numerous other studies have reported the superiority of methylphenidate in comparisons with placebo (Conners, 1971; Conners & Rothschild, 1968; Werry, 1970).

In classroom observation, methylphenidate has been shown to reduce isolation, produce higher percentages of on-task behavior, increase both teacher- and pupil-initiated positive contact, and decrease pupil-initiated noise and negative interaction (Sprague, Barnes, & Werry, 1970; Sprague, Werry, Greenwold, & Jones, 1969; Werry, 1970). In laboratory measurement, methylphenidate has been found significantly better than placebo in reducing seat activity (Sprague et al., 1970; Sprague & Christensen, 1972; Werry, 1970).

The evidence for behavioral change has not always been consistent from study to study. For example, Knights and Hinton (1969) found that teachers' ratings, although in the right direction, did not differ significantly between methylphenidate and placebo groups; Millichap, Aymat, Sturgis, Larsen and Egan (1968) and Sprague and Christensen (1972) reported no significant differences based on parents' reports. Reduction in seat activity was not found by Sprague et al. (1969). While positive results, based on observation, have been reported for some deviant classroom

behaviors, other behaviors such as out of seat and physical contact have not shown improvement (Sprague et al., 1969, 1970).

Werry (1970) and Sprague and Werry (1971), reviewing the research on the behavioral effects of methylphenidate, indicate that significant effects are difficult to obtain in a single study due to the large error variance of the measures and the multivariate determinants of drug response. They conclude, however, that while findings have not always been significant, they are consistent in indicating the superiority of methylphenidate to placebo, an indication which becomes even stronger when the results of a number of studies are considered.

In addition to behavioral improvement, there are reports of changes in cognitive functioning (intellectual, academic, and perceptual) based on standard psychological testing. However, in comparison with the evidence for behavioral improvement, findings of cognitive improvement have been less consistent. For example, comparing methylphenidate and placebo groups, Knights and Hinton (1969) reported a significant improvement, favoring the methylphenidate subjects, on the WISC Performance Scale. Conners (1972) and Weiss et al. (1971), however, found the Verbal score but not the Performance to be significantly improved with treatment. Conners (1972), in addition, reported significant differences on the Bender and Draw-A-Person, but Weiss et al. (1971) failed to obtain similar findings. As with the research on

cognitive deficit presented in Chapter 1, there is a failure to replicate the findings of cognitive improvement from study to study.

Based on the lack of consistency or specificity of cognitive improvement, Weiss et al. (1971) suggest that any positive effect of methylphenidate is an indirect one, possibly the consequence of improved attention. Having reacher similar conclusions, several investigators have suggested that finer, more discrete measures of cognitive functioning or style are needed since the traditional test measures are too global, and thus insensitive to drug effects.

Sykes et al. (1971) hypothesized that measures such as the WISC Digit Span and Coding subtests, in possibly not requiring sustained attention, may therefore not reflect momentary lapses in attention. Using a continuous performance test, they did find methylphenidate to improve the performance of subjects in comparison with a placebo control group. Campbell et al. (1971), studying cognitive style dimensions, reported less impulsive responding and improved ability to inhibit incorrect responses in children receiving methylphenidate. Conners and his associates (Conners, 1972; Conners & Eisenberg, 1963; Conners, Eisenberg, & Sharpe, 1964), in several articles have reported less impulsive responding as measured by the Porteus Maze Test in methylphenidate groups.

Werry (1970), reviewing the laboratory work on drugs and learning, concludes that under certain conditions, either

simple repetitive motor tasks or tasks which do not necessitate a higher level of cognitive organization, improvement is found in areas of vigilance, speed, short-term memory, and motor control. Cohen, Douglas, and Morgenstern (1971), in their review, found methylphenidate to improve attention, reduce impulsivity, increase ability to plan and correct errors, and shorten reaction times.

Summarizing cognitive data, Weiss et al. (1971) conclude that methylphenidate does appear to have a somewhat unpredictable but positive effect on a variety of tests. They caution, however, that final conclusions are still unwarranted as to the specific cognitive functions altered.

Antidepressant Drug Treatment

As indicated previously, stimulant drugs are the most generally prescribed and are considered to be the most effective in the treatment of the MBD child. The search for alternative pharmacological agents continues, however, for there are certain reservations regarding the stimulants. Huessy and Gendron (1970) indicate that in many children who have improved with treatment, there is an abrupt change between 11 - 13 years, with continued treatment resulting in an excitatory response to the drugs as found in adults. Wender (1971) reported two episodes in which MBD adolescents attempted to become "high" on amphetamines. Their comments were of a pleasant, perhaps calming effect, although apparently not euphoric. Following both episodes, treatment with imipramine, classified as a tricyclic antidepressant

drug, was instituted, with the result being a response similar to that produced by the stimulants in younger subjects, namely decreased motor activity and impulsivity, and improved social compliance and academic performance. The author cautioned, however, that in two or three other cases, imipramine was found to be ineffective.

Stating that the side effects of the stimulants indicated the need for a more satisfactory treatment, Rapoport (1965) instituted imipramine therapy for a variety of behavior disorders similar to those previously treated with stimulants. Past studies of imipramine in the treatment of enuresis had reported as an incidental effect positive behavioral change. Rapoport found, based on reports from parents, schools, and psychological testing, an 80% improvement rate with imipramine. Behaviorally, the drug was reported to increase alertness, decrease temper and compulsive behavior, and to improve sleep. Cognitively, improvements in intellectual and academic measures were obtained.

Krakowski (1965), in a placebo controlled study, reported a 72% improvement rate with amitriptyline, another of the tricyclic antidepressant drugs. Overall ratings of improvement were based on psychological testing and reports of scholastic performance and improvement in target symptoms such as activity, anxiety, and aggression.

Using criteria of parents' and teachers' reports, and academic performance as measured by report cards, Huessy and Wright (1970) found a 67% improvement rate in an MBD sample

receiving imipramine. When the treatment was temporarily interrupted after 4 months, only 4% of the subjects continued to do well. Based on their results, and the advantages of a single daily dose and minimal side effects, the authors conclude that imipramine is the drug of first choice in the treatment of MBD children.

Drug Treatment Critique

In the above review, evidence has been presented of the behavioral and, although less predictable, cognitive improvements resulting from short-term trials of medication. There have been, however, concerns and issues raised in regard to the methodology of the research, and also in regard to the long-term effects of drug treatment.

In a review of over 90 articles on the use of stimulants, McMahon, Deem, and Greenberg (1970) reported that only five met basic research design standards, including pre- and posttests, double-blind, and placebo procedures. Sulzbacher (1971), surveying the literature on behavior modifying drugs and children, found that of the more than 1100 studies reviewed, only 210 were considered to be controlled. In these 210, it was further found, that the more subjective (clinical opinion and rating scales) the measurement, the greater the report of significant differences between drug and placebo groups; given the criteria of psychological tests and direct behavioral measurement, relatively few studies reported such differences.

Apart from the methodological issues of drug research,

there are questions concerning the judiciousness of pharmacological treatment for MBD children. Side effects of stimulant and antidepressant drugs are generally reported to be minimal and manageable. There are, however, reported instances, although rare, of severe physical and behavioral reactions accompanying treatment. Lucas and Weiss (1971) presented two cases of hallucinosis and other gross behavior changes such as catatonic withdrawal and bizarre mannerisms in children receiving methylphenidate. Brown, Winsberg, Bialer, and Press (1973) observed the development of seizures concomitant with imipramine therapy in three children without previous history of convulsive disorders.

Even if toxicity is rarely a problem in short-term research, treatment may continue for months or years, and little is known of the long-term effects of drugs on development in children. Safer, Allen, and Barr (1972) reported that in nine children receiving dexedrine or methylphenidate for 2 or more years, weight gains were suppressed, and although more variable, there was an indication that percentile height was decreased in some subjects. The authors indicated that further research is needed, but nevertheless termed the findings alarming.

In children approaching or beyond puberty, there are added concerns, especially with the stimulant drugs as indicated above, of potential abuse or addiction. The only research available has not shown evidence of habituation or abuse in later years. In a follow-up questionnaire survey

of 100 children previously treated with stimulants, Laufer (1971) found that of approximately 60% of the subjects responding: 97% reported never having overdosed with any form of medication; 95% reported never having experimented with stimulants; and 91% reported never having experimented with marijuana or LSD. While there may be no evidence of drug risk in later years, it is nevertheless recommended that the risk of potential experimentation in adolescence be recognized (Department of Health, Education, and Welfare, 1971; Lucas & Weiss, 1971).

## Behavioral Treatment

Marwit and Stenner (1972) comment that crucial to the understanding and treatment of the MBD child is the realization that his heightened activity level is not a learned response, and for that reason cannot be unlearned; since there is a need for the child to express this activity, it makes little sense to attempt to eliminate or extinguish it other than by pharmacological means. Nevertheless, modification of hyperactivity has been attempted by behavioral rather than pharmacological means, with the evidence indicating that irrespective of etiology, behavior modification techniques can be effective.

Not surprising, behaviorists have not written specifically of "minimal brain dysfunction." They have, however, recognized that hyperacitivity is a complex dimension, operationally defined by a number of behavioral subclasses such as not attending, moving about, and making noise

(Patterson, Shaw, & Ebner, 1969). Whatever the antecedents of these high rate behaviors, constitutional, emotional, or environmental, they are considered detrimental to the development of social and academic skills (Doubros & Daniels, 1966; Patterson, Jones, Whittier, & Wright, 1965).

Operant Techniques

Within the behavior modification literature, one of the earliest studies with a hyperactive child was presented by Patterson et al. (1965). Subsequent to the establishment of a baseline of nonattending behavior, training was instituted within the classroom, with the subject receiving signals contingent upon attending behavior. The signals earned reinforcers for the subject and his class following each conditioning session. In comparison with a control subject, the experimental subject showed significantly fewer nonattending behaviors during the training phase, and this difference was maintained during a 4-week extinction phase. The authors did find that during the conditioning of attending behavior, various components of nonattending behavior were differentially affected. Thus, gross motor movements were only temporarily decreased by the procedure, but fiddling and distractibility showed marked decrements throughout.

Reviewing six studies using essentially the same procedure, Patterson et al. (1969) found that results similar to the above were replicated by investigators in different settings, working with hyperactive children of different

ages and IQs, and with varying levels of organic impairment. Decreases in deviant behavior ranged from about 10 to 36% (median 20%), and were obtained at an estimated cost of from 3 to 10 hours of intervention time.

Relating to the treatment of the hyperactive child, apart from the studies reviewed by Patterson et al. (1969), are numerous other classroom and laboratory reports of the successful application of operant conditioning procedures. Edelson and Sprague (1969) found that activity level as measured by seat cushion could be either raised or lowered with the application of contingent reinforcement. They indicated, however, that by just controlling movement, one does not necessarily control attention. Other studies have targeted attention specifically, reinforcing visual orientation (Quay, Sprague, Werry, and McQueen, 1967) or on task behavior (Allen, Henke, Harris, Baer, & Reynolds, 1967; Broden, Bruce, Mitchell, Carter, & Hall, 1970; Coleman, 1970; Doubros & Daniels, 1966; Nixon, 1969).

Academic achievement has likewise been specifically targeted, with contingent reinforcement resulting in improved performance (Glavin, Quay, Annesley, & Werry, 1971; McKenzie, Clark, Wolf, Kothera, & Benson, 1968; Sluyter & Hawkins, 1972; Wadsworth, 1971).

While the above studies have been successful in modifying activity, attention, and achievement, less successful and consistent are the persistence and generalization of these behavioral changes. As did Patterson et al. (1965)

in their earlier investigation, resistance to extinctions has been obtained by some experimenters (Doubros & Daniels, 1966; Knowles, Prutsman, & Raduege, 1968; Nixon, 1969). However, other studies have found that with the cessation of behavioral procedures, improvements are not maintained (Edelson & Sprague, 1969; Quay et al., 1967; Sluyter & Hawkins, 1972). Also, in studies which have attempted to transfer control initially gained by primary reinforcement to control by teachers' social reinforcement, a decline in improvement has likewise been found (Coleman, 1970; Quay et al., 1967). It should be emphasized, however, that such findings are not specific to the treatment of the hyperactive child, for as a review by O'Leary and Drabman (1971) has indicated, generalization across situations and generalization across time are critical issues in all classroom reinforcement procedures; generalization must be programmed rather than expected. But as Patterson (1971) comments, the question of how the school system can provide the reinforcers necessary for the success and maintenance of behavioral programs is an area just beginning to receive attention.

Patterson (1971) writes that in contrast to classroom intervention, the technology of family intervention is in a primitive state. Relevant to the treatment of the hyperactive child, there are reports of the successful modification of disruptive, aggressive, and oppositional behaviors, with parents in the role of behavior modifier

(Hawkins, Peterson, Schweid, & Bijou, 1966; O'Leary, O'Leary, & Becker, 1967; Patterson & Brodsky, 1966; Wahler, 1969a, 1969b; Wahler, Winkel, Peterson, & Morrison, 1965; Zeilberger, Sampen, & Sloane, 1968).

As did the classroom studies reviewed, most of the studies with parents have relied on direct intervention by the experimenter in initial phases of training. In the work with parents, this experimenter intervention has often been in the form of modeling or cueing, in home or clinic, the specific behavioral procedures to be used.

In teaching parents to observe behavior and to plan behavioral programs, Patterson and Gullion (1971a) have found that between 5 - 15 weekly training sessions are typically needed before adequate control of the child's behavior is obtained. In approximately 1/3 of their families having severe "problem children," the didactic presentation (observational training, reading, and discussion) of behavior principles was not sufficient, and the more direct procedures of cueing and modeling were required. In the extreme, when it was necessary for the experimenter actually to enter the home, the cost of such effort in terms of professional time ranged from 9 to 46 hours. Patterson (1971) concludes that training programs for parents appear a promising procedure, but as yet details necessary to evaluate the relative effectiveness are lacking.

Self-Management Techniques

In the above studies, reinforcement contingencies have

been arranged and implemented by the therapist or parent. Self-control, in contrast, is a procedure in which the individual initiates responses to control the probability of his own behavior (Cautela, 1969). Relevant to the behavioral treatment of the hyperactive child, a body of literature is available focusing upon the technique of verbally mediated self-control.

Presenting the theoretical basis for self-control training, Meichenbaum and Goodman (1969, 1971) explain that the internalization of verbal commands is considered a critical step in a child's development of voluntary control. Developmentally, verbal control begins with the speech of others having a directive function and progresses to the point at which the child's own internalized speech becomes self-directive, his own words gaining the status of discriminative stimuli.

Palkes, Stewart, and Kahana (1968) and Pontius (1972) hypothesize that for the hyperactive child, this developmental progression is not maintained, and his verbalizations do not optimally serve to control or channel his activity and impulsivity. Comparing impulsive and reflective children, Meichenbaum and Goodman (1969) did find that impulsive children rely less on the semantic content of their own speech, and under covert self-instructions, evidence less verbal control than do reflective children.

In an attempt to modify the impulsivity of hyperactive subjects, Palkes et al. (1968) instituted training in

self-directed verbal commands. During two training sessions, the children worked on a series of tasks, verbalizing aloud a set of commands prior to responding to any subpart of a task. The commands were printed on cards, and instructed the child to "stop," "listen," and "look and think" before answering. Directly following training, in comparison with a control group given the same tasks but without the command training, the experimental group was significantly less impulsive as measured by the quantitative and qualitative scores of the Porteus Maze Test.

Using a single training session, Meichenbaum and Goodman (1971) compared modeling alone with modeling plus self-instructional training. Following treatment, it was found that while both groups had slower decision times, modeling plus self-instructional training was more effective in altering decision times and in reducing errors. A similar procedure, over four sessions, resulted in similar cognitive improvements, with the gains following self-instructional training maintained on 4 week follow-up.

Although finding that their subjects had made cognitive gains, Meichenbaum and Goodman (1971) reported that based on classroom observation and teachers' ratings, no behavioral improvement followed training. Pollack (1968) did specifically focus upon training behavioral self-control. Verbal control training was instituted in an attempt to modify frustration reactions. Subjects were first taught to label their behavior, and were then given verbal and motor cues to

perform at the onset of explosive behavior in an attempt to inhibit the reaction. Results analyzed qualitatively indicated that significant behavioral improvement was seen in four of five cases, although the gains varied greatly in degree, with this variability appearing to be directly related to individual differences in language and conceptual skills.

Techniques with Normal versus Hyperactive Children

As the above review has indicated, the behaviors of hyperactive children have been modified by behavioral techniques, and there is no reason to assume that the laws of learning are in any way *different* for this particular population. The question remains, however, whether or not the modification of hyperactivity and its associated behaviors is in some way more *difficult* than the modification of other behavioral dimensions.

Operationally defined, it is the high rate of his behavior which is one of the distinguishing characteristics of the hyperactive child (Patterson *et al.*, 1969). In working with high rates of deviant behavior, Patterson (1971) suggests that longer periods of training may be required to obtain long-term control. But not only does the hyperactive child present one high rate behavior, upon observation a number of clusters of such behavior may be present. Given this array, Benson (1969) and Patterson (1971) suggest that it may initially be necessary for the experimenter to work directly with the child, bringing the

behavior under his control, and then transferring this control to parent, teacher, and/or peers.

In addition to the difficulties specifically related to the control of multiple high rate behaviors, it has also been suggested that the overall susceptibility of the hyperactive child to behavior modification techniques is somewhat diminished.

Comparing hyperactive and control subjects on a tone discrimination task, Boydstun et al. (1968) reported that 1/3 of the hyperactive children showed procedural irregularities, such as interfering with the equipment, which interrupted the session. On the task itself, while 92% of the control group did reach criterion, only 62% of the hyperactive group attained a comparable level of performance.

Dykman et al. (1970), comparing hyperactive and normoactive groups, both of average intelligence, found that the hyperactive children required extra instructions to learn a light discrimination task, and were slower in responding and higher in error rate during the acquisition and differentiation phases of the study.

Freibergs and Douglas (1969) reported that on a concept attainment task, hyperactive children did more poorly than controls under partial reinforcement, but found no difference between groups with continuous reinforcement.

Comparing the EEG recordings of hyperactive and normal control subjects during evoked potential procedures, Milstein, Stevens, and Sachdev (1969) found the hyperactive

group to have exaggerated initial responses to novel stimuli and a decreased capacity to disattend to redundant stimuli.

All of the above authors have hypothesized that neurologically, defects in cortical arousal and inhibitory processes impede sustained attention, and that in turn, the defects in sustained attention impede the susceptibility of the hyperactive child to modification by behavioral procedures.

Pharmacological versus Behavioral Treatment

Commenting upon the relationship between pharmacologists and behaviorists, Sprague and Werry (1971) write of a barrier of communication, a state in which neither group seems aware of the other. In fairness, however, it must be noted that in the drug treatment literature, frequent reference is made of other modes of treatment. Eisenberg (1972) stresses that drugs do not produce learning, but make it possible; remedial education and counseling are essential if the child is to resume a normal developmental course. Such statements are by no means unusual, with several other authors having indicated the need for concomitant psychological and educational management. What is not found, however, is a presentation by these same authors of what specifically constitutes these adjunct therapies. Pharmacological management is generally the sole treatment detailed; then, at best, cursory mention is added of the need for prompt reward or discipline, consistency and firmness, in home and school management. Given this state of

benign neglect, it is perhaps not surprising that direct comparisons of pharmacological and behavioral therapies, or for that matter direct comparisons of any therapies, in the treatment of the MBD child are limited.

In the early 1960s, Eisenberg, Gilbert, Cytryn, and Molling (1961) compared three short-term treatments: therapy, therapy plus placebo, and therapy plus perphenazine (a phenothiazine derivative). Therapy was described as supportive, consisting of five sessions with parents and five with child over 3 months. No further details were provided. Based on a pooling of reports from parents, teachers, and psychiatrists, no difference was found between the therapy and therapy plus placebo conditions; only 2 of the 12 combined MBD subjects were significantly improved. In the therapy plus perphenazine group, 6 of 11 children were significantly improved. Based on a clinic report, apart from the study, of a therapy alone condition, it was reported that the drop out rate for MBD families was 60% by the third month. The authors concluded that the model of treatment for neurosis, short-term psychotherapy, is unsuitable in the approach to the treatment of minimal brain dysfunction.

Recently, Conrad et al. (1971) presented a comparison of amphetamine therapy and prescriptive perceptual-cognitive tutoring over the course of 4 - 6 months. Their design entailed four groups: placebo/no tutoring; placebo/tutoring; amphetamine/no tutoring; and amphetamine/tutoring. Results indicated that behaviorally, parents' and psychologists'

ratings reflected a reduction in hyperactivity and improvement in attention only for those children receiving medication. However, teachers perceived greater behavioral improvement in the amphetamine/tutoring group than in the amphetamine/no tutoring condition. Cognitively, medication contributed to improvement on a number of tasks, those mostly affected by distractibility and impulsivity. Amphetamine/tutoring interactions indicated that reduction in activity and improvement in attention enabled subjects to make use of their tutoring experience in some perceptual-motor areas. It was concluded that regardless of the remedial approach employed, drug therapy is an important adjunct, but medication alone is sufficient treatment only for those MBD children having no specific learning problems.

A direct comparison reported in the literature between pharmacological treatment and what may properly be termed behavior modification is a laboratory study by Sprague and Christensen (1972). Four stages of the study were described: a non-drug baseline measurement of activity as recorded by seat cushion; a drug baseline measurement with one group receiving methylphenidate and another placebo; a behavioral procedure during drug or placebo treatment; and a post-behavioral, extinction procedure. During the third stage, the behavioral procedure, all subjects received reinforcement contingent upon reduced seat movement. The results indicated that throughout the sessions, the placebo subjects were higher in activity than those receiving methylphenidate.

With the introduction of reinforcement, seat activity was significantly reduced in both groups, but as indicated, subjects receiving methylphenidate continued to be superior, and also had less variability in their performance. During the extinction stage, placebo subjects showed an immediate increase in movement, while no comparable increase was found in the methylphenidate subjects. The authors conclude that a combination drug/behavior modification treatment is superior to either condition alone.

## Summary

Of the drugs employed in the treatment of minimal brain dysfunction, central nervous stimulants are the most widely prescribed, and within the stimulant grouping, based on efficacy and toxicity, methylphenidate appears to be of choice. Although not always statistically significant, methylphenidate has consistently been found superior to placebo in producing positive behavioral change. The evidence for cognitive improvement has been less consistent, but overall, the drug does appear to have a positive effect on the more discrete aspects of cognitive style, such as attention and impulsivity; however, final conclusions as to the specific cognitive functions altered are still unwarranted.

The search for alternative pharmacological treatment continues, for there are reservations with regard to the side effects and addiction or abuse potential of the stimulants. There have been a few studies suggesting the

usefulness of treatment with tricyclic antidepressant drugs, imipramine and amitriptyline. As with the stimulants, both behavioral and cognitive improvement have been reported with the antidepressants. However, the effects of stimulant and antidepressant drugs have not, as yet, been directly compared.

Behaviorists have recognized hyperactivity as a complex dimension, having serious implications for social and academic development. Relevant to the treatment of the hyperactive child, operant techniques in the classroom have been found effective in the modification of activity, attention, and achievement, although still troublesome are the persistence and generalization of these changes. With parents in the role of behavior modifier, the successful modification of disruptive, aggressive, and oppositional behaviors have been reported. As with classroom studies, most work with parents has relied on direct experimenter intervention during the initial phases. Self-management techniques, following a model of verbally mediated self-control, have also been found effective, specifically in the modification of cognitive impulsivity and behavioral frustration reactions.

Regarding the use of behavioral techniques with hyperactive children, there is evidence suggesting that the modification of multiple high rate behaviors requires longer periods of training along with direct experimenter intervention, and that the susceptibility of the hyperactive child to

modification may be somewhat diminished as a result of neurologically-based defects in sustained attention.

Comparisons of pharmacological and behavioral treatments are limited. The research that is available suggests that in the laboratory treatment of hyperactivity, methylphenidate is superior to behavioral procedures, but that a combination drug/behavioral treatment is superior to either condition alone. The effects of pharmacological and behavioral treatments have not, as yet, been directly compared within the clinic setting.

# CHAPTER 3

# METHOD

## Problem and Hypotheses

It is the aim of the present study: 1. to compare the behavioral and cognitive effects of pharmacological and behavioral therapies in the short-term, clinical treatment of minimal brain dysfunction; and 2. to compare the behavioral and cognitive effects of stimulant (methylphenidate) and antidepressant (imipramine) drugs in the short-term, clinical treatment of minimal brain dysfunction. The specific hypotheses to be tested are:

### Hypothesis 1

Behavioral treatment does not differ from two types of pharmacological treatment (imipramine and methylphenidate) in its effects upon:

a. selected behaviors, as measured by parents' and teachers' ratings, of MBD children.

b. selected areas of cognitive functioning, as measured by teachers' ratings and psychological testing, of MBD children.

### Hypothesis 2

Imipramine does not differ from methylphenidate in its effects upon:

a. selected behaviors, as measured by parents' and teachers' ratings, of MBD children.

b. selected areas of cognitive functioning, as measured by teachers' ratings and psychological testing, of MBD children.

## Subjects

From referrals to the Psychopharmacology Clinic of the University Affiliated Program for Child Development, Georgetown University Hospital, 29 boys were selected for the study. Subjects had been referred by physicians and school personnel for behavior and/or learning problems.

Based on pediatric and psychiatric evaluations, and a review of behavior rating scales completed by parents and teachers, the diagnosis of minimal brain dysfunction with hyperactivity was made by a child psychiatrist. Primary criteria for inclusion in the sample were behaviors of chronic and sustained hyperactivity, distractibility, and/or impulsivity as reported by the home and school. As specified by Clements (1966), the diagnosis of minimal brain dysfunction is reserved for the child whose neurologic symptomatology is mild or borderline, whose intellectual functioning is at least within near average range, and whose behavioral and cognitive disabilities are associated with deviations of the central nervous system. Thus, excluded from consideration were children with gross neurological dysfunctions, those who did not meet the minimum requirement of a Full Scale score of 70 on the Wechsler Intelligence Scale for Children, and/or those with primary emotional disorders.

The subjects selected ranged in age from 6 through 12

years (mean = 9.0), with WISC scores ranging from 72 through 126 (mean = 99.6). Approximately half of the subjects were reported by the school as having received some form of remedial instruction (ungraded or special class, remedial reading, speech correction, or tutoring). Some subjects had previously received psychological or pharmacological therapy, but not within the 6 months prior to their acceptance into the study. Although no social class criterion was specified, the families judged able to meet the clinic regimen, which included visits to the hospital, telephone progress contacts, and a private or community referral source for pharmacological management following the study, were predominantly of middle socioeconomic status.

## Procedure

At admission to the clinic, subjects were assigned in random permutations of three to the treatment groups: imipramine (N = 10); methylphenidate (N = 10); or behavior modification (N = 9). The total time of treatment for each child was 6 weeks.

### Pharmacological Treatment

For subjects within the imipramine and methylphenidate groups, medication was managed by a psychiatrist. Parents were encouraged to maintain telephone contact during the 6-week period, and a definite appointment with the parents was scheduled at 3 weeks to assess treatment progress. Based on the parental reports of behavior at home and at school, and any side effects occurring during the course of

treatment, dosage was individually titrated ranging from 75 - 150 mg/daily of imipramine, and 10 - 30 mg/daily of methylphenidate.

Behavioral Treatment

Meetings with parents. Parents of subjects assigned to the behavior modification group were individually seen by the author at the clinic 1 hour per week during the 6-week treatment period.

During the first session, parents were asked to discuss the general reason for their referral to the clinic. The behavioral approach was then presented, emphasizing that irrespective of etiology, the goal is to change behavior by changing reinforcement contingencies. Parents, with the aid of the experimenter, targeted specific problem behaviors to be considered during the treatment period (Table 1). They were asked to observe one of the behaviors during the coming week, and were supplied a copy of the programmed text Living with Children (Patterson & Gullion, 1971b) to be completed by the next meeting.

At the second session, building upon the information obtained from Living with Children, specific behavioral principles of social and token reinforcement, extinction, contingency contracting, shaping, and modeling were elaborated in regard to the specific problem behavior under observation by the parents. Working together, parents and experimenter devised a behavioral program to be instituted during the coming week.

During subsequent sessions, depending upon the success of

TABLE 1

Behavior Modification Group

Target Behaviors

| Subject | Target Behaviors |
|---|---|
| 1 | Interaction with teacher<br>Completion of classroom assignments |
| 2 | Getting ready for school on time<br>Fighting with sibling |
| 3 | Fighting with sibling and peers |
| 4 | Completion of classroom assignments<br>Hyperactivity in classroom<br>Coming home on time |
| 5 | Interaction with father<br>Completion of homework assignments |
| 6 | Completion of homework assignments<br>Fighting with siblings |
| 7 | Fighting with sibling<br>Coming home on time<br>Completion of chores |
| 8 | Fighting with peers |
| 9 | Obeying parents<br>Completion of classroom assignments |

the program as reported by parents, refinements or extensions, when appropriate, were implemented.

Meetings with subjects. While their parents were meeting with the author, subjects assigned to the behavior modification group were also individually seen. These sessions, conducted by a graduate student from the Department of Counseling and Personnel Services, University of Maryland, had a dual emphasis, behavioral control and cognitive control.

During the first part of a session, working from the problem area targeted by their parents, subjects were asked to discuss specific encounters, describing their behavior and the consequences of the behavior. Following the method of behavior rehearsal (Wolpe & Lazarus, 1966), the experimenter and the given subject then reenacted these incidents, rehearsing alternative, adaptive behaviors suggested by subject or experimenter, and, when necessary, modeled by the experimenter.

The second part of a session, devoted to cognitive control, followed the method of verbally mediated self-control.

Training tasks were assembled in the areas of trail making, matching pictures, and embedded figures, these areas chosen based on the study by Palkes et al. (1968). The specific training items for each session are contained in Appendix A.

Also derived from the study by Palkes et al. (1968), three visual reminder cards were constructed, each 5 x 7

inches, with commands printed in red and drawings in black. Card 1 read "Look and think before I move"; Card 2 "Look and check all the pictures before I answer"; and Card 3 "Look and think before I answer" (Appendix B).

Prior to the execution of training tasks, subjects were told:

> One of the things we are going to do is play some games. The important thing is to try not to make a mistake. I want you to get them right every time on your first try. One way to get them right is to think about your answer. These cards will help you to think about your answer.

During training, subjects verbalized commands printed on the visual reminder cards prior to responding to any subpart of a task. Responses correct upon initial attempt were reinforced. Session models were as follows:

| | |
|---|---|
| Session 1 - 3: | Overt commands<br>Continuous reinforcement |
| Session 4: | Overt commands<br>FR 3 reinforcement |
| Session 5: | Covert commands<br>FR 3 reinforcement |
| Session 6: | Covert commands<br>Final reinforcement |

A more detailed description of command and reinforcement procedures is provided in Appendix C.

Between clinic sessions, subjects were given practice assignments to complete daily. These assignments, with the appropriate commands attached, duplicated the areas covered by training tasks, trail making, matching pictures, and embedded figures. Appendix D contains the specific practice

items by day and week.

## Dependent Measures

For all groups, prior to and following treatment, behavioral and cognitive measures were obtained.

### Behavioral Measures

For hypotheses 1a and 2a, behavioral effects of treatment were assessed by the following:

Parent variables. Parents completed the Parent's Questionnaire (Conners, 1970), a behavior rating scale which is scored for eight factors: Conduct Disturbance, Anxiety, Hyperactivity, Learning Problem, Somatic Complaints, Obsessional Traits, Antisocial Behavior, and Muscular Tension. The specific observations comprising each of these factors are contained in Appendix E. Each item is rated for the degree to which it describes the child: not at all, just a little, pretty much, or very much. In scoring, these item ratings are assigned weights of 0 - 3, respectively, and then the appropriate items are summed to obtain factor-based scores. Reliability and validity data for the Parent's Questionnaire are summarized in Appendix F.

Teacher variables. Teachers were asked to complete pre- and posttreatment the Preliminary School Report and the Follow-Up School Report, respectively (Conners, 1969), scales yielding four factors: Conduct Disturbance, Distractibility, Anxiety, and Hyperactivity. The behavioral observations comprising the factors of the School Report are contained in Appendix G. The scoring procedures are

identical to those for the Parent's Questionnaire.

The Follow-Up School Report, in addition, provides for global ratings of behavioral improvement in: Classroom Behavior, Overall Behavior, Group Participation, and Attitude toward Authority. Categories of much worse, a little worse, unchanged, improved, and much improved are provided to describe behavioral change. In scoring, weights of 1 - 5, respectively, are assigned to obtain the global ratings of improvement. Reliability and validity data for the School Report are summarized in Appendix H.

Cognitive Measures

For hypotheses 1b and 2b, cognitive effects of treatment were assessed by the following:

Teacher variables. On the Follow-Up School Report, measures of academic achievement were obtained from teachers' global ratings of Reading, Spelling, and Arithmetic. The scoring procedures for these ratings of academic improvement are identical to those for the global ratings of behavioral improvement as described above.

Subject variables. Subjects were administered a battery of six psychological tests pre- and posttreatment: the Wechsler Intelligence Scale for Children, consisting of the 10 standard Verbal and Performance subtests and the supplementary Digit Span subtest (Wechsler, 1949); the Reading, Spelling, and Arithmetic subtests of the Wide Range Achievement Test (Jastak, Bijou, & Jastak, 1965); the Porteus Maze Test (Porteus, 1965); the Bender Gestalt Test for Young

Children (Koppitz, 1964); the Developmental Test of Visual-Motor Integration (Beery & Buktenica, 1967); and the Draw-A-Person (Goodenough & Harris, 1963).

All psychological tests were administered and scored by the author, following the standard procedures described in the respective test manuals. As the Wechsler scale was a selection criterion, it was always administered first in the battery. Other tests were ordered based on random permutations to control for possible sequence effects.

Scoring was blind with respect to subjects' group assignments for all tests administered pretreatment, and for the Porteus Maze, VMI, and Draw-A-Person tests administered posttreatment. Given the nature of the tests and/or the demands for school reporting, it was necessary to score protocols from the Wechsler, Wide Range, and Bender Gestalt either during testing or immediately following a subject's completion of the treatment; thus, in the posttreatment scoring of these three tests, the treatment anonymity of behavioral and pharmacological subjects could not be maintained, although the specific drug assignment of pharmacological subjects was still unknown. Independent, blind scoring was obtained for the Bender Gestalt Test, with the interrater reliability being .96.

## Statistical Analysis

Analyses of covariance, with pretreatment scores as the covariates and posttreatment scores as the criteria were computed on the data from the behavior factor ratings and

the psychological test battery.

Global ratings of improvement were treated by analysis of variance procedures.

In the application of analysis of variance and analysis of covariance procedures, the assumption of homogeneity of variance was tested by Hartley's $F_{max}$ Test.

For analysis of covariance procedures, the additional assumption of homogeneity of regression was conducted by computer program. When the assumption of homogeneity was not met, the Neyman-Johnson technique (Johnson & Jackson, 1959) was then applied to all three pairs of groups. This technique is used to locate a region of significant mean differences along a covariate for two groups measured on a criterion, when regressions are heterogeneous.

To test hypotheses 1 and 2 specifically, preplanned orthogonal contrasts were constructed comparing the average of the pharmacological treatment effects with the behavioral treatment effects, and comparing imipramine treatment effects with methylphenidate treatment effects, respectively. In the determination of differential treatment effects, a significance level of .05 was set. However, since this study was considered exploratory, for purposes of further research suggestions, group differences at the .10 level of significance were also reported.

When the F ratio from an analysis of variance or analysis of covariance was significant at the critical value for $\alpha = .05$, the Newman-Keuls technique for postmortem contrasts

was applied to assess the pairwise contrasts of imipramine treatment versus behavior modification, and methylphenidate treatment versus behavior modification.

Group means and error terms for the orthogonal contrasts and Newman-Keuls technique were adjusted appropriately when analysis of covariance procedures were in effect (Dayton, 1970).

Product-moment correlations were computed amongst the change scores from the behavior factor ratings, the change scores from the psychological test battery, and the global ratings of improvement.

Data were analyzed at the Computer Science Center of the University of Maryland. The MANOVA program (Clyde, Cramer, & Sherin, 1966) was utilized in analysis of variance, analysis of covariance, and orthogonal contrast procedures; the ANCOVA2 program (Dayton, undated) was additionally applied in covariance analyses for the testing of the homogeneity of regression assumption, and the application of Neyman-Johnson tests when indicated; and the FACTOR program (Clyde et al., 1966) was utilized in correlational analyses.

# CHAPTER 4

# RESULTS

## Hypothesis 1

To compare the average of the imipramine and methylphenidate treatments with the behavior modification treatment, the following preplanned contrast model (ignoring weights for unequal sample sizes) was constructed:

$$1/2\ (\overline{Y}_I + \overline{Y}_M) - \overline{Y}_B\ *$$

### Behavioral Measures

Hypothesis 1a:

Behavioral treatment does not differ from two types of pharmacological treatment (imipramine and methylphenidate) in its effects upon selected behaviors of MBD children.

Parent variables. For the data of the Parent's Questionnaire, the assumption of homogeneity of variance was met on all but the Obsessional Traits factor. To equalize sample variances on this factor, square root transformations were performed on the scores, and the analysis was then continued.

The assumption of homogeneity of regression was met on all but the Anxiety and Antisocial Behavior factors. In

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* Because of the unequal sample sizes of the groups, in the actual statistical computations, the sample sizes were entered into the contrast model as weights. The actual contrast, with weights and coefficients, was thus:

$$90(\overline{Y}_I + \overline{Y}_M) - 180\overline{Y}_B$$

Figure 1, the within-group regression lines, shown only over the observed range of pretreatment scores, are plotted for the Anxiety factor. As designated by the Neyman-Johnson technique, for imipramine and behavior modification groups, regressions were heterogeneous within the region of pretreatment scores between 0 and 1.39. The regression lines for methylphenidate and behavior modification did not differ significantly anywhere along the pretreatment axis, and therefore are not plotted together.

In Figure 2, the within-group regression lines for the Antisocial Behavior factor are shown. For imipramine and behavior modification groups, the region of significant heterogeneity was above the pretreatment score of .67. For methylphenidate and behavior modification groups, the regression lines above the pretreatment score of .37 differed significantly.

By orthogonal contrast procedures, no difference at or beyond the .10 level of significance was obtained between the average of the pharmacological treatments and the behavioral treatment on any of the factors from the Parent's Questionnaire (Appendix I).

Teacher variables. For the data of the School Report, homogeneity of variance and homogeneity of regression assumptions were met in all analyses.

By orthogonal contrast procedures, between the pharmacological and behavioral treatments, there was no difference at or beyond the .10 level based on teachers' factor ratings

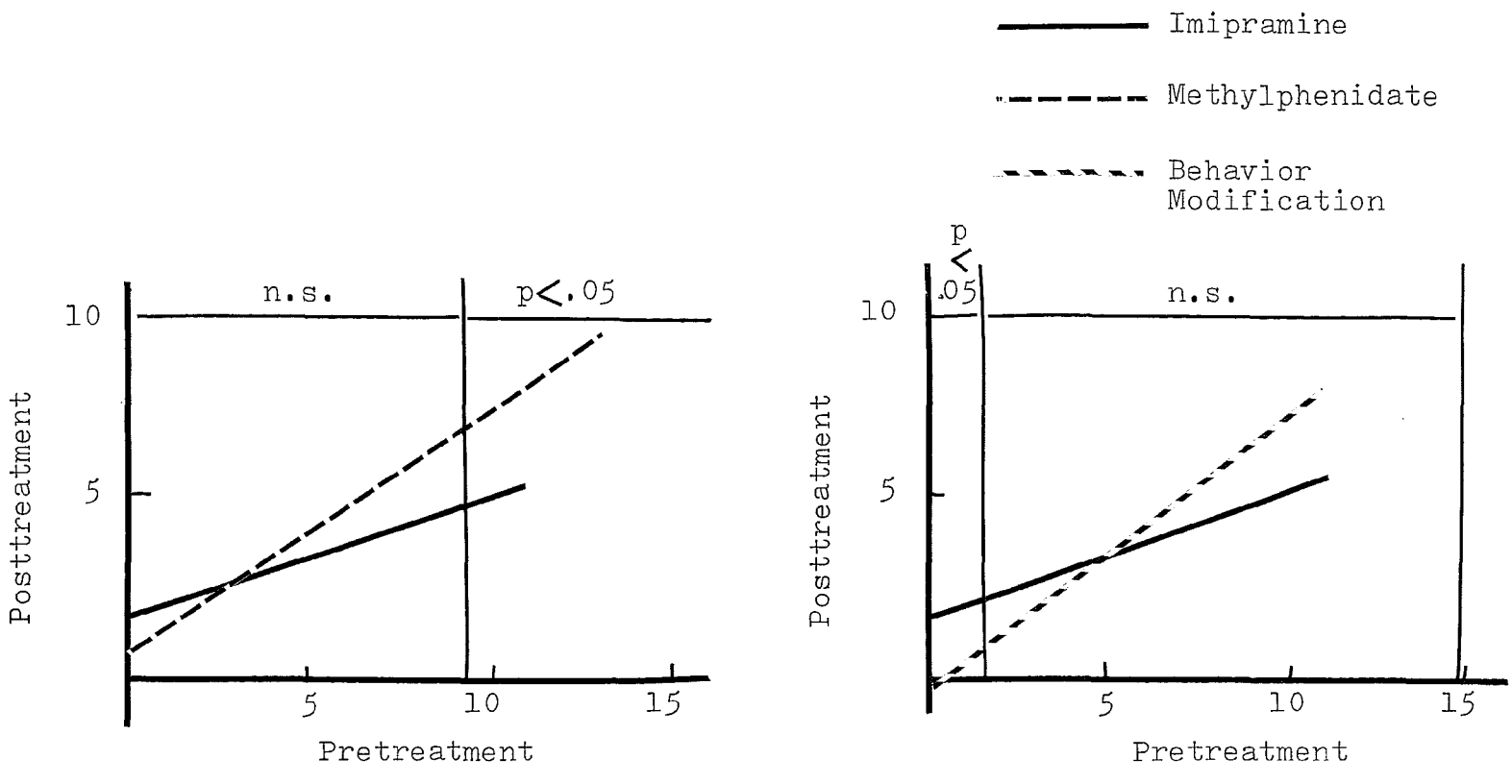


Fig. 1. Within-group regression lines for the Anxiety factor of the Parent's Questionnaire.

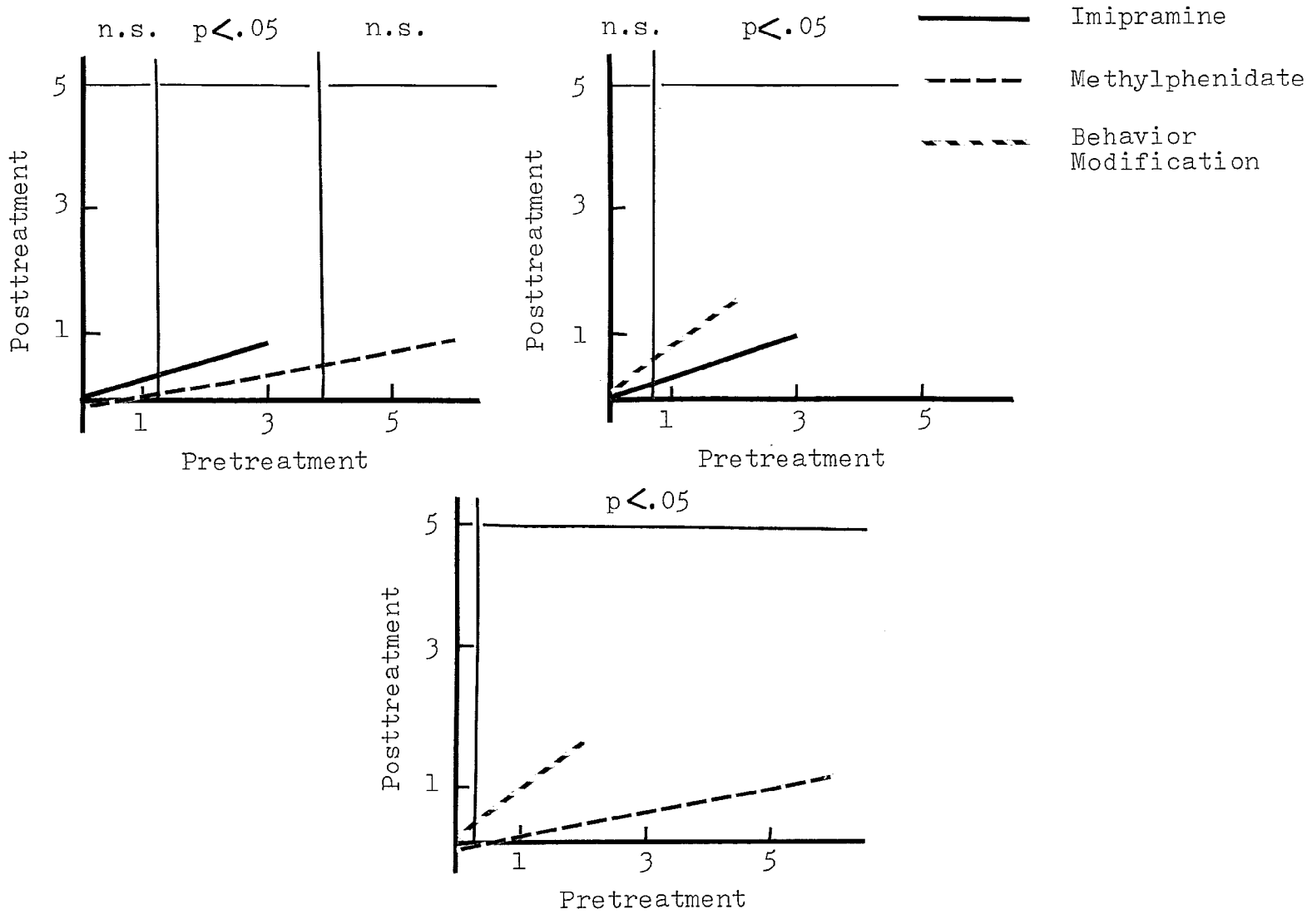


Fig. 2. Within-group regression lines for the Antisocial Behavior factor of the Parent's Questionnaire.

on the School Report (Appendix J).

There were differential treatment effects based on teachers' global ratings of behavior. Pharmacological treatment, on the average, was superior to behavioral treatment based on teachers' ratings of change in: Group Participation ($p < .001$), Classroom Behavior ($p < .01$), Attitude toward Authority ($p < .01$), and Overall Behavior ($p < .05$, Appendix K).

To test the specific pairwise contrasts of imipramine versus behavior modification, and methylphenidate versus behavior modification, Newman-Keuls tests were then applied to the global rating data. At the .05 level, the only contrast between imipramine and behavior modification to reach significance was in the category of Group Participation. Contrasting methylphenidate with behavior modification, differences between group means did exceed the critical value at the .05 level in all four categories of behavioral change (Appendix L).

Cognitive Measures

Hypothesis 1b:

Behavioral treatment does not differ from two types of pharmacological treatment (imipramine and methylphenidate) in its effect upon selected areas of cognitive functioning of MBD children.

Teacher variables. For the data of teachers' global ratings of academic achievement, homogeneity of variance and homogeneity of regression assumptions were met in all analyses.

By orthogonal contrast procedures, based on teachers' global ratings, pharmacological treatment, on the average, was superior to behavioral treatment in the area of Spelling ($p<.05$). In the area of Arithmetic, the difference between treatments, in favor of the pharmacological, was significant at the .10 level. No differential treatment effects were indicated in Reading achievement (Appendix M).

Specific pairwise contrasts between imipramine and behavior modification indicated that there was no significant difference at the .05 level between groups in either Spelling or Arithmetic achievement. Comparing methylphenidate and behavior modification, the difference between group means did exceed the critical value at the .05 level in the area of Spelling, but not in the area of Arithmetic (Appendix N).

Subject variables. For the data of the psychological test battery, the homogeneity of variance assumption was satisfied in all analyses.

The homogeneity of regression assumption was met on all but the Vocabulary subtest of the WISC. In Figure 3, the within-group regression lines for the Vocabulary subtest are plotted. For imipramine and behavior modification groups, regressions were heterogeneous within the region of observed pretreatment scores between 5.00 and 9.90. The regression lines for methylphenidate and behavior modification did not differ significantly anywhere along the pretreatment axis.

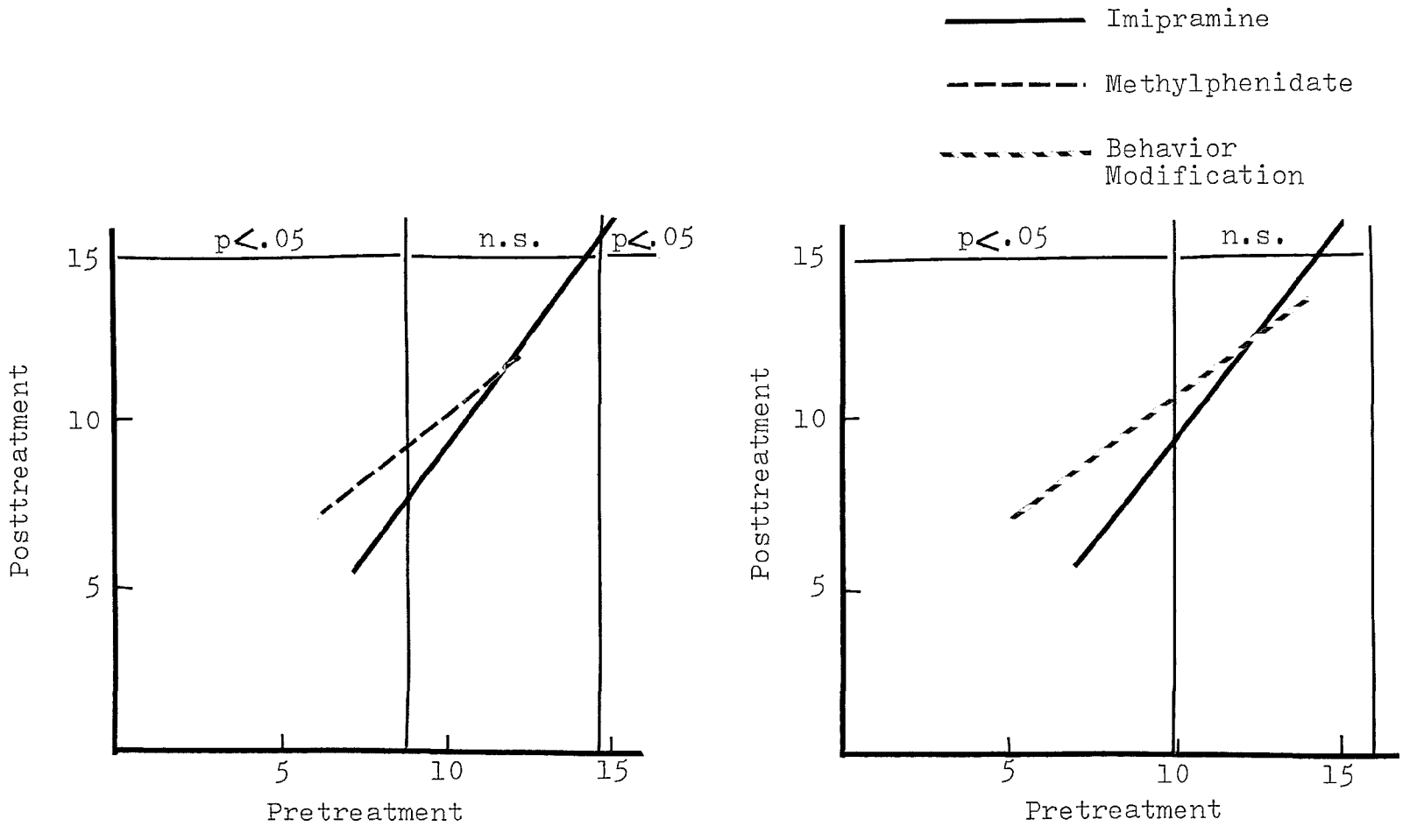


Fig. 3. Within-group regression lines for the Vocabulary subtest of the Wechsler Intelligence Scale for Children.

By orthogonal contrast procedures, comparing pharmacological and behavioral treatments on the psychological test battery, two variables were significant: behavioral treatment was superior to the average of the pharmacological treatments on the Object Assembly subtest of the WISC ($p<.05$); and pharmacological treatment, on the average, was superior to behavioral treatment on the Qualitative Score of the Porteus Maze Test ($p<.05$, Appendix O).

The specific Newman-Keuls pairwise contrasts of imipramine versus behavior modification, and methylphenidate versus behavior modification, did not reach the .05 level of significance in either analysis.

Hypothesis 2

The preplanned contrast model for the comparison of imipramine and methylphenidate treatments was:

$$\bar{Y}_I - \bar{Y}_M \ *$$

Behavioral Measures

Hypothesis 2a:

Imipramine does not differ from methylphenidate in its effects upon selected behaviors of MBD children.

Parent variables. As indicated above, in order to satisfy the assumption of homogeneity of variance, square root transformations were performed on the scores from the Obsessional Traits factor of the Parent's Questionnaire.

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* Sample sizes for imipramine and methylphenidate groups were equal, and therefore did not enter into the model as weights.

As also indicated above, the homogeneity of regression assumption was not met on the Anxiety and Antisocial Behavior factors. In Figure 1, as designated by the Neyman-Johnson technique, for imipramine and methylphenidate groups, regressions were heterogeneous on the Anxiety factor above the pretreatment score of 9.27.

In Figure 2, for imipramine and methylphenidate groups, regressions were heterogeneous on the Antisocial Behavior factor within the region of observed pretreatment scores between 1.25 and 3.85.

By orthogonal contrast procedures, no difference at or beyond the .10 level of significance was obtained between imipramine and methylphenidate on any of the factors of the Parent's Questionnaire (Appendix I).

Teacher variables. For the data of the School Report, homogeneity of variance and homogeneity of regression assumptions were met in all analyses.

By orthogonal contrast procedures, from the teachers' factor ratings of behavior, the difference between imipramine and methylphenidate in the reduction of Hyperactivity did reach the .10 level of significance, with methylphenidate favored. The differences between groups on the other three factors, Conduct Disturbance, Distractibility, and Anxiety, were nonsignificant (Appendix J).

Based on teachers' global ratings of behavior, methylphenidate exceeded imipramine in the categories of Group Participation and Attitude toward Authority, both

differences significant at the .10 level. The groups did not differ significantly in the remaining categories of Classroom and Overall Behavior (Appendix K).

Cognitive Measures

Hypothesis 2b:

Imipramine does not differ from methylphenidate in its effects upon selected areas of cognitive functioning of MBD children.

Teacher variables. For the data of teachers' global ratings of academic achievement, homogeneity of variance and homogeneity of regression assumptions were met in all analyses.

By orthogonal contrast procedures, based on teachers' global ratings, methylphenidate resulted in greater improvement, at the .10 level of significance, in the areas of Spelling and Arithmetic than did imipramine. No difference between the groups in Reading achievement was found (Appendix M).

Subject variables. For the psychological test data, the homogeneity of variance assumption was satisfied in all analyses.

The homogeneity of regression assumption was met on all but the Vocabulary subtest of the WISC. As indicated in Figure 3, for imipramine and methylphenidate groups, regressions were heterogeneous on the Vocabulary subtest with the region of observed pretreatment scores between 6.00 and 8.75.

By orthogonal contrast procedures, amongst the psychological test measures, the only difference between groups was evidenced on the Draw-A-Person, with the group mean of imipramine greater than the mean of methylphenidate at the .10 level (Appendix O).

For all behavioral and cognitive measures, group means and standard deviations are contained in Appendices P. Q. and R.

## Related Findings

In Table 2, the percent of subjects improved based on teachers' global ratings of Classroom Behavior are shown.

TABLE 2

Teachers' Global Ratings of

Classroom Behavior - Percentage Change

| | Treatment Group | | |
|---|---|---|---|
| Rating | Imipramine | Methylphenidate | Behavior Modification |
| Much Worse | 0 | 0 | 0 |
| Little Worse | 0 | 0 | 11 |
| Unchanged | 30 | 20 | 56 |
| Improved | 40 | 30 | 33 |
| Much Improved | 30 | 50 | 0 |

Note.—Cell entries are percent of subjects in each treatment group.

As indicated, 70% of the imipramine subjects and 80% of the methylphenidate subjects were rated as improved or much improved, while 33% of the behavior modification subjects were improved, with none being much improved. Specifically contrasting the two pharmacological groups, in the category of much improved, methylphenidate is favored to imipramine, with 50% of the methylphenidate subjects as compared to 30% of the imipramine subjects showing exceptional improvement.

Percentage change data for the remaining categories of behavioral and academic improvement as rated by teachers are contained in Appendices S and T, respectively, with similar patterns evident.

For each of the treatment groups, intercorrelations of change scores from the behavior rating scales, change scores from the psychological test battery, and the global ratings of improvement are contained in Appendix U. Upon inspection, the only discernible pattern appears to be the superiority of the methylphenidate group both in terms of the number and the directional consistency of the correlations. In reference to the latter, for example, for the behavior modification group, an increase in Conduct Disturbance on the School Report was directly related to an improvement on the Porteus Maze Test Age; for the imipramine group, a positive change in the WISC Full Scale score was negatively related to the teachers' global ratings of Classroom Behavior. Considering the overall pattern of correlations, such directional inconsistencies were much less

infrequent for the methylphenidate group than for the other two treatments.

# CHAPTER 5

# DISCUSSION

## Summary

It was the aim of the present study: to compare the effectiveness of pharmacological and behavioral therapies in the short-term, clinical treatment of minimal brain dysfunction; and, to compare the effectiveness of stimulant (methylphenidate) and antidepressant (imipramine) drugs in the short-term, clinical treatment of minimal brain dysfunction.

Twenty-nine boys, ranging in age from 6 through 12 years, with the diagnosis of minimal brain dysfunction with hyperactivity, were randomly assigned to three treatment groups: imipramine (N = 10); methylphenidate (N = 10); or behavior modification (N = 9). The total time of treatment for each child was 6 weeks.

For subjects within the imipramine and methylphenidate groups, medication dosage was individually titrated by a child psychiatrist. (Range: 75 - 150 mg/daily of imipramine, 10 - 30 mg/daily of methylphenidate.)

Parents of subjects within the behavior modification group individually met with an experimenter 1 hour per week. Behavioral principles were discussed, problem behaviors targeted, and behavioral programs devised for implementation during the treatment period.

Subjects assigned to the behavior modification were also individually seen once weekly. The first part of a session focused on behavioral control, following the method of behavior rehearsal. The second part was devoted to cognitive control, with training in self-directed verbal commands instituted.

For all groups, prior to and following treatment, behavioral and cognitive measures were obtained: parents completed the Parent's Questionnaire, a behavior rating scale; teachers completed the School Report, assessing behavior and academic achievement; and subjects were administered a battery of psychological tests which included the Wechsler Intelligence Scale for Children, Wide Range Achievement Test, Porteus Maze Test, Bender Gestalt Test, Developmental Test of Visual-Motor Integration, and Draw-A-Person.

Data were treated by analysis of variance and analysis of covariance procedures. Preplanned orthogonal contrasts were constructed comparing the average of the pharmacological treatments with the behavioral treatment, and comparing imipramine treatment with methylphenidate treatment. When indicated, the Newman-Keuls technique was applied to assess pairwise contrasts of imipramine versus behavior modification, and methylphenidate versus behavior modification.

The specific hypotheses to be tested were:

Hypothesis 1

Behavioral treatment does not differ from two types of

pharmacological treatment (imipramine and methylphenidate) in its effects upon:

a. selected behaviors, as measured by parents' and teachers' ratings, of MBD children.

b. selected areas of cognitive functioning, as measured by teachers' ratings and psychological testing, of MBD children.

Hypothesis 2

Imipramine does not differ from methylphenidate in its effects upon:

a. selected behaviors, as measured by parents' and teachers' ratings, of MBD children.

b. selected areas of cognitive functioning, as measured by teachers' ratings and psychological testing, of MBD children.

## Results

Prior to the consideration of the data as they bear upon the research hypotheses and the conclusions thus drawn, it is first necessary to consider the results in terms of the bounds of the design and the measurements themselves.

### Behavioral Measures

Parent variables. Between the pharmacological and behavioral treatments, and between imipramine and methylphenidate, no significant difference was found based on any of the factors from the Parent's Questionnaire.

Given samples of 10, 10, and 9 subjects, in viewing the lack of significance between groups, one of the primary

considerations must be statistical power. With sample sizes this small, the power of the statistical tests may be so limited as to fail to detect differential treatment effects.

Without the benefit of an untreated or placebo control group, it is also not possible to assess the absolute effectiveness of the treatments, only their relative effectiveness. As indicated in the review of the treatment literature, Chapter 2, there are a number of studies, based on the criteria of parents' reports, attesting to the superiority of stimulant as compared with placebo treatment. However, as also indicated, while this superiority is most apparent when the results of several studies are considered together, it has not necessarily been a consistent finding in each individual study. Thus, statistical power aside, without an established baseline and lacking control data, the lack of differential treatment effects could plausibly indicate that the treatments resulted in equal deterioration, lack of effect, or improvement.

A further point may be noted concerning the validity of parents' ratings. In one respect, in support of such ratings, it is contended that the person usually charged with the rating, the mother, is exposed to a more adequate sampling of behavior than is available in the laboratory or to the clinician (Weiss, Werry, Minde, Douglas, & Sykes, 1968). However, in another respect, it has also been contended that the relationship between parents' ratings and behaviors actually observed in the home is limited, and that

in a wish to please the clinician, there is likely to be a bias toward improvement in reports by parents (Patterson, 1971). Thus, in addition to considerations of statistical power or options of equal deterioration, lack of effect, or improvement, it is also possible to hypothesize that the lack of differential treatment effects based on parents' ratings may be due to the lack of validity of the ratings per se.

Teacher variables. From the School Report, based on teachers' factor ratings, no significant difference was obtained between pharmacological and behavioral treatments; between imipramine and methylphenidate treatments, of the four factors of the School Report, the only differential effect suggested (significant at the .10 level) was on the Hyperactivity factor.

As with the parents' ratings, lack of significant group differences based on teachers' factor ratings may possibly be a reflection of power limitations of the statistical tests, equal efficacy of the treatments, or validity of the measurements. Interpretations beyond this, based solely on the factor scores, are limited.

There were, however, significant differences between pharmacological and behavioral treatments, and differential effects were again suggested between imipramine and methylphenidate, based on teachers' global ratings of behavior. It is not necessarily uncommon to find that differences based on global ratings are significant, while more

discrete ratings fail to distinguish between treatments. Specifically in relation to pharmacological treatment effects, Werry (1970) indicates that due to the multivariate and multisituational nature of the responses, the less atomistic measure has the advantage of reducing error variance, and thus increases the chance of observing differential effects.

Cognitive Measures

Teacher variables. Based on teachers' global ratings of academic achievement, in the category of Spelling, a significant difference between pharmacological and behavioral treatments was indicated, and a differential effect was suggested in the category of Arithmetic. Between imipramine and methylphenidate, differential treatment effects were suggested in both Spelling and Arithmetic categories.

The differential treatment effects indicated or suggested on the basis of teachers' ratings, however, were not evidenced on the basis of the Wide Range Achievement Test. Again, this is not necessarily unexpected; global ratings may be more sensitive to treatment effects, and, as indicated below, time may be a crucial factor in the manifestation of improvement based on traditional test measures.

Subject variables. From the measures of the psychological test battery, the only significant differences between pharmacological and behavioral treatments were obtained on the Object Assembly subtest of the WISC and the Porteus Maze

Qualitative Score. Between imipramine and methylphenidate, there was a suggestion of differential effects based only on the Draw-A-Person.

In regard to the use of psychological tests as criteria, several points may be noted. Reviewing the general subject of testing and drugs, Baker (1968) reports that few, if any, changes based on the traditional measures of intellectual, visual-motor, and academic functioning were found as a result of pharmacological treatment. Baker indicates that while, in one respect, subject variability may mask treatment effects, in another respect, the limits of testing may not have been appreciated; the implicit assumption is that the traditional tests are sensitive to treatment effects, but this may not be. Especially applicable to research with MBD children, as indicated in the reviews of the literature, Chapters 1 and 2, neither the cognitive deficits of the population nor the cognitive effects of the drugs are fully understood. Thus, one does not even know what, if anything, exactly to expect in terms of altered test performance. Even if treatment were to lead to improvement in the specific functions tapped by testing, it may be that time is needed for this cognitive improvement to develop; given short-term treatment, post-testing intervals may not provide an adequate period of time for this improvement actually to have occurred or to be great enough to be reflected in test performance (Alexandris & Lundell, 1968).

Turning from the nonsignificant results on the majority of psychological tests to those tests on which differences were found (Object Assembly and Porteus Maze) or suggested (Draw-A-Person), it should be noted that in total, there were some 41 criterion variables designated in the study. Given the multiple analyses of variance and covariance computed and the multiple contrasts performed, results must be qualified with a consideration of the number of Type I error possibilities. Such qualification is especially relevant in assessing the results from the Object Assembly subtest and the Draw-A-Person. Upon consideration, there appears to be nothing unique in either of these measures to suggest a specific sensitivity to treatment effects that would not also be reflected in some of the other measures. The Porteus Maze Test, in contrast, is considered a more discrete measure, with the Qualitative Score especially sensitive to impulsivity. As indicated in Chapter 2, the test has in several studies been found to distinguish between placebo and stimulant drug groups. Thus, somewhat more confidence is placed in the differential effect between pharmacological and behavioral treatments based on this measure than in the results based on either the Object Assembly subtest or Draw-A-Person. Without replication, in regard to the latter measures, Type I error must be strongly considered.

Type I error considerations also enter into the interpretation of heterogeneity of regression as found on the

Vocabulary subtest of the WISC, and also on the behavioral measures of Anxiety and Antisocial Behavior on the Parent's Questionnaire. The suggestion of interaction based on Vocabulary performance, with posttreatment scores for methylphenidate and behavior modification above those for imipramine within the lower ranges of pretreatment scores, is particularly interesting, for both methylphenidate and behavior modification treatments are, in a way, linked with deficient language development: methylphenidate in that it has been found to increase speech productivity (Creager & Van Riper, 1967); and behavior modification in that verbally mediated self-control training is theoretically based on an assumption of interrupted or incomplete language development (Palkes et al., 1968). Again, without replication, interpretations of interaction on the Vocabulary subtest, or on the Anxiety and Antisocial Behavior factors, are limited, and further research is needed.

## Conclusions

### Hypothesis 1a

Hypothesis 1a of the equal effects of pharmacological and behavioral treatments on the behavior of MBD children was not supported. Data from teachers' global ratings of Classroom Behavior, Overall Behavior, Group Participation and Attitude toward Authority indicated the superiority of pharmacological treatment in comparison with behavioral treatment. Isolating specific group effects, on the basis of postmortem contrasts, contributing to the major portion

of the variance between treatments on the global ratings was the superiority of methylphenidate to behavior modification; in only one category, Group Participation, was the superiority of imipramine to behavior modification indicated. It is thus felt that further research is needed before conclusions as to the therapeutic comparability or lack of comparability of the behavioral effects of imipramine and behavior modification treatments are posited.

Due to the necessities of time and personnel, the behavioral treatment devised did not include direct work with teachers, but focused instead upon direct work with parents and children within the clinic setting. Three of the parents, with the experimenters' approval, did contact teachers to arrange for circumscribed token programs within the classroom; for the remaining six behavior modification subjects, no such school involvement was instituted, and for two of these six subjects, the behaviors targeted by parents were in no apparent way related to school concerns. Thus, since for the majority of subjects within this group, direct school involvement was not instituted, conclusions as to the therapeutic efficacy of the behavioral treatment based on the School Report may, in fairness, be questioned.

Comparative studies, as Patterson (1971) indicated, should consider the efficiency as well as the efficacy of treatments. Using the criterion of efficiency, pharmacological treatment does appear to be a superior short-term, clinical treatment in comparison with the behavioral

treatment as devised for the present study. Without separately targeting individual behaviors, and without concerns of setting specificity, pharmacological treatment, with a smaller professional investment, resulted in a wider spectrum of action than did the behavior treatment; that is, without specifically targeting such change, treatment effects at least equal to and at times superior to behavior modification were obtained in home behavior and school behavior, and also cognitive performance, at a cost of fewer professional hours with imipramine and methylphenidate treatments.

Hypothesis 1b

Hypothesis 1b of the equal effects of pharmacological and behavioral treatments on the cognitive functioning of MBD children was also not supported. Based on teachers' global ratings of Spelling achievement, pharmacological treatment was again shown to be superior to the behavioral treatment. The postmortem contrast between methylphenidate and behavior modification was significant, but not between imipramine and behavior modification. With reference to the latter groups, further research is again needed before conclusions as to the comparability or lack of comparability of effects on the basis of Spelling achievement are indicated.

The superiority of pharmacological treatment to behavioral treatment was also evidenced on the basis of the Porteus Maze Qualitative Score. From pretreatment to

posttreatment, for the behavioral treatment group, there was, in fact, an increase in cognitive impulsivity as measured by the Qualitative Score. As the postmortem contrasts of imipramine versus behavior modification and methylphenidate versus behavior modification were not significant, further research is indicated in regard to the differential effect of the individual drugs in comparison with behavioral treatment on the Maze test.

Hypothesis 2a

Hypothesis 2a concerned the equal effects of imipramine and methylphenidate treatments on the behavior of MBD children. Based on data from teachers' factor ratings of Hyperactivity and teachers' global ratings of Group Participation and Attitude toward Authority, differences between imipramine and methylphenidate were significant at the .10 level. Across factor ratings, with the exception of Anxiety, and across global ratings, the pattern of group means was consistent, with methylphenidate favored in comparison with imipramine. The comparability of the behavioral effects of imipramine and methylphenidate is thus in question, with the need for further research, with control and double-blind procedures in effect, definitely indicated.

Hypothesis 2b

Hypothesis 2b concerned the equal effects of imipramine and methylphenidate treatments on the cognitive functioning of MBD children. Again, across teachers' global ratings of

academic achievement, the pattern of group means was consistent, with methylphenidate favored in comparison with imipramine; the group differences were significant at the .10 level in the categories of Spelling and Arithmetic. Thus, the comparability of imipramine and methylphenidate treatments in terms of cognitive effects is also in question, and further research is indicated within the cognitive as well as the behavioral area.

## Application and Research Implications

In terms of the short-term, clinical treatment of MBD children, the data and intercorrelations of scores from behavioral and cognitive measures have shown pharmacological therapy to be a more efficient mode of treatment, in terms of the breadth of the effects obtained and the professional time invested, than the behavioral procedure as implemented in the present study. Efficiency, of course, is an important consideration in the treatment of the multiple problem MBD child, especially when a situation has become such as to necessitate crisis intervention. Thus, the suggestion as to the lack of comparability of pharmacological and behavioral treatments in this respect is of significance, and warrants further investigation under controlled and blind procedures.

Efficiency, however, while a major consideration in the evaluation of treatments, is not the only consideration, and, at times, may even be a somewhat irrelevant consideration. It is not applicable in cases when the child is a

nonresponder to the medication. With reference to the present study, based on teachers' global ratings, as high as 40% and 60% of imipramine subjects, and 20% and 30% of methylphenidate subjects, were rated as unchanged in various categories of behavior and academic achievement, respectively. Efficiency, also, in no way relates to those instances in which a child's medical status precludes pharmacological treatment, or when his reaction is so adverse as to necessitate a discontinuance of the treatment; it does not answer the question of the long-term influence of drugs on development; and it is unlikely to satisfy objections as to the increasing reliance on biochemical manipulation as a means of coping with problem behaviors. The usefulness of a non-drug, behavioral treatment cannot be assessed, therefore, solely by the criterion of efficiency.

The few follow-up studies available, as reviewed in Chapter 1, do suggest that behavioral and cognitive difficulties continue into the teen years even for those MBD children previously treated pharmacologically. Wiens and Anderson (1971) conclude on the basis of follow-up data now available that the concomitant application of psychological and pharmacological treatments appears imperative. The limited research available on the combination of behavioral and drug treatment does indicate that concomitant application of procedures results in a greater reduction of hyperactivity than does either procedure in itself (Sprague

& Christensen, 1972). There is also the suggestion from work by Conrad and Insel (1967) and Weiss et al. (1971) that the effectiveness of pharmacological treatment is related to the quality of the parent-child relationship; thus, as Cantwell (1972) indicates, there is need for professionals to include consideration of this relationship in the plan of treatment for the MBD child. It is apparent, then, that there is sufficient reason and considerable need for continued research into the application of behavioral programs with MBD children, both independent of and in conjunction with pharmacological treatment.

Pragmatically, as is now the case, it is likely that a substantial number of MBD children will continue to be referred to clinics; and given the limitations of personnel and time, behavioral treatment, whether alone or in combination with pharmacological treatment, will continue to be clinic-based for a portion of these children. Even when school-based programs are a possibility, again pragmatically with limitations of personnel, time, and funding, it is likely that many such programs will not be able to approach the procedural sophistication with regard to apparatus and personnel of much of the behavioral research as reported in the literature. It is felt that suggestions are provided by the present study as to the clinic-based and, to a limited extent, the school-based implementation of behavioral programs. Although it was not possible to isolate statistically the components of the behavior

modification treatment, it was the author's impression that some aspects of the treatment more than others appear to offer promise.

The work directly with the behavior modification subjects, focusing on behavioral control, did not appear to be especially beneficial. In listening to the tape recordings of the sessions, it was the author's impression that for the majority of subjects, the discussion and rehearsal of behaviors were difficult; subject-initiated verbalizations were limited, and responses in answer to or at the suggestion of the experimenter were likewise meager. Behavior rehearsal had been reported by Gittelman (1965) to be a useful technique in the modification of impulsive and aggressive behaviors. Gittelman's subjects were older (12 to 13 years) than the subjects of the behavior modification group, and age may have been a factor in the difficulties encountered with the behavior rehearsal procedure in the present study. It has also been suggested by Pollack (1968) that, given the language deficits of many MBD children, a procedure heavily reliant on speech, as was the behavioral control training, may be more successful with groups other than MBD children.

Using the criterion of Porteus Maze performance, the cognitive control training with behavior modification subjects was not found to be an effective procedure. Results, thus, did not support the findings of the Palkes et al. (1968) study, which had reported a reduction in impulsivity using a similar verbally mediated procedure with the Porteus Maze as

the criterion. What specific factors may have contributed to the discrepancy between studies, such as time, tasks, or reinforcement procedures, warrant further research before such training can be considered a viable treatment technique. Process measures of time and errors during training would be beneficial in determining whether a reduction in impulsivity had, in fact, been obtained, but had failed to generalize across tasks or time. It has been suggested that simple delay training may be a necessary but not sufficient condition for sustained reflective responding (Siegelman, 1969; Zelniker, Jeffrey, Ault, & Parsons, 1972). What may be needed is explicit training in attention deployment or search strategy rather than just in tempo; without the correction of strategy, delay alone may only lead to increased distractibility.

In reference to the training sessions with parents, based solely on parents' reports as there were no direct home observations, there appeared to be a wide variability in the degree and consistency with which programs were actually implemented. It was the author's impression that the success of the procedure, as reported by parents, was directly related to the extent and quality of the implementation. That parents do vary in their willingness and/or ability to implement programs, and that success is dependent upon implementation rather than discussion, is certainly not surprising, and has been reported by other investigators (Patterson & Gullion, 1971a; Salzinger, Feldman, and Portnoy,

1970). In the interest of furthering such implementation, as also indicated by these investigators, it is suggested that the observation and recording of behavior by parents be made definite requirements of the training, and that provisions be included in the program for the experimenter's cueing or modeling of techniques, and when necessary, his direct intervention with the child in the home and/or clinic setting.

While there are reports in the literature of limited generalization of behavioral change from home to school (O'Leary et al., 1967), it has more generally been found that home and school settings are functionally independent (Wahler, 1969b). Certainly, the preferred strategy in obtaining classroom improvement is to work specifically within the school setting, involving teachers, peers, and parents in the behavioral program (Patterson et al., 1969). Within the context of the present study, when parents did arrange for circumscribed programs within the classroom, it appeared that the likelihood for improvement in the behaviors so targeted was increased. For example, with a daily note sent home contingent upon one subject's completion of arithmetic, it was found that on the Follow-Up School Report the teacher had rated Arithmetic achievement as improved although other behavioral and academic categories were rated unchanged or worse. Thus, even though treatment may originate in the clinic, if school behaviors are of concern, it is suggested that efforts, whenever

possible, be made for the implementation of behavioral programs directly within the school setting. It may be noted that in regard to other possible predictors of either behavioral or academic change, examining the relationship between pretreatment measures and teachers' global ratings for the behavior modification subjects, no stable pattern of intercorrelations was obtained.

With reference to behavioral procedures, one further consideration is offered. The treatment interval of the present study was limited to 6 weeks for all groups. While this is within the traditional time period of short-term pharmacological research, the 6-week interval, with one session per week, falls at the lower end of the 5 to 15 weekly sessions Patterson and Gullion (1971a) have found to be necessary for parents to obtain adequate behavioral control, and below the 8 to 10 sessions recommended even when direct classroom intervention procedures, with instrumentation, are in use (Patterson et al., 1969). In terms of research and implementation of behavioral procedures with MBD children, it would thus be suggested that the time allotted for behavioral treatment, even when in conjunction with pharmacological treatment, be extended, determined by the behavioral model in effect.

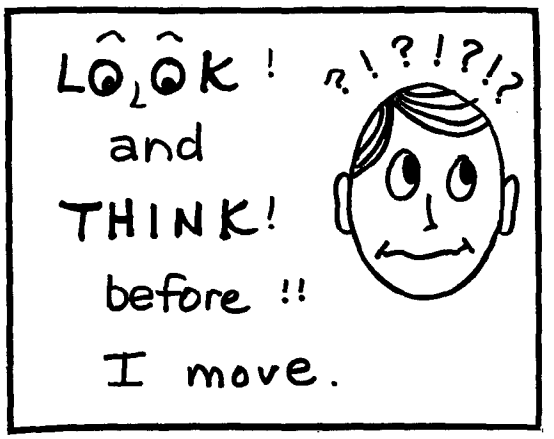
APPENDIX A

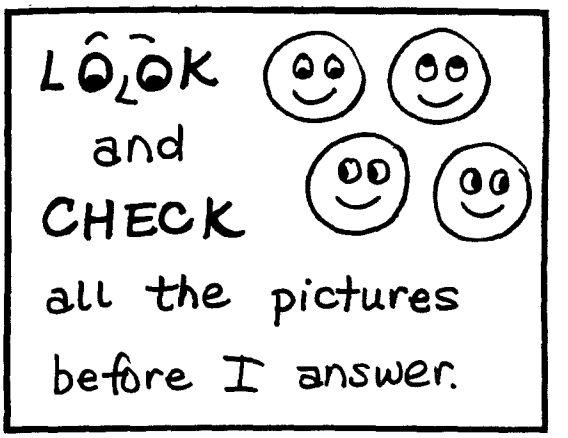
Training Tasks

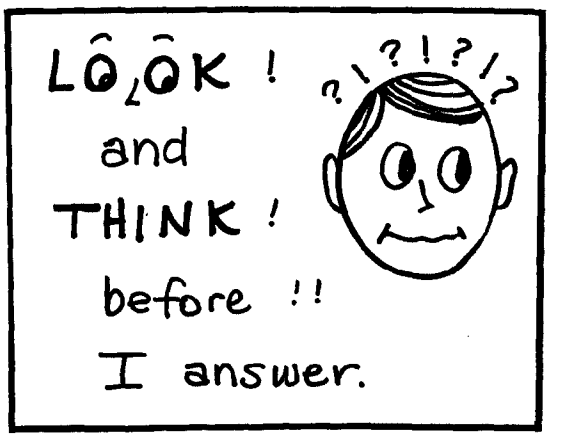
| Sessions | Tasks |
|---|---|
| 1 & 4 | Trail Making Test:<br>Part A<br><br>Columbia Mental Maturity Scale:<br>Items 1-39, 42, 43, 47, 48, 50, 51, & 57<br><br>Illinois Test of Psycholinguistic Abilities:<br>Visual Closure - D, 1, & 2 |
| 2 & 5 | Trail Making Test:<br>Part B<br><br>Leiter International Performance Scale:<br>Items V-2, VI-2, & VI-4<br><br>Illinois Test of Psycholinguistic Abilities:<br>Visual Closure - 3 & 4 |
| 3 & 6 | Frostig FG:<br>Exercises 10, 15, & 19<br><br>Leiter International Performance Scale:<br>Items VIII-2, IX-3, & X-2<br><br>Children's Embedded Figures Test:<br>Tent Series (session 3)<br>House Series (session 6) |

APPENDIX B

Visual Reminder Cards



## APPENDIX C

### Command and Reinforcement Procedures for Cognitive Control Training.

During sessions 1 through 4, the subjects verbalized aloud the commands printed on the visual reminder cards prior to responding to any subpart of a task: Card 1 for trail making tasks from the Trail Making Test (Reitan, 1955) and the Frostig Program for the Development of Visual Perception (Frostig & Horne, 1964); Card 2 for matching pictures from the Columbia Mental Maturity Scale (Burgemeister, Blum, & Lorge, 1959) and the Leiter International Performance Scale (Leiter, 1948); and Card 3 for embedded figures from the Illinois Test of Psycholinguistic Abilities (Kirk, McCarthy, & Kirk, 1968) and the Children's Embedded Figures Test (Karp & Konstadt, 1971).

During sessions 5 and 6, self-directed commands were read silently.

For each response correct upon initial attempt during sessions 1 through 3, subjects received a poker chip, later exchanged for M&M candies.

During sessions 4 and 5, poker chips were dispensed on an FR 3 schedule of reinforcement.

During session 6, no chips were dispensed during the performance of training tasks, but upon the completion of the session, subjects were reinforced based on the experimenter's record of correct responses.

APPENDIX D

Practice Assignments

| Week | Day | Assignment |
|---|---|---|
| I. | 1 | Trail Making |
| | 2 | Frostig FG: Exercise 22 |
| | 3 | Frostig FG: Exercise 23 |
| | 4 | Frostig PS: Exercise 24 |
| | 5 | Frostig FG: Exercise 21 |
| | 6 | Frostig PS: Exercise 23 |
| II. | 1 | Frostig FG: Exercise 16 |
| | 2 | Frostig PS: Exercise 7 |
| | 3 | Frostig PS: Exercise 6 |
| | 4 | Frostig PS: Exercise 3 |
| | 5 | Frostig FG: Exercise 17 |
| | 6 | Frostig FG: Exercise 25 |
| III. | 1 | Frostig PS: Exercise 22 |
| | 2 | Frostig FG: Exercise 37 |
| | 3 | Highlights Hidden Pictures |
| | 4 | Frostig PS: Exercise 10 |
| | 5 | Frostig FG: Exercise 40 |
| | 6 | Highlights Hidden Pictures |
| IV. | 1 | Highlights Hidden Pictures |
| | 2 | Frostig FG: Exercise 27 |
| | 3 | Frostig FG: Exercise 63 |
| | 4 | Highlights Hidden Pictures |
| | 5 | Frostig FG: Exercise 44 |
| | 6 | Frostig FG: Exercise 60 |
| V. | 1 | Highlights Hidden Pictures |
| | 2 | Frostig FG: Exercise 39 |
| | 3 | Frostig FG: Exercise 41 |
| | 4 | Highlights Hidden Pictures |
| | 5 | Frostig PS: Exercise 4 |
| | 6 | Frostig FG: Exercise 62 |

APPENDIX E

Parent's Questionnaire Observations

| Factor | Observation |
|---|---|
| Conduct Disturbance | Bullying<br>Bragging and boasting<br>Sassy to grown-ups<br>Mean<br>Fights constantly<br>Picks on other children<br>Blames others for his mistakes |
| Anxiety | Afraid of new situations<br>Afraid of people<br>Afraid of being alone<br>Worries about illness and death<br>Shy<br>Afraid others do not like him<br>Is afraid to go to school |
| Hyperactivity | Inattentive, easily distracted<br>Constantly fidgeting<br>Cannot be left alone<br>Always climbing<br>A very early riser<br>Will run around between mouthfuls at meals<br>Unable to stop a repetitive activity<br>Acts as if driven by a motor |
| Learning Problem | Has no friends<br>Is not learning<br>Does not like to go to school<br>Will not obey school rules |
| Somatic Complaints | Awakens at night<br>Headaches<br>Stomach aches<br>Vomiting<br>Aches and pains |

APPENDIX E (continued)

| Factor | Observation |
|---|---|
| Obsessional Traits | Everything must be just so<br>Things must be done same way every time<br>Sets goals too high |
| Antisocial Behavior | Stealing from parents<br>Stealing at school<br>Stealing from stores and other places<br>Gets into trouble with police |
| Muscular Tension | Gets stiff and rigid<br>Twitches, jerks, etc.<br>Shakes<br>Lets himself get pushed around by other children |

## APPENDIX F

### Reliability and Validity Data for the Parent's Questionnaire

Development of the Parent's Questionnaire (Conners, 1970) was based on data from a study with hyperkinetic, neurotic, and normal children, the purpose of which was to determine whether parent ratings of symptomatology could serve to distinguish among the groups.

Subjects ranged in age from 5 to 16 years. The clinical sample consisted of 166 hyperkinetic and 137 neurotic children seen at an outpatient psychiatric clinic. The normal sample consisted of 365 children attending public schools, with any child with a psychiatric history or known adjustment problem excluded.

Parents of all subjects completed a 73-item symptom rating scale. Information concerning the reliability of the ratings was not provided.

The data were treated by rotated principal components factor analyses, resulting in six factors: aggressive conduct disorder; anxious-inhibited; antisocial; enuresis; psychosomatics; and anxious-immature.

Between patient and control groups, there appeared to be general agreement in the general factor structure of symptomatology, but the severity of symptomatology was higher for the hyperkinetic and neurotic subjects.

Between hyperkinetic and neurotic groups, significant differences in severity were indicated on factors of

aggressive conduct disturbance, antisocial, and enuresis, with the hyperkinetic subjects being higher in each of these categories.

APPENDIX G

School Report Observations

| Factor | Observation |
|---|---|
| Conduct Disturbance | Sullen or sulky<br>Quarrelsome<br>Acts "smart"<br>Destructive<br>Steals<br>Lies<br>Temper outbursts, explosive and unpredictable behavior<br>No sense of fair play<br>(-) Submissive<br>Defiant<br>Impudent<br>Stubborn<br>Uncooperative |
| Distractibility | Coordination poor<br>Inattentive, easily distracted<br>Fails to finish things he starts - short attention span<br>Daydreams<br>Appears to be easily led<br>Appears to lack leadership |
| Anxiety | Overly sensitive<br>Overly serious or sad<br>Submissive<br>Shy<br>Fearful<br>(-) Attendance problem |
| Hyperactivity | Constantly fidgeting<br>Hums and makes other odd noises<br>Restless or overactive<br>Excitable, impulsive<br>Disturbs other children<br>Teases other children or interferes with their activities |

## APPENDIX H

### Reliability and Validity Data for the School Report

Development of the School Report (Conners, 1969) was based on data from a pharmacological study of dextroamphetamine and placebo treatment of children with behavior disorders, hyperactivity, or poor attention spans associated with learning problems.

The sample consisted of 82 boys and 21 girls, with a mean age of 117.5 months, referred to an outpatient psychiatric clinic.

Prior to and during the last week of a 3-week treatment period, teachers completed a 39-item rating scale. Frequency distributions indicated that each of the items was responded to at least 10 per cent of the time, and thus all were retained for further analysis.

The pre-drug questionnaires were subjected to a rotated principal components factor analysis, and resulted in five factors: aggressive conduct disorder; daydreaming-inattentive; anxious-fearful; hyperactivity; and a poorly defined sociability factor. The highest loaded items on each factor were retained to give factor-based scores.

An indication of the reliability of the scale was provided by the correlations, ranging from .72 to .91, between pre- and posttreatment scores for the placebo group; for the drug group, pre - post correlations ranged from .63 to .71.

Drug and placebo groups did not differ on any factors before treatment. Pre- to posttreatment change scores were computed for each group, and the net differences between groups were evaluated by t tests. Results indicated significant changes with drug treatment on all five factors, as compared with the changes in placebo scores.

Inasmuch as changes with drug treatment had been confirmed by objective measures and other forms of rating (although these were not elaborated), it was concluded that the School Report reflects real changes rather than artifacts of measurement.

APPENDIX I

Analysis of Covariance Summary Table for Parent's Questionnaire Factor Ratings

| Factor | Source: 1/2 (I + M) - B; Error | df: 1; 24 | | Source: I - M; Error | df: 1; 24 | |
|---|---|---|---|---|---|---|
| | $MS_{treat}$ | $MS_{error}$ | F | $MS_{treat}$ | $MS_{error}$ | F |
| Conduct Disturbance | .15 | 8.78 | .01 | 5.59 | 8.78 | .63 |
| Anxiety | 1.79 | 1.95 | .91 | .29 | 1.95 | .15 |
| Hyperactivity | 4.92 | 19.17 | .25 | .40 | 19.17 | .02 |
| Learning Problem | .13 | 2.91 | .04 | 3.91 | 2.91 | 1.34 |
| Somatic Complaints | 3.51 | 3.37 | 1.04 | .00 | 3.37 | .00 |
| Obsessional Traits | 2.49 | 3.18 | .78 | 6.46 | 3.18 | 2.03 |
| Antisocial Behavior | .43 | .15 | 2.86 | .28 | .15 | 1.86 |
| Muscular Tension | 2.88 | 2.52 | 1.14 | .09 | 2.52 | .03 |

Note.—Degrees of freedom for Error is 24 rather than 25 due to missing data in the methylphenidate group.

APPENDIX J

Analysis of Covariance Summary Table for School Report Factor Ratings

| Factor | Source: 1/2 (I + M) - B; df: 1 / 25 | | | Source: I - M; df: 1 / 25 | | |
|---|---|---|---|---|---|---|
| | $MS_{treat}$ | $MS_{error}$ | F | $MS_{treat}$ | $MS_{error}$ | F |
| Conduct Disturbance | 61.91 | 33.63 | 1.84 | 38.98 | 33.63 | 1.15 |
| Distractibility | 15.64 | 9.11 | 1.71 | 7.75 | 9.11 | .85 |
| Anxiety | .09 | 3.07 | .03 | .77 | 3.07 | .25 |
| Hyperactivity | 21.98 | 10.70 | 2.05 | 34.16 | 10.70 | 3.19* |

*$p < .10$.

*APPENDIX K*

*Analysis of Variance Summary Table for Teachers' Global Ratings of Behavior*

| Category | Source: 1/2 (I+M) - B, df: 1, Error: 26 | | | Source: I - M, df: 1, Error: 26 | | |
|---|---|---|---|---|---|---|
| | $MS_{treat}$ | $MS_{error}$ | F | $MS_{treat}$ | $MS_{error}$ | F |
| Classroom Behavior | 5.34 | .60 | 8.87 *** | .45 | .60 | .74 |
| Overall Behavior | 5.47 | .79 | 6.90 ** | 1.25 | .79 | 1.57 |
| Group Participation | 5.73 | .31 | 18.20 **** | 1.25 | .31 | 3.96 * |
| Authority Attitude | 8.52 | 1.09 | 7.79 *** | 4.05 | 1.09 | 3.70 * |

* $p \leq .10$.
** $p \leq .05$.
*** $p \leq .01$.
**** $p \leq .001$.

APPENDIX L

Pairwise Contrasts of Imipramine versus Behavior Modification and Methylphenidate versus Behavior Modification for the Teachers' Global Ratings of Behavior (Newman-Keuls Technique)

| Category | $s_m$ | Critical Value $\alpha = .05$ 1 rank separation | $\bar{Y}_I - \bar{Y}_B$ |
|---|---|---|---|
| Classroom Behavior | .24 | .79 | .77 |
| Overall Behavior | .28 | .91 | .68 |
| Group Participation | .18 | .57 | .71 * |
| Authority Attitude | .33 | 1.07 | .72 |

| Category | $s_m$ | Critical Value $\alpha = .05$ 2 ranks separation | $\bar{Y}_M - \bar{Y}_B$ |
|---|---|---|---|
| Classroom Behavior | .24 | .98 | 1.07 * |
| Overall Behavior | .28 | 1.13 | 1.18 * |
| Group Participation | .18 | .71 | 1.21 * |
| Authority Attitude | .33 | 1.33 | 1.62 * |

* $p < .05$.

APPENDIX M

Analysis of Variance Summary Table for Teachers' Global Ratings of Academic Achievement

| Category | Source: 1/2 (I+M) - B; df: 1; Error: 26 | | | Source: I - M; df: 1; Error: 26 | | |
|---|---|---|---|---|---|---|
| | $MS_{treat}$ | $MS_{error}$ | F | $MS_{treat}$ | $MS_{error}$ | F |
| Reading | .73 | .58 | 1.25 | .80 | .58 | 1.36 |
| Spelling | 2.44 | .41 | 5.85 ** | 1.25 | .41 | 2.99 * |
| Arithmetic | 1.41 | .46 | 3.08 * | 1.80 | .46 | 3.91 * |

* $p < .10$.
** $p < .05$.

APPENDIX N

Pairwise Contrasts of Imipramine versus Behavior Modification and Methylphenidate versus Behavior Modification for the Teachers' Global Ratings of Academic Achievement (Newman-Keuls Technique)

| Category | $s_m$ | Critical Value $\alpha = .05$ 1 rank separation | $\bar{Y}_I - \bar{Y}_B$ |
|---|---|---|---|
| Spelling | .20 | .66 | .37 |
| Arithmetic | .21 | .69 | .17 |
| Category | $s_m$ | Critical Value $\alpha = .05$ 2 ranks separation | $\bar{Y}_M - \bar{Y}_B$ |
| Spelling | .20 | .82 | .87 * |
| Arithmetic | .21 | .86 | .77 |

* $p < .05$.

APPENDIX O

Analysis of Covariance Summary Table for Psychological Test Variables

| Test | Source: 1/2 (I + M) - B | | df: 1 | Source: I - M | | df: 1 |
|---|---|---|---|---|---|---|
| | Error | | 25 | Error | | 25 |
| | $MS_{treat}$ | $MS_{error}$ | F | $MS_{treat}$ | $MS_{error}$ | F |
| WECHSLER | | | | | | |
| Verbal | 23.59 | 26.62 | .88 | 63.80 | 26.62 | 2.39 |
| Performance | 16.58 | 64.87 | .25 | 23.32 | 64.87 | .36 |
| Full Scale | 17.31 | 40.55 | .42 | 4.68 | 40.55 | .11 |
| Information | 3.37 | 2.03 | 1.65 | .45 | 2.03 | .22 |
| Comprehension | .45 | 6.63 | .06 | 18.14 | 6.63 | 2.73 |
| Arithmetic | 9.75 | 4.96 | 1.96 | .05 | 4.96 | .01 |
| Similarities | 5.19 | 8.32 | .62 | 6.10 | 8.32 | .73 |
| Vocabulary | 1.36 | 1.95 | .69 | .14 | 1.95 | .07 |

APPENDIX O (continued)

| Test | Source: 1/2 (I+ M) - B | | df: 1 | Source: I - M | | df: 1 |
|---|---|---|---|---|---|---|
| | | | df: Error 25 | | | df: Error 25 |
| | $MS_{treat}$ | $MS_{error}$ | F | $MS_{treat}$ | $MS_{error}$ | F |
| Digit Span | 10.33 | 3.61 | 2.85 | .05 | 3.61 | .01 |
| Picture Completion | 1.65 | 5.24 | .31 | 5.30 | 5.24 | 1.01 |
| Picture Arrangement | 11.85 | 5.15 | 2.29 | .00 | 5.15 | .00 |
| Block Design | 6.84 | 3.08 | 2.22 | .00 | 3.08 | .00 |
| Object Assembly | 40.93 | 5.35 | 7.64 ** | .29 | 5.35 | .05 |
| Coding | .02 | 6.22 | .00 | .52 | 6.22 | .08 |
| WIDE RANGE | | | | | | |
| Reading | 9.82 | 22.11 | .44 | 60.24 | 22.11 | 2.72 |
| Spelling | 2.28 | 20.55 | .11 | 12.43 | 20.55 | .60 |
| Arithmetic | .00 | 34.83 | .00 | 9.18 | 34.83 | .26 |

APPENDIX O (continued)

| Test | Source: 1/2 (I + M) - B; Error | df: 1; 25 | | Source: I - M; Error | df: 1; 25 | |
|---|---|---|---|---|---|---|
| | $MS_{treat}$ | $MS_{error}$ | F | $MS_{treat}$ | $MS_{error}$ | F |
| PORTEUS MAZE | | | | | | |
| Test Age | 6.38 | 3.18 | 2.00 | .04 | 3.18 | .01 |
| Qualitative Score | 4873.10 | 988.12 | 4.93 ** | 116.61 | 988.12 | .11 |
| BENDER GESTALT | | | | | | |
| Errors | 3.88 | 3.60 | 1.07 | 2.21 | 3.60 | .61 |
| VMI | | | | | | |
| Forms Passed | .23 | 7.38 | .03 | .21 | 7.38 | .02 |
| DRAW-A-PERSON | | | | | | |
| Standard Score | 11.81 | 50.54 | .23 | 164.53 | 50.54 | 3.25 * |

* $p < .10$.
** $p < .05$.

APPENDIX P

Adjusted Group Means and Standard Deviations for Behavior Factor Ratings

| Factor | | Treatment Group | | |
|---|---|---|---|---|
| | | Imipramine | Methylphenidate | Behavior Modification |
| PARENT'S QUESTIONNAIRE | | | | |
| Conduct Disturbance | M | 5.8 | 6.8 | 6.4 |
| | SD | 2.1 | 3.1 | 3.4 |
| Anxiety | M | 2.9 | 3.2 | 2.5 |
| | SD | 1.0 | 1.6 | 1.5 |
| Hyperactivity | M | 8.4 | 8.1 | 7.3 |
| | SD | 4.9 | 3.9 | 4.0 |
| Learning Problem | M | 3.2 | 2.3 | 2.6 |
| | SD | 1.6 | 1.9 | 1.5 |
| Somatic Complaints | M | 1.5 | 1.5 | 2.3 |
| | SD | 1.5 | 1.9 | 1.9 |
| Obsessional Traits | M | 2.6 | 1.4 | 1.4 |
| | SD | 2.6 | 1.1 | 0.9 |
| Antisocial Behavior | M | 0.3 | 0.0 | 0.4 |
| | SD | 0.3 | 0.2 | 0.5 |
| Muscular Tension | M | 1.5 | 1.6 | 0.8 |
| | SD | 1.5 | 2.1 | 0.9 |
| SCHOOL REPORT | | | | |
| Conduct Disturbance | M | 9.1 | 6.3 | 10.9 |
| | SD | 6.0 | 4.5 | 6.4 |
| Distractibility | M | 6.3 | 5.0 | 7.2 |
| | SD | 3.1 | 2.1 | 3.6 |

APPENDIX P (continued)

| Factor | | Treatment Group | | |
|---|---|---|---|---|
| | | Imipramine | Methylphenidate | Behavior Modification |
| Anxiety | M | 2.3 | 2.7 | 2.7 |
| | SD | 1.8 | 1.9 | 1.4 |
| Hyperactivity | M | 8.5 | 5.9 | 9.1 |
| | SD | 3.0 | 3.2 | 3.4 |

APPENDIX Q

Group Means and Standard Deviations for

Teachers' Global Ratings

| Category | | Treatment Group | | |
|---|---|---|---|---|
| | | Imipramine | Methylphenidate | Behavior Modification |
| BEHAVIOR | | | | |
| Classroom | M | 4.0 | 4.3 | 3.2 |
| | SD | 0.8 | 0.8 | 0.7 |
| Overall | M | 3.8 | 4.3 | 3.1 |
| | SD | 0.8 | 0.8 | 1.0 |
| Group | M | 3.6 | 4.1 | 2.9 |
| | SD | 0.5 | 0.6 | 0.6 |
| Authority Attitude | M | 3.5 | 4.4 | 2.8 |
| | SD | 1.2 | 0.8 | 1.1 |
| ACADEMIC ACHIEVEMENT | | | | |
| Reading | M | 3.7 | 4.1 | 3.6 |
| | SD | 0.8 | 0.6 | 0.9 |
| Spelling | M | 3.6 | 4.1 | 3.2 |
| | SD | 0.7 | 0.7 | 0.4 |
| Arithmetic | M | 3.4 | 4.0 | 3.2 |
| | SD | 0.5 | 0.8 | 0.7 |

APPENDIX R

Adjusted Group Means and Standard Deviations

for Psychological Test Variables

| Test | | Treatment Group | | |
|---|---|---|---|---|
| | | Imipramine | Methylphenidate | Behavior Modification |
| WECHSLER | | | | |
| Verbal | M | 101.1 | 104.7 | 101.0 |
| | SD | 5.2 | 5.3 | 4.6 |
| Performance | M | 111.1 | 108.9 | 108.3 |
| | SD | 7.2 | 10.1 | 5.4 |
| Full Scale | M | 106.3 | 107.3 | 105.1 |
| | SD | 6.0 | 7.6 | 4.7 |
| Information | M | 10.2 | 10.4 | 9.6 |
| | SD | 1.2 | 1.6 | 1.3 |
| Comprehension | M | 9.7 | 11.6 | 10.4 |
| | SD | 1.7 | 3.4 | 2.0 |
| Arithmetic | M | 9.8 | 9.9 | 8.6 |
| | SD | 2.3 | 2.4 | 1.9 |
| Similarities | M | 10.4 | 11.5 | 11.9 |
| | SD | 2.9 | 2.7 | 3.0 |
| Vocabulary | M | 10.7 | 10.9 | 11.3 |
| | SD | 1.8 | 1.1 | 1.0 |
| Digit Span | M | 10.2 | 10.3 | 9.0 |
| | SD | 2.3 | 1.5 | 1.6 |
| Picture Completion | M | 11.6 | 10.6 | 11.6 |
| | SD | 1.8 | 2.8 | 2.0 |
| Picture Arrangement | M | 12.5 | 12.5 | 11.0 |
| | SD | 1.9 | 2.8 | 1.7 |

APPENDIX R

| Test | | Treatment Group | | |
|---|---|---|---|---|
| | | Imipramine | Methylphenidate | Behavior Modification |
| Block Design | M | 12.2 | 12.2 | 11.1 |
| | SD | 1.9 | 2.0 | 1.0 |
| Object Assembly | M | 10.9 | 10.7 | 13.4 |
| | SD | 2.1 | 2.7 | 1.8 |
| Coding | M | 10.2 | 9.9 | 10.0 |
| | SD | 2.4 | 2.6 | 2.2 |
| WIDE RANGE | | | | |
| Reading | M | 102.3 | 98.8 | 99.3 |
| | SD | 4.5 | 5.8 | 2.9 |
| Spelling | M | 92.7 | 94.3 | 94.1 |
| | SD | 4.1 | 5.4 | 3.4 |
| Arithmetic | M | 91.8 | 93.1 | 92.4 |
| | SD | 5.1 | 7.4 | 4.2 |
| PORTEUS MAZE TEST | | | | |
| Test Age | M | 12.0 | 12.1 | 11.0 |
| | SD | 1.7 | 1.6 | 2.0 |
| Qualitative Score | M | 77.2 | 72.4 | 102.9 |
| | SD | 32.8 | 31.6 | 27.2 |
| BENDER GESTALT | | | | |
| Errors | M | 4.2 | 3.6 | 4.7 |
| | SD | 2.2 | 1.4 | 2.0 |

APPENDIX R (continued)

| Test | | Treatment Group | | |
|---|---|---|---|---|
| | | Imipramine | Methylphenidate | Behavior Modification |
| VMI | | | | |
| Forms Passed | M | 14.0 | 14.2 | 13.9 |
| | SD | 3.2 | 2.2 | 2.4 |
| DRAW-A-PERSON | | | | |
| Standard Score | M | 97.8 | 91.9 | 93.5 |
| | SD | 8.4 | 6.9 | 4.3 |

APPENDIX S

Teachers' Global Ratings of Behavior—Percentage Change

| Rating | Treatment Group | | |
|---|---|---|---|
| | Imipramine | Methylphenidate | Behavior Modification |
| | Overall Behavior | | |
| Much Worse | 0 | 0 | 11 |
| Little Worse | 0 | 0 | 11 |
| Unchanged | 40 | 20 | 33 |
| Improved | 40 | 30 | 44 |
| Much Improved | 20 | 50 | 0 |
| | Group Participation | | |
| Much Worse | 0 | 0 | 0 |
| Little Worse | 0 | 0 | 22 |
| Unchanged | 40 | 10 | 67 |
| Improved | 60 | 70 | 11 |
| Much Improved | 0 | 20 | 0 |
| | Attitude Toward Authority | | |
| Much Worse | 0 | 0 | 0 |
| Little Worse | 0 | 0 | 11 |
| Unchanged | 60 | 30 | 56 |

APPENDIX S (continued)

| | Treatment Group | | |
|---|---|---|---|
| | Imipramine | Methylphenidate | Behavior Modification |
| Improved | 40 | 40 | 33 |
| Much Improved | 0 | 30 | 0 |

Note.—Cell entries are percent of subjects in each treatment group.

APPENDIX T

Teachers' Global Ratings of Academic Achievement—Percentage Change

| Rating | Treatment Group | | |
|---|---|---|---|
| | Imipramine | Methylphenidate | Behavior Modification |
| | Reading | | |
| Much Worse | 0 | 0 | 0 |
| Little Worse | 0 | 0 | 0 |
| Unchanged | 50 | 10 | 67 |
| Improved | 30 | 70 | 11 |
| Much Improved | 20 | 20 | 22 |
| | Spelling | | |
| Much Worse | 0 | 0 | 0 |
| Little Worse | 0 | 0 | 0 |
| Unchanged | 50 | 20 | 78 |
| Improved | 40 | 50 | 22 |
| Much Improved | 10 | 30 | 0 |
| | Arithmetic | | |
| Much Worse | 0 | 0 | 0 |
| Little Worse | 0 | 0 | 11 |
| Unchanged | 60 | 30 | 56 |

APPENDIX T (continued)

| Rating | Treatment Group | | |
|---|---|---|---|
| | Imipramine | Methylphenidate | Behavior Modification |
| Improved | 40 | 40 | 33 |
| Much Improved | 0 | 30 | 0 |

Note.—Cell entries are percent of subjects in each treatment group.

APPENDIX U

Matrices of Significant Intercorrelations of Cognitive Change Scores, Behavioral Change Scores, and Teachers' Global Ratings

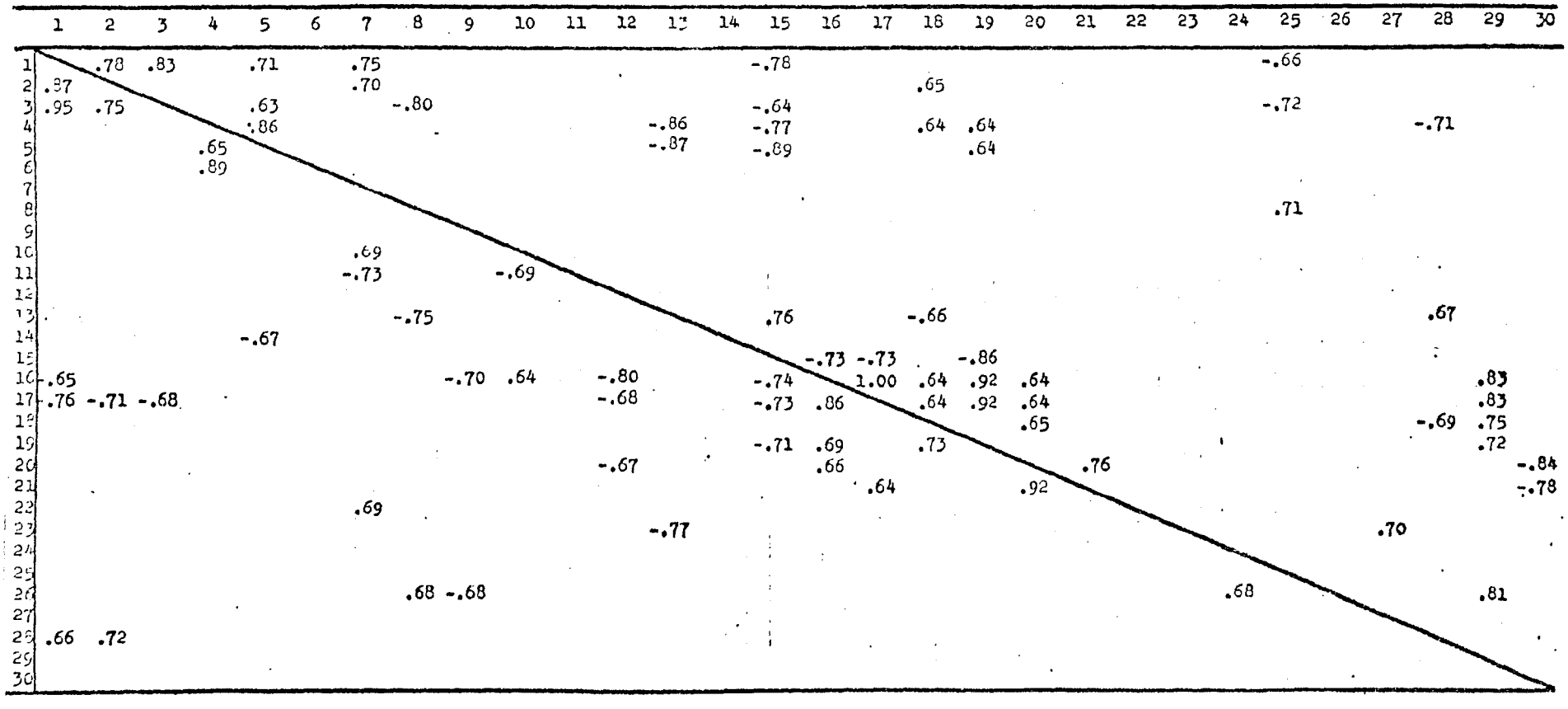
Variable Labels

| Number | Variable |
|---|---|
| 1 | WISC - Full Scale |
| 2 | WISC - Verbal |
| 3 | WISC - Performance |
| 4 | Wide Range - Reading |
| 5 | Wide Range - Spelling |
| 6 | Wide Range - Arithmetic |
| 7 | Porteus Maze - Test Age |
| 8 | Porteus Maze - Qualitative |
| 9 | Bender Gestalt |
| 10 | VMI |
| 11 | Draw-A-Person |
| 12 | School Report - Conduct Disturbance |
| 13 | School Report - Distractibility |
| 14 | School Report - Anxiety |
| 15 | School Report - Hyperactivity |
| 16 | Teachers' Global Rating - Classroom Behavior |
| 17 | Teachers' Global Rating - Overall Behavior |
| 18 | Teachers' Global Rating - Group Participation |
| 19 | Teachers' Global Rating - Authority Attitude |
| 20 | Teachers' Global Rating - Reading Achievement |
| 21 | Teachers' Global Rating - Spelling Achievement |
| 22 | Teachers' Global Rating - Arithmetic Achievement |
| 23 | Parent's Questionnaire - Conduct Disturbance |
| 24 | Parent's Questionnaire - Anxiety |
| 25 | Parent's Questionnaire - Hyperactivity |
| 26 | Parent's Questionnaire - Learning Problem |
| 27 | Parent's Questionnaire - Somatic Complaints |
| 28 | Parent's Questionnaire - Obsessional Traits |
| 29 | Parent's Questionnaire - Antisocial Behavior |
| 30 | Parent's Questionnaire - Muscular Tension |

APPENDIX U (continued)

Matrix of Significant Intercorrelations *

Imipramine and Methylphenidate Groups



| | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | .78 | .83 | | .71 | | .75 | | | | | | | | -.78 | | | | | | | | | | -.66 | | | | | |
| 2 | .87 | | | | | | .70 | | | | | | | | | | | .65 | | | | | | | | | | | | |
| 3 | .95 | .75 | | | .63 | | | -.80 | | | | | | | -.64 | | | | | | | | | | -.72 | | | | | |
| 4 | | | | | .86 | | | | | | | | -.86 | | -.77 | | | .64 | .64 | | | | | | | | | -.71 | | |
| 5 | | | | .65 | | | | | | | | | -.87 | | -.89 | | | | .64 | | | | | | | | | | | |
| 6 | | | | .89 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | | | | | .71 | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | .69 | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | | | | | | | -.73 | | | -.69 | | | | | | | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 13 | | | | | | | | -.75 | | | | | | | .76 | | | -.66 | | | | | | | | | | .67 | | |
| 14 | | | | | -.67 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | | | | | -.73 | -.73 | | -.86 | | | | | | | | | | | |
| 16 | .65 | | | | | | | | -.70 | .64 | | -.80 | | | -.74 | | 1.00 | .64 | .92 | .64 | | | | | | | | | .83 | |
| 17 | .76 | -.71 | -.68 | | | | | | | | | -.68 | | | -.73 | .86 | | .64 | .92 | .64 | | | | | | | | | .83 | |
| 18 | | | | | | | | | | | | | | | | | | | | .65 | | | | | | | | -.69 | .75 | |
| 19 | | | | | | | | | | | | | | | -.71 | .69 | | .73 | | | | | | | | | | | .72 | |
| 20 | | | | | | | | | | | | -.67 | | | | .66 | | | | | .76 | | | | | | | | | -.84 |
| 21 | | | | | | | | | | | | | | | | | .64 | | | .92 | | | | | | | | | | -.78 |
| 22 | | | | | | | .69 | | | | | | | | | | | | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | | -.77 | | | | | | | | | | | | | | | .70 | | |
| 24 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 26 | | | | | | | | .68 | -.68 | | | | | | | | | | | | | | | .68 | | | | | .81 | |
| 27 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 28 | .66 | .72 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

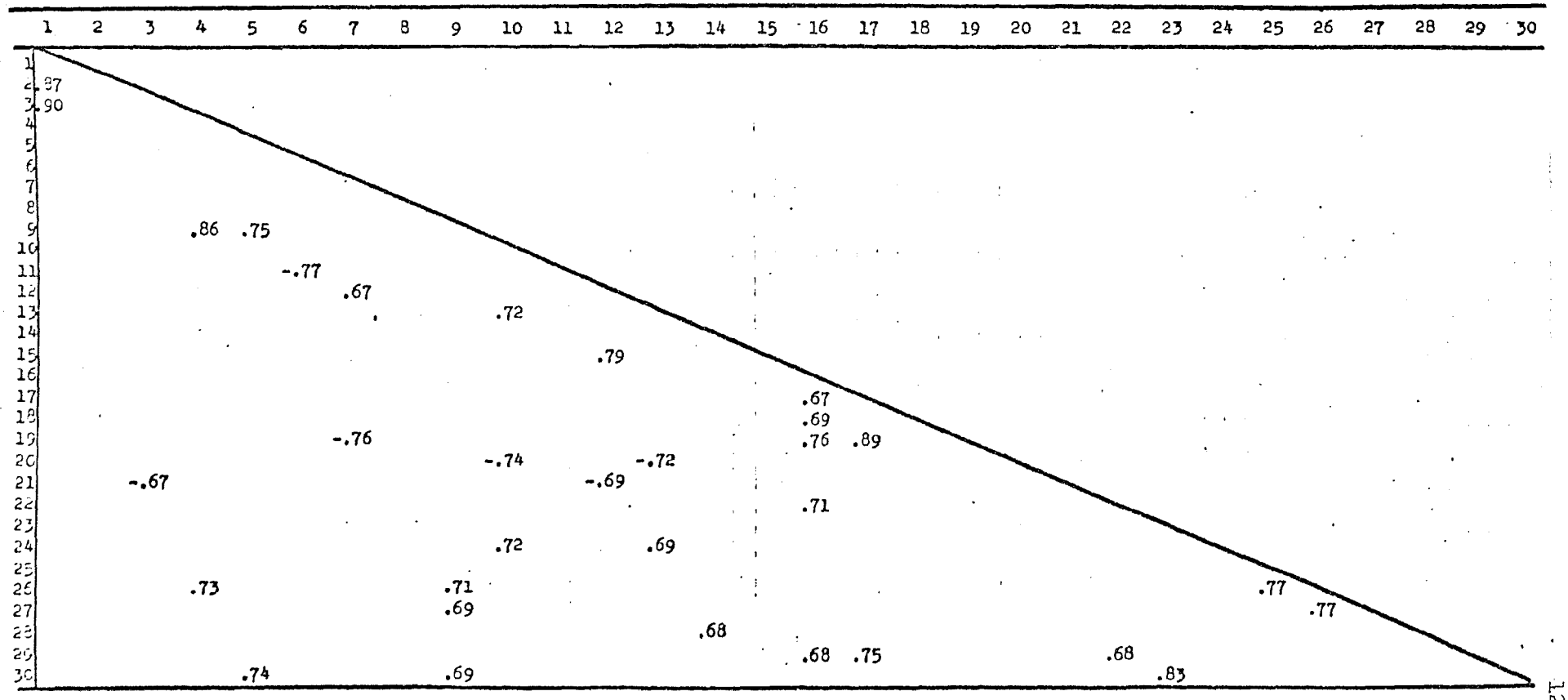
Note.—Correlations for the imipramine group are presented below the diagonal; correlations for the methylphenidate group above the diagonal.

* $p < .05$.

APPENDIX U (continued)

Matrix of Significant Intercorrelations *

Behavior Modification Group




* $p < .05$.

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