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# EFFECT OF TWO LEVELS OF METHYLPHENIDATE HYDROCHLORIDE FOR HYPERKINETIC CHILDREN ON MEASURES OF ATTENTION AND MOTHER-CHILD INTERACTION.

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# EFFECT OF TWO LEVELS OF METHYLPHENIDATE HYDROCHLORIDE FOR HYPERKINETIC CHILDREN ON MEASURES OF ATTENTION AND MOTHER-CHILD INTERACTION

by

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## ABSTRACT

### EFFECT OF TWO LEVELS OF METHYLPHENIDATE HYDROCHLORIDE FOR HYPERKINETIC CHILDREN ON MEASURES OF ATTENTION AND MOTHER-CHILD INTERACTION

The intent of the present investigation was to test the finding that specific dose response relationships determine the way in which Ritalin improves the social and attention behaviours of hyperkinetic children. It was predicted that attention would benefit from a low dose of Ritalin while parent-child interactions and parent ratings of the child's behaviour would improve optimally at high dosage levels.

Twelve hyperkinetic boys (seven to twelve years) were observed under three medication conditions— placebo, Ritalin 0.3 mg/kg, and Ritalin 1.0 mg/kg for all dependent measures. A Latin square design with repeated measures permitted the examination of each subject under all dosage conditions.

The attention task employed consisted of a novel continuous performance task. Three scores were derived including: Attention Correct, Errors of Omissions, and Errors of Commission. A cooperative drawing task was employed with mothers and their children. Verbal interactions

were recorded and later scored under the following mother-child categories: Direction, Explanation, Praise, Criticism, Off-Task remarks, and Impulse-Control suggestions. A Total as well as Abbreviated form of the Conners' Parent Rating Scale was completed at the end of each testing day.

No main effects for medication were noted for scores on the Attention task, nor was medication level observed to exert an influence on any of the categories of mother-child interaction. However, for both sets of variables, active medication conditions were observed to optimally enhance the performance of greater numbers of subjects than placebo. Medication did influence the drug-sensitive items of the abbreviated Conners' scale, but meaningful interpretation of one significant analysis out of seventeen dependent measures was felt to be difficult.

Both the attention and social interaction measures were considered, in retrospect, to be too stimulating and lacking in achievement focus to demonstrate well documented facilitation of performance for this sample of hyperkinetic subjects.

The observation of wide intersubject variation in optimal dosage levels of medication called into question the universality of dose response relationships across samples of subjects; the present results as well as previous investigations suggest that an individual's response to medication may vary considerably from group dose response

relationships for specific target behaviours.

Further research was encouraged to differentiate the dose response specificity of Ritalin for groups and for individuals. The acute laboratory trial of medication response with each subject serving as his own control appears to be a useful tool for examining drug response. It was suggested that in future examinations a more representative sample of medication dosage levels be included to prevent the inappropriate classification of favourable responders.

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TABLE OF CONTENTS

LIST OF TABLES

## LIST OF FIGURES

# CHAPTER I

## INTRODUCTION

Approximately three (Cole, 1975) to ten per cent (Laufer & Shetty, 1975) of school age children suffer from a disorder which has been most appropriately characterized by an inability to "stop, look, and listen" (Douglas, 1972). Representing up to forty per cent of the referrals of children to mental health clinics (Satterfield & Dawson, 1971), hyperkinesis is a disorder about which much confusion and speculation abound. Although little is known regarding specific etiology, many have assumed an organic or biochemical dysfunction within the brain (Gross & Wilson, 1974; Levy, 1966; Wender, 1975) to be responsible for the impulsive, driven behaviour common to the disorder. Central nervous system (CNS) stimulant medication, known to improve cognitive functioning in fatigued adults, was successfully introduced by Bradley (1937) to the treatment of the hyperkinetic child. Since that time, the use of CNS stimulants with hyperkinetic children has increased greatly due to the well-documented calming effects (Millichap, 1975), and general improvement of behaviour and learning in school (Stewart & Olds, 1973). Methylphenidate Hydrochloride (Ritalin) has been the most

widely used and researched CNS stimulant in work with children. However, the clinical utility and experimental investigation of this drug have been hampered by a notable absence of rigorous scientific methodology. Hence, little is known regarding the specific costs and benefits of pharmacotherapy with hyperkinetic children. Effective treatment strategy is contingent upon a more precise definition of the disorder.

Early Definitions

The hyperkinetic child is not a recent invention. Kahn and Cohen (1934) first described a condition of "organic drivenness" in which hyperkinesis, as exemplified by choreiform or tic-like movements of the face, trunk, and extremities, was the primary symptom. Additional symptoms included impulsivity in action and verbalization, motor awkwardness and clumsiness, and a generalized inability to inhibit activity. Damage to the brain-stem, produced as a sequelae to encephalitis epidemica, prenatal encephalopathy or injury, birth trauma, or merely constitutional variation, was posited as the root of the behavioural syndrome. At about the same time, Bond and Smith (1935) independently described a group of children who presented with similar clinical features as suffering from "post-encephalitic behaviour disorder". In all cases a precipitating traumatic event such as encephalitis or head injury could be identified and shown to be followed later in childhood by behaviour which tended "in the

direction of restlessness, disobedience, aggressiveness, loss of fear of punishment, truancy, stealing, (and) mawkish affection (p. 18)". Asphyxia in infancy was similarly identified as a precursor of later childhood hyperkinesis and attention difficulties (Rosenfeld & Bradley, 1948).

As Kahn and Cohen's paper revealed (1934), there was no small debate as to the specific mechanism responsible for the apparently "driven" behaviour. While Kahn and Cohen favoured an interpretation which attributed the hyperkinesis and associated difficulties to a "defective brain-stem", speculation included at the end of their discussion suggested that cortical injury, which would result in a failure of inhibitory controls over "lower-order"centres, might produce a similar clinical picture.

A far larger group of children has been identified which shares identical clinical features to the "post-encephalitic" or "driven" child in the absence of obvious organic pathology. Levy (1966) felt that ascription of psychological etiology to such children by default was a reprehensible practice, attributable to the fascination of psychiatry with more colourful but less useful psychodynamic formulations. Laufer et al. (1957) recognized the error in ignoring the possible organic basis of hyperkinesis in such children, and felt that the term "hyperkinetic impulse disorder" would more accurately describe all children who presented with the striking behavioural characteristics already described. A sample of institutionalized

hyperkinetic youngsters, and control children who presented with mixed clinical diagnoses, were chosen for study by Laufer et al. . Even in the absence of an organic precipitant to the impulse disorder, there was evidence to suggest that the hyperkinetic youngsters suffered from a disturbance of function to the diencephalon. In an examination of photometrazol threshold[1], hyperkinetic children demonstrated a lower threshold than their controls. Low metrazol threshold had been shown by earlier investigators (Gastaut & Hunter, 1950) to accompany damage to the diencephalon. Morruzi and Magoun (1949) had previously identified "a system of reticular relays ascending to the diencephalon" which mediated between afferent stimulation travelling from the receptors to the cortex. Laufer et al., observing the "normalizing" influence of amphetamines on the metrazol thresholds of their hyperkinetic sample, postulated that CNS stimulants served to regulate synaptic transmission within the diencephalon, thus preventing a flooding of the cortex with stimulation and subsequent hyperkinetic behaviour in the child.

Early opinion then, considered the hyperkinetic youngster to be suffering from cortical overarousal as a result of damage or impairment of function of synaptic transmission within the reticular formation. Pharmacotherapy with CNS

[1] The amount of metrazol required to produce a myoclonic jerk of the forearms and EEG spike wave bursts, when exposed to a flickering stroboscopic light within a critical frequency range.

stimulant medication quickly became the treatment of choice for hyperkinetic youngsters, due not only to the remarkable calming effect on the hyperkinetic behaviour, but also because of the assumed regulation of an underlying brain dysfunction.

Diagnostic Problems

As might be expected, the inclusion of clearly organic cases of hyperkinesis with those of uncertain etiology led to a lack of precision in the differential diagnosis of the hyperkinetic syndrome. Most of the children without obvious brain pathology came to the attention of school personnel due to their poor academic performance despite average intelligence (Douglas, 1972; Flynn & Rapoport, 1976), or their high frequency, off-task behaviour within the classroom. Others were referred to their pediatricians or psychiatric outpatient clinics by frustrated parents who could no longer cope alone with the impulsive, driven behaviour of their young charges. Minimal brain dysfunction (MBD) became a popular term to describe this large group of children who shared both symptomatology as well as a favourable response to the CNS stimulants with those children for whom organic etiology was well established (Levy, 1966; Wender, 1975). Opponents of the MBD hypothesis have been quick to question the utility of such a label in light of the extreme variation of symptoms and absence of any of the typical organic signs

within this heterogeneous group of children (Dubey, 1976; Klein & Gittleman-Klein, 1975). For example, perceptual-motor problems (Wender, 1975), soft neurological signs (Gross & Wilson, 1964), and physical anomalies (Rapoport & Quinn, 1975) have been observed as common but not exclusive features of hyperkinesis. Findings from studies of electroencephalographic (EEG) records of hyperkinetic and normal children have failed to substantiate the claim that hyperkinetic youngsters are identifiable on the basis of EEG abnormalities (Dubey, 1976). Douglas (1972) maintains that many of the presumed dysfunctions, which have served to substantiate the equivalence of hyperkinesis with MBD, represent "clinical myths"; there exist many hyperkinetic children who show no evidence of other presumably organic conditions. The problem has arisen since clinicians tend to see those children for whom there are a number of presenting problems, and these may include in addition to hyperkinesis, perceptual-motor difficulties, mental retardation, or memory impairment. Whether all hyperkinetic children share these deficits is a matter for empirical investigation. In defense of his position, Wender (1975) has argued that MBD, similar to rheumatic fever or schizophrenia, may present with a varied clinical picture despite an apparently uniform, underlying pathogenesis. However, the acceptance of Wender's argument, which does not seem to be essential in understanding the phenomena of hyperkinesis, serves to dismiss the variability in the clinical

picture in much the same way that the concept of penetrance operates in the field of genetics (Rosenthal, 1970). It is quite probable that the etiology of hyperkinesis is a multivariate puzzle. Presumably, then diet (Feingold, 1975), and other environmental and psychological factors (Stableford et al., 1976) interact with biological predisposition to produce the varied clinical picture seen in this disorder.

Levy (1966) held the opinion, similar to Wender (1975), that variability in presenting symptomatology, although annoying, did not present a serious problem to the experienced diagnostician. However, despite his recommendation that all sources of information, including parental histories, physical and neurological examinations, and psychological testing be gleaned for significant clues, Levy was unable to provide any firm guidelines regarding the critical decision as to the presence or absence of the disorder. Several clinicians have attested to the complexities involved in rendering a reliable diagnosis of hyperkinesis (Cole, 1975; Douglas, 1972; Klein & Gittleman-Klein, 1975; Weiss, 1975).

Aside from the confounding influence of multiple etiology, two broad classes of factors have been posited as contributing to the lack of uniformity in the presenting features of the hyperkinetic disorder: those attributable to variables within the child, and those features of the environment to which the child is responsive. Kahn and Cohen (1934) for example, in describing their sample of brain-stem-injured

children, remarked that ultimate clinical dysfunction was dependent not only on the extent of the brain damage, but also on the mediating influence of the personality and the controlling factor of the environment. The rapid deterioration of behaviour in some of these children after leaving the highly structured institutional programme demonstrated the powerful effect of external variables which serve to inhibit or exacerbate a potential for hyperkinesis. The interaction of environmental and intraindividual factors in determining clinical appearance was clearly described by Campbell et al. (1977a, 1977b) in a follow-up study of preschool hyperkinetic children initially observed by Schliefer et al. (1975). Two subgroups of hyperkinetic subjects were identified: "trues" and "situationals". While both subgroups were differentiated from normal controls in terms of their short attention span and high activity level, the "trues" were observed to be consistently more hyperactive across situations which differed in the amount of structure present. Both groups, however, were felt to be suffering from the same disorder due to their identical response to stimulant medication and their similar clinical appearance in some situations. Hence, there appears in this example not only the influence of individual (subgroup) variation, but also the interaction of an environmental component in producing the clinical symptoms. There seems to be little doubt that even the most hyperactive of hyperkinetic children will be indistinguishable from normal

children in terms of activity level, provided that the situation is either highly stimulating or novel for the child (Klein & Gittleman-Klein, 1975; Zentall, 1975). There should be little surprise then, that to attempt to diagnose a child on the basis of his activity level during a clinical interview could render highly unreliable results. Accurate diagnosis seems to be more difficult with younger children due to the similarity of many of the signs of the hyperkinetic disorder, such as hyperactivity and short attention span, with the behaviours typical of the immature, developing, normal child (Lambert et al., 1976; Schliefer et al., 1975; Thomas et al., 1968).

The most frequently employed method to establish a diagnosis of hyperkinesis in the past has been the detection of pathognomonic signs in the child's history. Despite the obvious value of parental reports, the poor reliability of such accounts suggests that corroboration by independent sources is required (Klein & Gittleman-Klein, 1975). Clinicians are at a decided disadvantage to other individuals such as teachers when it comes time to identify the hyperkinetic child, due to the absence of a control group with which the child's behaviour can be referenced (Conners, 1969). The introduction of standardized behaviour rating scales for use with parents (Conners, 1970) and teachers (Conners, 1969) has helped the clinician greatly by providing him with additional data with which he can make an informed decision regarding diagnosis.

The routine use by several clinicians (Katz et al., 1975; Lambert et al., 1976; Sandoval et al., 1976) of multiple informants and more objective reporting devices should help further to reduce the interference of the clinician's theoretical bias in the delivery of reliable and valid diagnoses. If the more effective systems of data collection are to be of use though, there must be some rationale for evaluating the data. Owing to the variability of symptomatology both within and across children, diagnosis will never be an easy matter. However, the experimental delineation of the precise deficits observed in hyperkinetic children has provided valuable information to aid the clinician in his task.

Experimental Definitions

As a result of the complex difficulties in establishing definitive diagnostic criteria through the usual clinical means, the hyperkinetic child has been placed under intensive laboratory examination. Fortunately, much of the research has been guided by the same interdisciplinary teams which have been involved in the diagnosis and treatment of hyperkinetics.

Activity level. Although traditionally, hyperactive, disorganized activity has been considered by clinicians to be the sine qua non for the diagnosis of hyperkinesis (Gross & Wilson, 1974; Millichap, 1975), others have recognized the extreme and at times oppositional clinical pictures evident in the histories of hyperkinetic youngsters, especially with respect

to activity level (Laufer & Shetty, 1975). Douglas (1972) has wisely cautioned that "...hyperactivity is only one of a constellation of critical symptoms (p. 260)".

To determine whether hyperkinetic children could be discriminated from normals on the basis of activity level, Sykes et al. (1971) recorded the movements of forty, five to twelve-year-old hyperkinetic youngsters during a continuous performance task[2] by use of a stabilimetric cushion[3]. As compared to a matched group of normal control children, the hyperkinetic subjects were discovered to display greater motor restlessness; and further, while both groups were observed to exhibit increased motor activity with the passage of time, hyperkinetic youngsters became fidgety significantly more quickly than controls. Zentall and Zentall (1976) similarly found with their sample of sixteen, seven to eleven-year-old hyperkinetic children, that as the novelty of the experimental task wore off, activity level, as measured by wrist and ankle activity meters, rapidly increased. By manipulation of background lighting, wall decorations, and piped-in music, they also demonstrated that the activity level of hyperkinetic subjects was significantly greater under low rather than high stimulation conditions. These findings go far to explain

[2] Subjects must respond to a visually-presented, preselected target letter which is buried within a sequential list of letters, presented via a television monitor.

[3] Microswitches connected to the seat of the child's chair recorded left-right and front-rear movements during the task.

the difficulty experienced by clinicians in discriminating the hyperkinetic child on the basis of office interview behaviour alone: not only is the child only seen for a brief time, but also the clinician's office is usually a novel, highly stimulating environment for the child.

The activity level of most preschoolers is often greater than that of older children, in part due to the younger child's lack of socialization. However, parental reports have suggested that some preschool children may be distinguished from normally active agemates: "They never seem to walk", or "They are always on the go"; they are not merely healthy, active youngsters according to parents and neighbours. Such descriptions fit the twenty-eight, three to four-year-old children diagnosed as hyperkinetic in a study of activity level conducted by Schliefer et al. (1975). Matched controls were compared to their hyperkinetic peers on several interpersonal activities within both a "free play" and "structured play" situation. Unexpectedly, the blind ratings of two psychiatrists revealed that when children were left to wander freely about a playroom full of toys, two teachers, and five agemates (each class consisted of three hyperkinetic and three control children), the activities of hyperkinetic subjects was indistinguishable from that of controls. That is, not only were the raters unable to identify the hyperkinetic sample at a greater than chance level, but also ratings on specific behaviours including aggressiveness, approaching peers

and teachers, and even engagement in prolonged activities, failed to differentiate the two groups. However, with children instructed to remain seated at a desk with only one activity, raters were able to discriminate hyperkinetic children from controls in terms of both out-of-seat or "up" behaviour, and absence-from-desk or "away" activities: hyperkinetic preschoolers spend a greater time engaged in such purposive but off-task activities than do normal children who follow explicit directions more closely. Despite the expected finding that hyperkinetic children as a group were more active than normal controls, Schliefer et al. discovered that hyperkinetic youngsters were not uniformly hyperactive. On the basis of nursery school teachers' observations, ten of the twenty-eight hyperkinetic youngsters were judged to be extremely hyperactive, and thus the label "true" was assigned; the remaining eighteen, who were judged to be hyperactive by the parents but not teachers, were called "situationals". Although all hyperkinetic youngsters considered together were more active ("up" behaviour) and less occupied with on-task behaviours (more "away" activities) than controls during structured play, subgroup differences were also apparent. "Situationals" were considered to be more like controls in their ability to engage in on-task activities; whereas "trues" had to be brought back to their desk significantly more often than either "situationals" or controls. A three-year follow-up of these children (Campbell et al., 1977b) revealed that preschoolers

identified as hyperkinetic were later rated as more active than normals by their grade-school teachers. Both "true" and "situational" subgroups tended to engage in more disruptive behaviours, including physical and verbal interference with ongoing lessons, than controls. Similar to earlier observations (Schliefer et al., 1975) though, "trues" continued to be differentiated from both "situationals" and controls on both activity level and off-task behaviours: "trues" were more active and less involved with ongoing activities of the class than both "situationals" and normal children.

In sum, it appears that activity level per se may, under some circumstances, be useful in discriminating hyperkinesis in children. That is, some hyperkinetic youngsters are decidedly more active than normal children under conditions which restrict their activities to one pre-defined task. An increase in activity level and subsequent unrelated, off-task activities will depend upon: initial novelty of the task; length of time involved; age of the child; and degree of severity of the hyperkinetic disorder.

Impulsivity. Several clinicians have observed that the activity of hyperkinetic children differs from others not only quantitatively but also in quality. Reports from clinicians consistently identify an impulsive, driven aspect in the behaviour of hyperkinetic children (Campbell, 1975; Kahn & Cohen, 1934; Katz et al., 1975; Laufer et al., 1957; Levy, 1966). Douglas (1975) suggested that a central feature to

the hyperkinetic syndrome was a faulty cognitive style characterized by an inability to "stop, look, and listen":

> They tend to react with the first idea that occurs to them or to those aspects of the situation which are the most obvious or compelling (p. 201).

Impulsivity, like activity level, may be assessed in a variety of ways, but the most usual tasks involve measures of latency and accuracy of response to visually presented puzzles or problems; impulsivity being defined by shorter latency in combination with higher error scores. Campbell et al. (1971) found that hyperkinetic children responded more rapidly and with less accuracy than matched controls when requested to select a familiar visual stimulus from among four common figures. Subsequent comparison of subjects on a test requiring identification of a simple geometric design, which was buried in a complex visual overlay (Embedded Figures Test), led to the finding that hyperkinetic youngsters were more "field dependent" than their normal counterparts. Thus, the hyperkinetic child's impulsivity may be partially explained by his propensity for being seduced by the most attractive, but not necessarily most salient, stimulus presented to him. Similar results have been obtained with a sample of preschool hyperkinetics (Schliefer et al., 1975). The tendency to respond prematurely was clearly demonstrated by Sykes et al. (1971) who observed that hyperkinetics gave more incorrect responses to non significant stimuli on a continuous performance task

than controls. Not unexpectedly, when provided with a longer interval to consider the accuracy of their response, hyperkinetic youngsters, perhaps owing to their inability to monitor their own performance, failed to benefit whereas controls increased the accuracy of their responding. According to Cohen et al. (1971), part of the hyperkinetic's impulsivity may stem from a lack of inhibitory control. These investigators observed that when instructed to respond in a delayed reaction time experiment with button presses, hyperkinetic children emitted significantly more impulsive motor responses (button presses) in anticipation of the signal, than controls.

As was mentioned with regard to activity level, certain conditions within the environment have been identified which bear a relation to impulsivity. For example, the exploratory research of Douglas (1975) has demonstrated that impulsivity is intimately related to the operative reinforcement contingency: non contingent reinforcement and even partial reinforcement schedules exacerbate impulsivity in hyperkinetic children, while continuous reinforcement and negative feedback for incorrect responding serve to reduce impulsive responses. Conditions conducive to impulsive responding may curiously be present in the typical classroom, where rewards tend to be delivered for both positive and negative behaviours, and at a relatively low frequency. The hyperkinetic's impulsivity guaranties reward for bad behaviour. While most classes have not been able to provide the consistently low

teacher-student ratio necessary to implement one hundred per cent reinforcement schedules, a more practical intervention has been suggested which is deficit-oriented. Self-verbalization techniques, which provide the impulsive child with required mediational skills for more efficient problem-solving, have served to reduce impulsive responding in groups of both normal impulsive children (Debus, 1970; Michenbaum & Goodman, 1971; Ridberg et al., 1971) and hyperkinetic youngsters (Douglas, 1975; Palkes et al., 1968).

Attention. In recent years, attributable in part to the clinician's increased reliance upon reports from the classroom, greater emphasis has been placed upon the apparent attention difficulties (Gross & Wilson, 1974; Laufer et al., 1957; Levy, 1966; Wender, 1975) and distractibility (Cole, 1975; Katz et al., 1975; Klein & Gittleman-Klein, 1975) of these youngsters. Douglas (1975) has cautioned, however, that assumed deficits have often been suggested on the basis of inadequate data. That is, a teacher's rating of a problem in attentiveness does not constitute the type of evidence required to differentiate an attention difficulty from overactivity.

Experimental investigation of attentional processes in hyperkinetic children has generally supported the hypothesis that these youngsters do experience difficulty, relative to normals, in maintaining a focus on stimuli presented to them. Sykes et al. (1971) for example, demonstrated that in a situation requiring sustained attention to visually-presented

material, hyperkinetic children were less able to identify target stimuli than controls. The continuous performance measure employed by Sykes et al. was reported to be especially sensitive to brief lapses in attention, thought to be typical of hyperkinetic children: the appearance of the critical stimuli is brief and unpredictable, whereas other measures permit prolonged exposure of the relevant stimuli. Douglas (1972) described the dilemma of the classroom teacher who at one time observes the hyperkinetic child to perform quite well while at other times his performance falls far below his demonstrated potential. What the teacher may not be sensitive to, however, is that in the former situation, the child was free to examine the problem at his own speed, while in the latter condition, the problem was presented rather quickly on only one occasion. The contradiction in performance may lead the teacher to erroneously assume that the child is not attention-impaired, but rather is wilfully refusing to attend to and benefit from instruction.

The nature of the attention deficit was more clearly elucidated in a delayed reaction time study by Cohen and Douglas (1972). Considering skin conductance as a measure of autonomic reactivity, and a reliable component of the orienting reflex[4]

[4] The orienting reflex consists of several physiological and behavioural changes within the organism which occur in response to changes in external stimulation and which suggest that the organism is attending to or preparing in some way to respond to the stimulus.

(OR), they observed that hyperkinetics and normals did not differ under a condition of passive observation; there was no difference in either intensity or habituation of the OR when subjects did not have to actively respond to the stimulation. However, when subjects were required to identify each relevant stimulus from irrelevant information following an alerting signal, not only were hyperkinetics less effective in terms of behavioural response, but also their ORs were less intense and tended to habituate faster. Cohen and Douglas thus concluded that hyperkinetics, while not unresponsive to their environment, do experience difficulty in focusing their attention. Hyperkinetic youngsters then, are less able to make use of instructions since their level of autonomic arousal lacks the sensitivity and persistence of their normal counterparts.

Distractibility. While the above identified deficit in attention has been supported by other researchers (Zambelli et al., 1977), there has been no confirmation of the related assumption that hyperkinetic children are distractible. Zentall (1975) suggested that clinicians have often assumed hyperkinetics to be distractible based upon the observation of increased impulsivity and activity in complex, structured situations. Such clinicians, he felt, were working from the hypothesis that the hyperactivity was being caused by the child's inability to handle the overload of stimulation produced by distraction within the classroom. In a later experiment, which controlled intensity of the visual and auditory complexity of

the background, Zentall and Zentall (1976) observed no detrimental effects resulting from the presence of more intense stimulation. Similarly, Sykes et al. (1971) failed to obtain any differential deterioration of performance between hyperkinetics and normal controls on a continuous performance task in which an auditory distractor was employed. Therefore, rather than being distracted by his environment, the hyperkinetic child fails to attend to the relevant aspects of the problem situation. He searches for stimulation (Zentall, 1975) but because he is unable to focus on appropriate dimensions of a situation, his behaviour is incorrectly assumed by observers to be disorganized and haphazard (Douglas, 1972).

Secondary symptomatology. Although the hyperkinetic child differs from other children in only a few areas, it may be assumed that these areas affect his experience. The preceding discussion admits that the final clinical picture will depend upon factors within the child as well as the environment. However, the attention deficit seems to be the most persistent and disabling problem for the child, and is felt by some clinicians to be the pivotal feature of the disorder (Douglas, 1972, 1975; Zentall, 1975; Zentall & Zentall, 1976). His nervous system seems unable to focus on and respond to important events outside of himself. Unable to identify what is required of him, the hyperkinetic child, despite adequate intelligence, finds compliance with demands of parents, learning in a quickly-paced classroom, or fitting into the local

peer group an impossible task. To the outside observer, the hyperkinetic child in this position appears to be dull, distractible, and even malevolent.

To extend the reasoning suggested above, many of the problems exhibited by hyperkinetic children are explicable when reference is made to their demonstrable deficit in attentional processes. The presence of other problems, however, as has already been discussed, is highly variable, thus contributing to the confusion felt by clinicians when faced with diagnostic concerns. Not only is it probable that the primary difficulties in attention, impulse control, and activity will lead to the development of other problems for the child, but also it is equally possible that problems existing in the child's personality make-up and external environment will serve to exacerbate the attentional difficulties or interact to produce secondary symptomatology (Klein & Gittleman-Klein, 1975).

Hyperkinetic children have frequently been viewed by clinicians as aggressive and destructive (Laufer & Shetty, 1975; Levy, 1966) in their interactions with others. Nursery school observations of hyperkinetic three and four-year-olds confirmed that relative to control and "situationally" hyperactive children, those children rated to be hyperactive at home and school ("trues") engaged in more aggressive acts toward peers. Paternite et al. (1976) have distinguished between primary versus secondary symptoms in hyperkinesis:

children who were found not to differ with regard to such primary symptoms as hyperactivity, inattention, and impulsivity were shown to vary widely as to aggressiveness of interactions with others. While socio-economic status was found to bear a relationship to the presence of aggressiveness (lower socio-economic levels were associated with higher ratings of interpersonal aggressiveness), parenting variables such as parental hostility and inconsistency were shown to contribute more heavily to the prediction of aggressiveness in the child. Schliefer et al. (1975) similarly reported greater parental frustration and use of physical punishment in the homes of "true" hyperactive children than "situationals"; these parents may be merely responding with punishment, albeit ineffectively, to the child's annoying primary symptoms. While it is difficult to establish a causal connection between parental management and child behaviour, the work of Bandura (1968) supports the hypothesis that the child will often fashion himself after the behaviour of those who are senior in status and power: the parents. A propensity to act-out aggressively would merely be exacerbated by the child's inability to inhibit his own responding and to anticipate the negative consequences of such behaviour for himself.

There is much evidence to suggest that interaction with a hyperkinetic child, particularly if intended to be goal-directed and purposeful, can be a highly frustrating experience which often results in negative consequences for the

child. For example, Campbell (1977a), in following up the preschoolers of Schliefer et al. (1975), found that hyperkinetic youngsters received more negative feedback from their teachers than controls; furthermore, the entire class of which the hyperkinetic child was a pupil received more negative feedback from the teacher than a comparable control classroom. It would appear, consistent with general systems theory (Von Bertalanffy, 1969), that "...the presence of a hyperactive child affects the ecology of a classroom... (Campbell et al., 1977a, p. 247)". Katz et al. (1975) have suggested that the hyperkinetic child, deviant in many respects from his classmates, is readily chosen as the class scapegoat. Although scapegoating is frequently used as a mechanism of stability in systems as a means of maintaining homeostatic balance (Messer, 1970), the adoption of such a role by the hyperkinetic child often incurs great costs for him. Not only does the hyperkinetic child start out with a handicap of having difficulty discriminating the complex rules and rituals which must be navigated for successful integration into the peer culture (Weiss, 1975), but also his fate as "class clown" or "trouble maker" prevents his being accepted by agemates for his whole person. Low self-esteem (Campbell, et al., 1977a; Paternite et al., 1976) as well as other emotional difficulties (Campbell, 1975; Campbell et al., 1977b; Conners, 1970) have frequently been viewed as sequelae to the chronically frustrating peer and family interactions which

are the lot of many hyperkinetic children.

Both qualitative as well as quantitative aspects of the parent-child interaction have been compared for groups of hyperactive, learning disabled, and normal boys (Campbell, 1975); mothers and their sons were observed during a brief problem-solving task in which the mother was free to help her son or not with the solution. Not only were mothers of hyperkinetic boys found to offer more negative or disapproving remarks than other mothers, as has already been suggested, but also more non specific suggestions (ie. "try something else"), more comments regarding impulse control (ie. "slow down"), and more encouragement. Relative to learning disabled boys and controls, hyperkinetic boys asked for more feedback and generally were more talkative during the task, reflecting often on what the task was and what they were doing. Campbell concluded that mothers of hyperkinetic youngsters tend to be aware of the difficulty experienced by the child in controlling impulses and organizing his plan of attack; they attempt to provide structure for the child and thereby insure his success. These results imply a congruency in the interaction of the mother and child. However, Campbell et al. (1977b) found a lack of reciprocity between the verbalizations of hyperkinetic youngsters and their mothers. Similar to Campbell (1975), they observed that "true" hyperactives requested more feedback from mothers than control children; and further, mothers of hyperkinetics offered more impulse-control suggestions.

However, the verbalizations of control children and their mothers tended to be related: maternal comments were related to the child's requests and other verbal behaviour. The comments of hyperkinetics and their mothers, in contrast, did not seem to share a reciprocity. Such low reward conditions would be optimal for enhancing impulsivity in the responses of the child, thus increasing the probability of parental dissatisfaction with the interaction.

The varied clinical appearance of children labelled hyperkinetic has led some clinicians to propose complex schemas which describe subtypes of the syndrome (Katz et al., 1975). However, just as all diabetics do not behave the same, nor does the same diabetic react in an identical fashion across situations, except with regard to the underlying physiological dysfunction, so too are hyperkinetic youngsters to be thought of as individuals first. Clinicians have been tempted to embrace the secondary symptomatology of the hyperkinetic syndrome as immutable features of the disorder. To reiterate Douglas's (1972) invocation, well-controlled study of the disorder is required to counteract the perpetuation of "clinical myths".

Response to Treatment

Prior to the introduction of chemotherapy for hyperkinesis, the fate of many of these youngsters was institutionalization. The grim reality facing clinicians of an earlier day

was described rather light-heartedly in a discussion group before the 1935 meeting of the American Psychiatric Association:

> Certainly I have no suggestions as to how such a child could be managed at home...In our selection, we (at the Franklin School) may have avoided the Parkinsonian group, the more severe organic cases and the feebleminded, but we haven't put up any bars against bad behaviour, and if there is any behaviour that is worse than the behaviour of the children we have taken in, I should hate to see it (Bond & Smith, 1935, p. 33).

The residential programme of Bond and Smith was described as a "constructive restrictive tolerant environment". A twenty-five per cent success rate was attributed to the unique combination of rigid structure and complete acceptance afforded each child; many of the other children in the programme showed for the most part satisfactory behaviour while in care, but quickly deteriorated at home.

Early pharmacotherapy. Since many of the children who have been hospitalized for behavioural problems also suffered from clearly defined organic conditions, such as epilepsy, they were given varied medications. While appropriate for some of their problems, the sedatives, tranquilizers, and anticonvulsants tended to exacerbate or merely mask hyperkinetic symptoms with an unnatural drugged appearance (Katz et al., 1975; Levy, 1966; Sprague et al., 1970). Bradley (1937) was the first to introduce CNS stimulant medication in the treatment of hyperkinesis. Aware of Benzedrine's dramatic

facilitation of motivation and attention in adults, Bradley reasoned that this medication might similarly enhance the attentive and learning skills of a group of hospitalized children who were presenting with a wide range of behaviour problems. While the effect of the medication was varied, owing in part to the lack of uniformity in the presenting problems, those children who were most active tended to become more complacent, subdued, and attentive. Rather than viewing the stimulant medication as having a "paradoxical" calming effect on hyperkinetic children, as has been suggested by later writers (Cole, 1975; Millichap, 1975), Bradley argued that the amphetamines and other CNS stimulants probably innervated inhibitory control centres, located at the level of the cortex. These inhibitory centres, once stimulated, would suppress the overactivity occurring in lower areas of the brain. This reasoning was in accord with the theorizing of Kahn and Cohen (1934) who felt that overactivity of the brain-stem was responsible for the observable impulsive and driven behaviour of the hyperkinetic child.

In the next forty years, CNS stimulants, particularly the amphetamines and later Ritalin, became the cornerstone of the treatment regime for the hyperkinetic syndrome (Weithorn & Ross, 1976); psychotherapy for the child and or parents, or remedial tutoring have generally been viewed as adjunctive to stimulant medication (Sandoval et al., 1976), although this view has received much opposition (Stableford et al.,

1976; Weithorn & Ross, 1976). While some clinicians argue for a new look at the hyperkinetic syndrome to evaluate the role of diet and other factors extraneous to the child (Feingold, 1973), there are a growing number of clinicians who feel the need for a more prescriptive approach to the problem in which medication, behaviour modification, or training in adaptive cognitive strategies would be employed as indicated (Douglas, 1975; Katz et al., 1975; Palkes et al., 1968).

Clinical efficacy. Despite the current controversy regarding the primacy of pharmacotherapy for the treatment of hyperkinesis, there seemed to be little doubt among clinicians that administration of the CNS stimulants, particularly Ritalin, yielded beneficial results for the hyperkinetic youngster both at home and in the classroom (Katz et al., 1975; Levy, 1966). A review of those articles which reported the clinical efficacy of stimulant medications in the treatment of hyperkinetic children suggested a mean "improvement" rate of seventy-four per cent for the amphetamines, and seventy-seven per cent for Ritalin (Barkley, 1977). Similarly, Knights and Hinton (1969) reported that following five months of treatment with Ritalin, parents (seventy-three per cent) as well as teachers (eighty-eight per cent) reported significant improvements in the children receiving active medication. However, as Barkley (1977) cautioned, these investigators also found evidence of a strong placebo effect: as high as sixty-seven per cent for teachers' ratings of children on placebo.

Less impressive records of improvement have been observed with preschool populations (Schliefer et al., 1975).

Evidence from follow-up studies has convinced Douglas (1975) that while overactivity in hyperkinetic children may attenuate during or after adolescence, impulsivity and attention problems remain; medication may thus be a long-term venture. However, Zambelli et al. (1977) reported that a few of their adolescent subjects demonstrated dramatic improvement over a three-year period in selective attention and cortical evoked potentials in response to auditory stimuli. Thus, there is the possibility that impairments of hyperkinetic children may attenuate with increased maturity. However, long-term prognosis has not usually met with great success. The use of medication is hence viewed as serving the short-term needs of the child. Of course, a long-term benefit accruing from the use of medication may be the prevention of serious emotional and academic problems rather than any cure of the proposed underlying disorder.

Side-effects. The possibility that the child may require medication for life, with little demonstration of benefit when not medicated, has led some writers to question the wisdom of using drugs "merely because they work" now. Cole's criticisms (1975) center about the unknown side-effects of prolonged use of stimulant medications. A concern of many parents is whether their child will develop an addiction to their medication or be more likely to turn to drugs as teenagers. Thus

far, there have been no reported cases of drug abuse in children attributable to their earlier therapy with stimulant medication (Katz et al., 1975). The abuse of stimulants by hyperkinetic children, while not an impossibility, is unlikely due to the relatively low dosages used with these children as compared to "street" dosages, and the different psychological effect: a "normalization" rather than a "high" (Cole, 1975).

Other side-effects of stimulant medication therapy have been reported, however. At higher dosage levels, Ritalin has been known to produce apathy, staring, irritability, and clinginess (Katz et al., 1975), particularly in preschoolers (Schliefer et al., 1975). Katz et al. (1975) suggested that the most frequent side-effects of stimulant medication, including sleep disturbance, anorexia, headaches, and abdominal discomfort, were usually short-lived and responsive to changes in dosage level: usually a reduction. At present there remains some controversy as to the weight-suppressant effect of this medication, as well as its suspected influence on cardiovascular functioning. In a widely cited paper, Safer and Allen (1975) concluded from their observation of growth curves that Ritalin contributed to a growth deficit of seventeen per cent of expected annual gain for hyperkinetic adolescents who had been receiving Ritalin for over two years in excess of 20 mg per day. However, when holidays were given from drug intake during the summer months, children receiving medication were able to catch up to expected levels of height and weight.

These investigators also recorded increases in resting pulse rate for children receiving medication, but habituation seemed to occur by the fifth month of administration. Aman and Werry (1975) have similarly noted an increase in pulse rate after acute administration of Ritalin 5 mg, at both rest and under work conditions. However, their measurement of respiration rate suggested that rather than displaying impaired physiological functioning, hyperkinetic children taking low doses of Ritalin actually used less oxygen through a decrease in respiration rate at work.

Side-effects of which even less is known are the psychological costs for the child of being identified as a problem requiring specialized psychiatric or medical intervention. It is apparent, however, from the comments of Campbell et al. (1977a), that the hyperkinetic child is already the focus of much negative attention quite early in his school career. If the result of medication is to reduce the frequency or intensity of aversive and stigmatizing interactions between the hyperkinetic child and his environment, then the specialized attention could be worth the costs. Unfortunately, this conclusion reinforces Cole's (1975) admonition that we use what works without knowing how, why, and at what hidden expense.

Administration procedure. Administration of most medications in clinical practice follows closely the method of titration as outlined by Katz et al. (1975). After preparatory interviews with the parents, and hopefully child as well,

a low dosage, usually Ritalin 5 mg b.i.d., is given to the parents to administer at home. Frequent telephone or office contacts with parents establish the nature of the child's response to medication. The dosage is gradually increased by 5 mg per administration, every three to seven days, until optimum clinical benefits, in the absence of side-effects, are observed. In the event of side-effects, the dosage is reduced to the previously beneficial level. Titration has received intelligent criticism for its lack of scientific rigor (Sprague & Sleator, 1975). Parental reports, which form the basis for the decision to increase or lower dosage, have been shown, Sprague and Sleator argued, to be of questionable reliability in the reporting of symptoms. In addition, they felt that the ceiling levels for dosage were more closely related in this procedure to the training philosophy of the clinician than to the effect of the drug on the child.

Ritalin is a "short-acting", CNS stimulant: effects on behaviour are noticeable within thirty to sixty minutes; optimum drug response is produced within two to four hours; clinical effects seem negligible after approximately six hours (Katz et al., 1975; Kinsbourne et al., 1977). Drug holidays have frequently been suggested as a means to reduce the possibility of growth suppression (Safer & Allen, 1975), and others have suggested that medication only be administered during school hours (Cole, 1975) if the child is not difficult to manage at home. Both of these suggestions have been criticized, as will

be discussed below, due to their neglect of the state-dependent effect on learning observed with this medication (Kinsbourne et al., 1977; Swanson & Kinsbourne, 1976). Again, although not typical of clinical practice, Kinsbourne et al. (1977) suggested the administration of Ritalin one-half hour before meals to increase the likelihood that the medication will be absorbed into the bloodstream rapidly, without interference from digestive processes.

Action of medication. Despite the sophisticated advances in the description of brain function over the past forty years (Milner, 1970), the presumed action of Ritalin within the nervous system, and even the proposed sites of its action, remain highly speculative. Bradley (1937) initially reasoned that, due to the quieting influence of stimulant drugs on hyperkinetic youngsters, the site of the drug action was the inhibitory control centres of the cerebral cortex. However, Laufer et al. (1957), observing that the amphetamines raised the abnormally low photo-metrazol threshold (an indication of dysfunction within the diencephalon) of hyperkinetic children, postulated that the amphetamines were active within the diencephalon, improving synaptic transmission of electrical impulses. Consistent with existing theories of hyperkinesis, Laufer et al. reasoned that the amphetamines lowered the rate of synaptic transmission within the diencephalon thereby decreasing the overarousal of the cortex. More recently, as the role of neurotransmitter substances has been recognized in the regulation

of emotions and behaviour, the hypothesis was formulated that CNS stimulants tended to increase the availability and uptake of norepinephrine, thus facilitating more efficient synaptic transmission within the brain (Wender, 1975). Satterfield and Dawson (1971) found that, contrary to the traditional theory of over arousal, hyperkinetics displayed lower basal skin conductance and smaller spontaneous galvanic skin responses (GSRs) to auditory stimuli than controls, thus suggesting lower arousal of the central nervous system. Stimulant medication tended to raise the levels of autonomic functioning to that of controls, presumably by stimulating the midbrain reticular activating system which was known to be involved in the maintenance of attention (Morruzi & Magoun, 1949).

Cohen and Douglas (1972) have argued against simplistic formulations regarding the underlying physiological mechanism in hyperkinesis; there is little support for the notion that hyperkinesis is due to either strictly over or under arousal of the cortex and lower centres. On a measure of passive attention to auditory stimuli, hyperkinetics did not differ from normal controls as reflected by a component of the orienting reflex (skin conductance level). However, Cohen and Douglas did observe that hyperkinetic youngsters were inferior to controls in terms of the orienting reflex when an active response was required, thus suggesting a more complex deficit of the brain's alerting mechanism. Zentall (1975) has suggested the adoption of a homeostatic model of physiological functioning

which accommodates much of the data with which both unipolar models of arousal struggle. For example, increasing the complexity of the background, and generally involving hyperkinetic children in an interesting task tends to reduce their hyperactivity (Zentall & Zentall, 1976). Similarly, Zentall (1975) suggests that stimulant drugs and other effective treatments such as behaviour modification, or cognitive training are successful because they provide the child with needed stimulation. However, there are occasions during which the child receives sufficient stimulation from his environment that he does not appear to be hyperactive, nor does he benefit from increasing his level of stimulation. In fact Comly (1971) has reported that providing stimulant drugs to hyperkinetic children during free-play situations tends to increase their level of activity.

Optimal stimulation theory seems to explain much of the hyperkinetic phenomena. However, our lack of understanding of not only the specific action and sites of activity of the stimulant medication, but also the complex workings of brain physiology, combine to render any hypothesis highly speculative.

Criticisms of medication. Anecdotal accounts of parents, teachers, and even physicians who have refused to "drug" children are familiar to the clinician who treats the hyperkinetic child. The erroneous assumption resulting in this attitude is that drugs such as Ritalin act as a "mental straight-jacket"

to control the child. Such criticisms are clearly fallacious and consequently are easily dealt with through education (Katz et al., 1975). More serious, however, is the criticism that stimulant medications are frequently administered in a cavalier fashion, with little attention directed to selection criteria as well as standards for improvements and follow-up (Katz et al., 1975; Weithorn & Ross, 1976).

The problem of identifying drug-responsive youngsters from the larger group of children presenting with hyperkinetic symptomatology has been well documented (Knights & Hinton, 1969); the usual recommendation has been to try each likely candidate on a home trial of medication following the titration procedure (Levy, 1966; Millichap, 1975; Wender, 1975). Klein and Gittleman-Klein (1975) argued that the identification of the subgroup of children responsive to CNS stimulants required a trial of medication since there was currently no reliable diagnostic tool to predict this propensity.

While it is a relatively simple matter to place all suspected cases of hyperkinesis on a brief trial of Ritalin, a more difficult and critical decision is how success is defined; great variability among clinicians has been observed regarding their criteria for improvement (Barkley, 1977). Contributing to the variation in the criteria have been the types of data available. That is, reports of parents, which are the most frequent source of information for the clinician, have been found to be highly unreliable (Sprague & Sleator,

1975, 1977). Weithorn and Ross (1976) have speculated that since parents often provide the impetus to the decision to place the child on medication, therefore their judgment as to whether the child is benefiting from medication would be highly biased. Parents as well as teachers may well feel that the child has improved if he seems more controlled, without any consideration given to the child's central problem: poor attention (Rie et al., 1976). A partial remedy to this clinical dilemma has been offered by the introduction of factor-analytically-derived rating scales for use with parents (Conners, 1970) and teachers (Conners, 1969); these scales have been shown to be responsive to changes in medication (Conners, 1975; Sprague & Sleator, 1977). Further refinement of clinical procedures has been suggested by laboratory studies of the effects of medication on hyperkinetic youngsters. Kinsbourne et al. (1977) detailed a two-day, double-blind procedure for examining a child's responsiveness to Ritalin, employing measures of paired-associate-learning (PAL) as a measure of cognitive functioning. Their work has demonstrated that the identification of Ritalin-responsive youngsters can be accomplished after acute administration of the medication under reliable experimental conditions, rather than employing the highly variable home or classroom situation. A double-blind administration prevents the bias of clinicians and parents from influencing the ultimate clinical decision. Sprague and Sleator (1977) have similarly employed a double-

blind administration of drug and placebo, for testing a child's response to medication, both on laboratory learning tasks as well as teacher-rated social behaviour within the classroom. Once the child's response to medication has been established by controlled, experimental procedures, the adjustment of dosage level and later follow-up procedures become a much more simplified matter.

Experimental findings. Not only have laboratory experiments helped to establish more reliable clinical procedures for determining a child's response to medication, but also studies involving the administration of CNS stimulants have aided in further delineation of the hyperkinetic syndrome.

Aware of the reported beneficial effects of Ritalin on the behaviour of hyperkinetic children, Knights and Hinton (1969) wished to determine whether the CNS medication would exert its greatest effect on the facilitation of attention or the control of motor impulsivity. Unfortunately, the study was hampered not only by the administration of a fixed dosage of Ritalin for all subjects, but also by the selection of subjects with both hyperkinesis and learning problems; the poor control of both variables would tend to diminish the probability of obtaining a significant drug effect (Sprague & Sleator, 1975). However, Knights and Hinton did observe that following a double-blind administration of Ritalin or placebo over a six-week period, subjects receiving Ritalin demonstrated superior performance on mazes relative to controls, and had

significantly increased their scores on the Performance section of the Wechsler Intelligence Scale for Children (WISC), whereas controls had not. The results were interpreted as confirmation that Ritalin improves attention rather than motor control since the subjects' improvement was related to an increased facility in recognizing and correcting their own errors rather than drug improvement of motor coordination. Two rating scales, employed for use with teachers and parents, similarly revealed decreases in such behaviours as distractibility. However, Knights and Hinton's analysis of the ordinal data provided for each item in the questionnaires using the $t$ distribution violates the assumption of "truly numerical" data (Siegal, 1956). In addition, Knights and Hinton implied in their discussion of results that both rating scales revealed improvement in the ratings of parents and teachers for those children who were receiving Ritalin but not placebo. However, inspection of their data revealed that significant improvements were only achieved for the parents' ratings on one of the scales; the other ratings only approached significance. While the findings of Knights and Hinton seem to support the notion that the main action of Ritalin for hyperkinetic children is to enhance attention, the many methodological and statistical problems tend to reduce the potency of this interpretation.

Attention, as measured by one-trial learning on a picture recognition task, has been shown to improve for those

hyperkinetic children given Ritalin (Sprague & Sleator, 1970). Using a crossover design with subjects serving as their own controls for all drug conditions, Sprague and Sleator observed that one-trial learning was significantly enhanced by Ritalin but not by either Thioridazine (a tranquilizer) or placebo. In addition, both the placebo and tranquilizer failed to affect the child's activity level while Ritalin served to reduce activity. Classroom ratings of students' behaviour similarly reflected a beneficial effect of Ritalin alone, thus supporting and extending the laboratory findings: increases in absolute frequencies of "on task" behaviours, and both student as well as teacher-initiated, pupil-teacher interaction suggested that the effect of Ritalin was to increase the child's attention to the demands of the classroom. Other investigators have similarly observed an improvement of short-term memory and learning in hyperkinetic children who have been supplied with Ritalin (Sprague & Sleator, 1975, 1977; Swanson & Kinsbourne, 1976).

Conners et al. (1964) unexpectedly observed Porteous maze performance but not PAL to improve for children given Ritalin as compared to placebo. While Conners et al. argued that PAL task difficulty as well as variability in the subjects' presenting problems contributed to the lack of uniform results, it is more likely that the method of drug administration employed was responsible for the failure of Ritalin to improve performance on both measures of learning.

For example, Sprague and Sleator (1975) have stated that the use of a fixed-dosage level, as was the case in this study, reduces the chance of observing a significant effect of medication since not all subjects receive a therapeutic level of medication; some subjects require more or less medication for optimal enhancement of performance. Secondly, since the dosage level of Ritalin tends to be rather specific for different target behaviours, as will be discussed shortly, it may be that the PAL and maze performance are enhanced for most subjects at different dosage levels. Swanson and Kinsbourne (1976), also using fixed-dosage levels of Ritalin but only one target behaviour, observed significant improvement of performance of hyperkinetic children on a PAL task when given Ritalin but not placebo.

In order to determine whether Ritalin acts to improve attention rather than memory, researchers have employed the continuous performance task, which is sensitive to brief lapses in vigilance. Sykes et al. (1971) observed, when hyperkinetic children were required to monitor a screen for predetermined visual target letters, performance was markedly enhanced for subjects receiving Ritalin, but not placebo. Not only were their scores more accurate, but also there was less evidence of impulsive, incorrect responses under the Ritalin condition. Lengthening of the interstimulus interval permitted subjects more time to consider a response, but only when children were receiving Ritalin did their performance

reflect increased reflectivity during the longer inspection period; the increased time did not similarly benefit children receiving placebo. The findings of other researchers that school-age (Campbell et al., 1971), as well as preschool hyperkinetic youngsters (Schliefer et al., 1975), have demonstrated increased scores on a measure of reflectivity when given Ritalin gives additional support to the conclusion of Sykes et al. (1971): that Ritalin acts not only to reduce impulsivity but also to increase the ability of the child to focus his attention to facilitate problem-solving. Conners' (1975) inability to extend these findings to a preschool sample of children using a continuous performance task was attributed to the inability of any child under five to cooperate in a relatively boring, stationary task. The variability of scores obtained for his preschoolers does suggest though, that for those children who are able to comply with task demands, the benefits of Ritalin on attention may be demonstrable. The failure to obtain improvement in two different target behaviours, in this case out-of-seat behaviour and response to visual stimuli, may be explained with reference to the proposed dosage specificity of Ritalin (Sprague & Sleator, 1975), which will be discussed shortly. Significant in this respect, Conners (1975) did observe the beneficial effects of Ritalin for a different target behaviour in his preschool sample: an improvement of scores on a measure of general intelligence. Conners attributed the improvement of intelligence test

scores to the attention-enhancing properties of Ritalin. It may be shown that the drug affects other target behaviours at different dosage levels.

Researchers have reasoned that if Ritalin increases the ability of hyperkinetic children to focus their attention, as demonstrated by improved performance on behavioural measures of attention, then the effects of Ritalin should similarly produce enhancement of the physiological correlates of attention. The skin conductance level (SCL), a measure of the electrical conductivity of the skin, has been assumed to be a component of the more general OR of humans (Cohen et al., 1971). Consistent with predictions, administration of Ritalin according to the titration method resulted in significantly faster reaction times, less variability in performance, and fewer impulsive motor responses for hyperkinetic children in a delayed reaction time experiment, than placebo. Basal skin conductance levels were found to increase for subjects receiving Ritalin, thus suggesting an arousal effect for autonomic functioning. However, contrary to expectations, there was no difference between Ritalin and placebo on either the amplitude of the OR to the first signal stimulus, or on the rates of habituation of the OR to signal and non signal stimuli. Cohen et al. reasoned that the initially large increase in basal skin conductance level decreased the likelihood that a significant increase in OR to novel stimuli would occur. Barkley (1977) has referred to the equivocal findings which

have accrued from the large number of studies researching physiological effects of stimulant medication; there seems to be great difficulty in defining the functioning of the central nervous system from unstable peripheral indices.

In summary, the evidence from both clinical and laboratory studies suggests that Ritalin tends to promote a more reflective, controlled cognitive style within hyperkinetic children, which is typically absent in the non-medicated state. The increased ability to focus attention on the relevant aspects of a problem, after the administration of Ritalin has been demonstrated for both preschool as well as school-age hyperkinetic youngsters. Although Ritalin tends to improve the hyperkinetic child's performance on a variety of measures such as psychometric tests, learning tasks, and perceptual-motor problems, the beneficial effects of medication are thought to be due to the more rudimentary facilitation of attentional processes. The most consistent improvements in attention due to Ritalin have been observed in studies which employ tasks which require sustained attention for relatively long periods of time (ten to fifteen minutes), and which are free from the confounding influence of complex learning, memory, or motor coordination requirements. Despite the demonstration of improved attention on such tasks following the administration of Ritalin, there has been meagre success in documenting consistent and parallel changes in measures of peripheral physiological responses of the autonomic

nervous system. However, it has been argued that changes in functioning of the central nervous system rarely correspond in any simple way to fluctuations of autonomic reactivity, at least as observed by the relatively crude methodology thus far employed by science. The laboratory measures then, confirm the earlier clinical reports that the Ritalin-responsive youngster demonstrates increased reflectivity, attention span, and impulse control, and decreased activity level, when receiving active medication as compared to placebo.

Dosage level. If, as Kinsbourne et al. (1977) suggest, Ritalin serves to "normalize" the behaviour of hyperkinetic youngsters, we should expect to receive confirmation of such beneficial action from several quarters, including the laboratory, home, and school environments. Unfortunately, global improvement of function has been rarely observed (Riddle & Rapoport, 1976). Weiss (1975) has remarked:

> ...we have the rather paradoxical result that (M)ethylphenidate continues to be symptomatically effective while not having influenced such basic aspects of measurements of emotional adjustment, delinquency, number of grades failed, and so on (p. 222).

Rie et al. (1976), in the same vein, observed that while several psychological tests and teachers' ratings of classroom behaviours reflected improved performance for children given individually-titrated doses of Ritalin, measurement of achievement on typical academic tasks revealed no such beneficial effects of medication. Although these authors felt that

medication was not the panacea for hyperkinesis and thus other treatments might be in order, Sprague and Sleator (1975) have suggested that the dosage specificity of Ritalin for certain target behaviours may explain the failure of Ritalin to lead to global improvement of disparate functions. Initially using low doses of Ritalin (.25 mg/kg and .35 mg/kg), Sprague and Sleator observed that both children's performance on a laboratory learning task as well as teachers' ratings of their classroom behaviour improved, with no differential effect of dosage level apparent for the two measures. However, these investigators have hypothesized (1975), and later demonstrated (1977), that performance on cognitive tasks within the laboratory were selectively enhanced by relatively small dosage levels of Ritalin (.3 mg/kg) whereas larger doses (1.0 mg/kg) impaired learning performance. While both levels of active medication led to improvements of classroom behaviours, as reflected in teachers' ratings, optimal facilitation occurred at the higher dosage condition. Side effects were observed to increase dramatically with dosage level and to reach deleterious levels at approximately the same dosage level as that used for optimal social improvement (see Figure 1). In commenting regarding dosage effects Kinsbourne et al. (1977) have suggested on the basis of their clinic data that impairment of learning precedes deterioration of the emotional and physical well-being of the child, as dosage increases. These larger doses reflect the amounts often reached using the

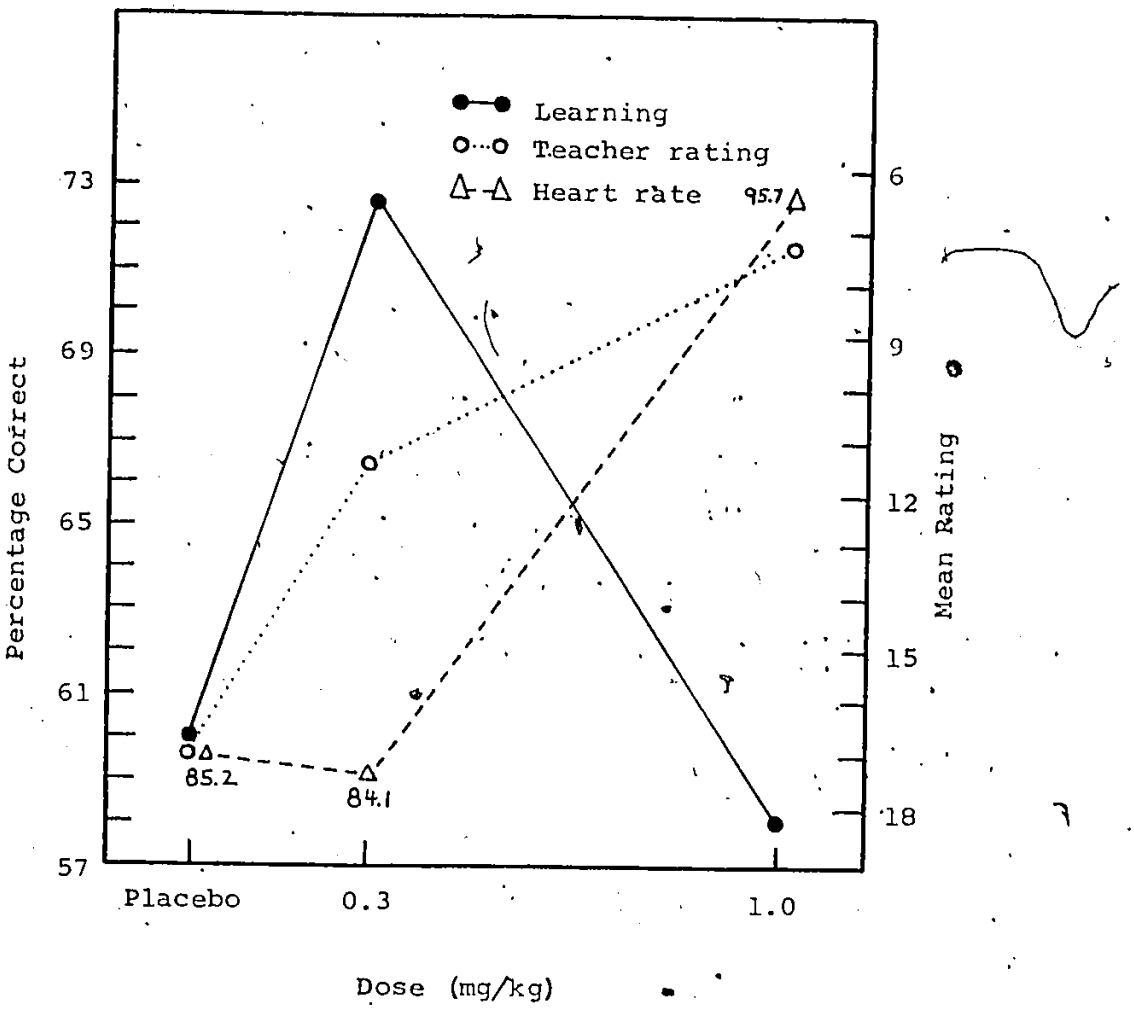



Fig. 1. Dose response relationships of Ritalin for three separate target behaviours (Sprague & Sleator, 1977, p. 1275).

clinical titration procedure, which depends on reports of parents or teachers regarding social behaviours. Gittleman-Klein and Klein (1975) reported that following a titration procedure for the administration of Ritalin, general behavioural improvement was observed at school with no increased performance on measures of cognitive functioning. Similarly, Schliefer et al. (1975) observed that after preschoolers had been given Ritalin, using mothers' reports as the basis for the titration procedure, behavioural improvements were noted at home as well as for a task which measured reflectivity, however, there seemed to be no improvement on objective measures of specific behaviours in the nursery school. The conclusion to be taken from these studies is that drug response is highly related to dosage level. The implication of this conclusion is that clinicians must decide a priori which behaviours are to be specified for change.

A second confounding issue with regard to administration of medication, the determination of beneficial effects, and the regulation of effective clinical dosage, pertains to the state-dependent effect, first noted by Overton (1964). Overton discovered that administration of Sodium Pentobarbital, a sedative, suppressed a previously learned response in rats. Rats were shown, however, to suffer less memory loss if learning and recall were conducted under similar rather than different drug states. Further, the amount of learning that was

transferred from one state to another was inversely correlated with the size of the dose given. Swanson and Kinsbourne (1976) had determined that stimulant medications such as Ritalin, owing to their facilitation of learning in hyperkinetic children, should show similar but positive state-dependent effects. Consistent with their hypothesis, Swanson and Kinsbourne demonstrated that when a "therapeutic dose" of Ritalin was administered, state-dependent facilitation of learning was observed for hyperkinetic children. That is, relearning on a PAL task was facilitated when children were given the same drug that was administered during initial learning; the effect was demonstrated for both placebo and Ritalin conditions. Impairment of relearning occurred when the drug state was altered from that of the initial learning condition: placebo during acquisition followed by Ritalin during relearning, or conversely, Ritalin during acquisition followed by placebo for relearning.

The finding that Ritalin produced state-dependent learning in hyperkinetic youngsters, combined with the implication from Overton's work that the state-dependent-learning effect is dependent on dosage level, contains important implications for the clinical administration of medication. For example, the suggestion that "drug holidays" be given during the summer months, or whenever the child is out of school, such as on the weekends or at night (Katz et al., 1975; Safer & Allen, 1975; Stewart & Olds, 1973) fails to account for the disruptive

effect that such well-intentioned breaks in the medication schedule may have on the continuity of learning for the hyperkinetic child. A lesser problem is related to the short-term action of Ritalin in the body. Optimal enhancement of learning occurs within a few hours, with a decline in effect occurring rapidly within the next two hours (Kinsbourne et al., 1977). Thus, unless the child is medicated frequently during the day to insure continuous optimal blood levels of the drug, there will occur parallel fluctuations in the extent to which state-dependent learning is operative. That is, the amount that a child will initially learn and later recall will depend upon the similarity of drug states occurring across the two situations. Training in problem-solving carried out at home by the mother when the child is not medicated will not be expected to optimally influence his performance in school the next day under medication conditions. This dilemma will only be resolved when Ritalin or some other medication is available in spansule form, which will insure the gradual release of medication into the bloodstream over a long period of time.

## Statement of the Problem

Ritalin, a CNS stimulant medication, has formed the cornerstone in the treatment of hyperkinetic children due to its reported reduction of hyperactive (Sprague & Sleator, 1970), impulsive (Campbell et al., 1971; Sykes et al., 1971),

and inattentive behaviours (Knights & Hinton, 1970; Sykes et al., 1971); and as a result, improvement of learning performance (Sprague & Sleator, 1975, 1977; Swanson & Kinsbourne, 1976) and the quality of interpersonal interactions ( Humphries et al., 1978; Sprague & Sleator, 1970). However, some researchers have observed that Ritalin does not uniformly benefit the varied behavioural deficits of hyperkinetic children at the same dosage level (Sprague & Sleator, 1975, 1977).

The work of Sprague and Sleator, by investigating the dose-response relationships for two distinct target behaviours, illuminated a major error in clinical methodology: Ritalin is initially prescribed to aid the hyperkinetic child in focusing his attention and hence improve learning performance; however, later alterations of dosage level are made contingent upon parental or school ratings of improvement in social functioning, rather than learning performance. Sprague and Sleator demonstrated that teachers' ratings of classroom behaviour show optimal improvement at high dosage levels which produce deterioration in learning relative to placebo conditions. Learning performance though, shows significant improvement under relatively low dosage levels of Ritalin.

The present study is a response to Sprague and Sleator's call for further systematic evaluations of the dosage specificity of Ritalin for various target behaviours. Attention functioning on a continuous performance task; parental ratings of child symptomatology; and the quality of the mother-

child interaction were chosen as target variables.

The inclusion of attention functioning as a target behaviour was prompted by two observations: a dysfunction of attention processes has been posited as the primary impairment in hyperkinesis (Douglas, 1972, 1975); and improvement in learning performance for children receiving Ritalin has often been attributed to improved functioning in the area of attention (Swanson & Kinsbourne, 1976).

While teachers are commonly asked to evaluate a child's progress on medication (Sprague & Sleator, 1970), it is often the report of the parent regarding the child's social adjustment that is employed by the clinician in arriving at the decision to alter the medication. Thus, a comparison of the dose-response relationships between dosage level of Ritalin and the performance on an attention task versus parental (maternal) ratings of social adjustment would be of relevance to clinicians.

Related to the maternal evaluation of the child's behaviour is the nature of the mother-child interaction. Disturbance in this area of relationship functioning often provides the initiative for the referral of the hyperkinetic child to the clinician (Millichap, 1975). Since the quality of the mother-child interaction has been shown to be responsive to alteration of medication (Humphries et al., 1978), this third target variable has been included in this proposed investigation of dose-response relationships of Ritalin for

the hyperkinetic child.

Sprague and Sleator (1975) have suggested a cross-over design in the investigation of drug-response relationships in children; a repeated measures design has been employed in the current study. Each child serves as his own control for the administration of high and low dosage levels of Ritalin as well as placebo. Although past studies of drug responsiveness in children have been conducted after several days or weeks of drug administration, recent evidence with Ritalin has demonstrated significant behavioural change evident after an acute administration of one tablet (Humphries et al., 1978; Swanson & Kinsbourne, 1976). The present study was thus able to accumulate data for each subject on the three consecutive days of the testing programme.

Hypotheses

There is much experimental evidence to suggest that an impairment in selective attention is the primary behavioural deficit in hyperkinetic children (Douglas, 1972, 1975; Knights & Hinton, 1970; Swanson & Kinsbourne, 1976). These children typically fail to attend to the relevant stimulus characteristics in a given problem situation. While at times the hyperkinetic child may fail to respond to task demands, and instead amuse himself with non relevant aspects of his environment (Douglas, 1972), his performance may also be characterized by excessive, impulsive responding (Campbell et

al., 1971; Sykes et al., 1971). Given the requirement to respond by button pushes to visually-presented stimuli, which appear at unexpected rates, we would expect the hyperkinetic child's performance to be characterized by lapses in attention, or failure to attend and impulsive or excessive responding. Improvement in learning and problem-solving in hyperkinetic children who have been given Ritalin has usually been attributed to facilitation of attentional processes (Sprague & Sleator, 1970; Swanson & Kinsbourne, 1976; Sykes et al., 1971). From the work of Sprague and Sleator (1975, 1977), it is presumed that performance on an attention task would be facilitated by a low dosage level of Ritalin. Thus, it would be expected that on the measure of attention employed in this study that:

> 1. (a) the number of target and non target stimuli correctly identified will be significantly greater at the low dosage level of Ritalin, relative to placebo; but a significant decrease in the accuracy of this discrimination will be observed at the higher dosage level, relative to both placebo and low dosage conditions.

Error scores have been shown to be significantly higher for hyperkinetic children than controls in response to a selective attention task (Zambelli et al., 1971): errors of commission, which indicate additional responses, are a measure of impulsive responding; while errors of omission, which denote a failure to respond to a stimulus, are suggestive of a lapse in attention. Again, following the rationale of the

dose-response relationship described by Sprague and Sleator (1975, 1977) for learning performance (a suggested indice of attention), it would be expected that on the measure of attention employed in this study that:

> 1. (b) errors of commission and omission will be significantly reduced at the low dosage level of Ritalin, relative to placebo; but a significant increase in both types of errors will be observed at the higher dosage level, relative to both placebo and low dosage conditions.

Campbell (1975) has observed that relative to the interaction of learning disabled and normal control children with their respective mothers, the relationship of hyperkinetic youngsters and their mothers was characterized by greater maternal control. That is, as compared to controls, mothers of hyperkinetic children tended to respond to their child's difficulty with impulse control and inattentiveness by offering more comments of encouragement and explicit direction as well as greater criticism and instructions to control the child's faulty problem-solving. Humphries et al., (1978), employing a less intricate coding system for interaction, confirmed Campbell's observation that control and directiveness were characteristic of the interaction between the hyperkinetic child and his mother. However, when the child was given Ritalin, as compared to placebo, his behaviour became less impulsive and inattentive with the result that his mother's behaviour altered in a complementary fashion. For

example, as the child took more of an active interest in directing task performance, and was generally more positive in his comments, the mother assumed a less directive and more positive stance. The parallel coding categories offered by Humphries et al., (1978) provide for a more systematic and unbiased view of the mother-child interaction than Campbell's (1975) code to the extent that both participants could conceivably engage in similar behaviour despite their difference in status and developmental stage. However, the schema of Humphries et al. requires expansion to include greater emphasis on the impulsive tendencies of the hyperkinetic child (Campbell et al., 1971; Sykes et al., 1971) which were recognized in the more elaborate coding of Campbell (1975). Thus, the present interaction schema would include recognition of both off-task behaviours as well as impulse-control suggestions in addition to cooperative explanatory comments, directions, praise, and criticism. The measures of mother-child interaction, falling within the domain of social behaviour, would be expected to conform to the dose-response relationship described by Sprague and Sleator (1975, 1977). Thus, as dosage level increased from placebo, to low, and finally to the high dosage level of Ritalin, it would be assumed that the mother would relinquish her directiveness and negativism as the son assumed greater control of the task. That is:

> 2. (a) in interaction with their hyperkinetic child, the mother will offer significantly

> fewer impulse-control suggestions, direction, criticism, and off-task comments, but more explanation and praise under the low dosage level of Ritalin, relative to placebo. Further, these changes in maternal behaviour will be significantly enhanced in the same direction under the high dosage level of Ritalin, relative to the low dosage condition.

Also:

> 2. (b) in interaction with their mother, the hyperkinetic child will offer significantly more impulse-control suggestions, direction, explanation, and praise, but less criticism and off-task comments under the low dosage level of Ritalin, relative to placebo. Further, these changes in the child's behaviour will be significantly enhanced in the same direction under the high dosage level of Ritalin, relative to the low dosage condition.

Conners (1973) has demonstrated the utility of both parent and teacher-scored symptom rating scales in reflecting the beneficial effects of Ritalin for hyperkinetic youngsters. Although there are differences in the way in which parents and teachers view the same child (Schliefer et al., 1975), it would be reasonable to expect that the dose-response relationship observed by Sprague and Sleator (1975, 1977) for teacher-rated social adjustment of hyperkinetic children given Ritalin would hold for parental ratings of similar target behaviours employed in this study. Thus:

> 3. a mother's rating of her hyperkinetic child's social behaviour will indicate significant improvement under the low dosage condition of Ritalin, relative to placebo;

and further, will display significant improvement under the high dosage condition, relative to both low dosage and placebo conditions.

# CHAPTER II

## METHOD

### Subjects

In order to secure a sufficient number of subjects for study without waiting for new referrals to accumulate, two successive years (1976-1977) of out-patient charts at the Community Psychiatric Hospital (CPH) in Guelph were initially reviewed. When the required number of subjects was not obtained following further screening described below, the first six months of 1978 were also reviewed. The CPH serves a combined urban and rural catchment population of approximately one hundred and fifty thousand people, covering two counties of mid-southern Ontario.

Criteria for initial selection stipulated: 1) males between six years, zero months and twelve years, eleven months; 2) presenting problems include mention of hyperactivity and or attention difficulties, both at home and school; 3) a diagnosis of hyperkinesis without evidence of psychosis, mental retardation, or organic brain syndrome; and 4) no mention of prescribed psychoactive medication with the exception of Ritalin.

The parents of children selected by initial screening

procedures received a letter explaining the intent and rationale for the study (Appendix A). A telephone contact followed the letter by a few days in order to establish the family's willingness to participate in the study as well as to determine that the child fulfilled the fifth pre-condition: that he was currently receiving and responding favourably to Ritalin.

A parent-child interview at the clinic prior to the study served several functions: an abbreviated Wechsler Intelligence Scale for Children (Glasser & Zimmerman, 1967) and the Bender Gestalt were administered[5] if there was no indication that these tests had been given to the child within the last two years; each child was weighed to determine dosage ratios for medication; and, each parent was given the rationale and structure of the study as well as the opportunity to ask pertinent questions prior to signing the release/consent form (Appendix B). The mother was informed that a token payment of $6.00 would be provided on the first day of testing to help defray transportation expenses. Mothers were given three copies of the Conners rating scale for parents (Appendix C) with instructions to complete one form at the

[5] To be eligible for the experiment, each child must not obtain a prorated Full Scale IQ < 80 (the sum of scores obtained on the Information, Comprehension, Arithmetic, Picture Arrangement, and Object Assembly subscales, multiplied by two), nor a Koppitz score on the Bender Gestalt greater than that indicated as within normal limits for his age group (Koppitz, 1963).

end of each medication period, on each of the three consecutive days of testing, and to return them to the clinic in a pre-addressed envelope. The schedule of testing as well as the pick-up date for the medication was arranged at this time. Recruitment and testing were completed during summer vacation, thereby eliminating difficulties for individual subjects in missing school. Family physicians were notified by mail of the design and intent of the study (Appendix D); their questions and input were encouraged. Feedback was provided to the physicians by mail at the conclusion of the study; also, each parent was contacted by telephone for feedback purposes as well as to obtain additional comments regarding their participation in the project.

Twelve males (Appendix E) ranging in age from 88 to 152 months were selected to participate in this experiment with their mothers (mean age of children = 121.6 months; standard deviation = 20.3 months). Median grade placement in school was 4, with subjects ranging from grade 1 to grade 7. One third of the subjects had never failed a grade, while the remainder had failed one or more times. Body weight varied from 23.6 kg to 41.8 kg (mean body weight = 31.1 kg; standard deviation = 6.3 kg). As stipulated, no boy received an IQ score less than 80 (mean IQ = 97; standard deviation = 10.1). The Hollingshead and Redlich index of social class (1958) determined that the three lowest classes were represented in the present sample (median social class rating = 4).

Apparatus and Materials

A spacious playroom (6.6 metres x 9.8 metres) was utilized for both experimental tasks (see Appendix F). No attempt was made to conceal various play materials which were located about the room, including a hobby horse, sand box, blackboard, and toy chest. One corner of the room was set aside for the attention task; the video tape recorder and pen recorder were placed in an adjacent observation room which provided convenient access by the experimenter for regulation of the equipment at the beginning and end of the experimental session. However, the experimenter remained seated behind the subject in the experimental room during the attention task. Parent and child were required to sit side-by-side at a hexagonal table during the social interaction task. For observational purposes, this table was located immediately in front of a one-way mirror; the experimenter observed the interaction through the window, while a Sony portable tape recorder, concealed behind a screen in the centre of the room, recorded the verbal interaction.

Attention task. A vigilance task, which is especially sensitive to the attention deficit in hyperkinetic youngsters (Sykes et al., 1971) requires a subject to respond to an experimenter-paced stimulus array by correctly identifying a pre-determined signal stimulus from irrelevant stimuli. A novel simulation of a radar-detection task was created to

combat the reported boredom of the typical, continuous performance task (Conners, 1975). A realistic soundtrack of air-traffic controllers' flight talk, prepared by the sound crew of a local radio station, was piped in through the speaker of the Concord, black and white, video tape monitor. Children were required to attend to a 17 minute, video-taped "radar-detection" task, and to signal the presence of "Aircraft" on their video screen with the use of two telegraph keys which were placed before them on the table (Appendix G). The subjects were seated at a table approximately 1 metre from the video monitor; and the room was darkened during the presentation.

The video tape consisted of tachistoscopic presentations (1/8 second) of a 16 dot matrix (Appendix H) which appeared every 3, 5, or 7 seconds. The "No Aircraft" matrices were created by taking slide photographs[6] of 16 circular dots, drawn with black India ink on white bond paper (1/4 inch diameter; 3/4 inch centres). Fifty per cent of the 192 stimulus presentations consisted of an "Aircraft Present" stimulus: target matrices consisted of a similar 16 dot array, except that one of the dots was larger than the remainder (3/8 inch diameter). The position of the larger dot, the interstimulus

[6] Slide photographs were taken using Kodak Kodalith "Ortho 3", 35 mm film with a Nikon Cameron macro lens. Two overhead photographic flood lights, adjusted to 45 degrees, illuminated the two dimensional stimulus array such that negligible shadow was detected using a standard light meter.

interval, and the order of appearance of target and non-target stimuli within the 17 minute sequence, were completely randomized. A Kodak Carousel projector, fitted with a tachistoscope and a random access slide presentation device (model 960), was employed to display the slides. The presentation was then recorded using a Sony 3/4 inch, colour video system. A later editing transcribed the presentation for use with the clinic's 1/2 inch Concord video tape recorder and monitor.

Subjects responded to the video presentation by pressing the "Aircraft Present" key whenever a target stimulus appeared, or the "No Aircraft" key whenever a non-target flashed on the screen. Identification of the buttons was accomplished by means of an appropriate line drawing on a 2 inch by 2 inch, white card affixed opposite each button: an aircraft beside the "Aircraft Present" key and a plain black space beside the "No Aircraft" key. The response keys were connected to a six-channel, Campden pen recorder which, moving a paper tape at the speed of 3 1/2 inches per minute, kept a record of all responses emitted by the subject even in the absence of a stimulus. The experimenter operated a third key connected to the pen recorder in order to designate the beginning of the series for later scoring. The vigilance task yielded three scores for analysis including: an accuracy score (number of signal and non-signal stimuli correctly identified); an error of omission score (the number of failures to respond in the presence of a stimulus); and an error of commission

score (the number of responses given in excess of one per stimulus presentation). If more than two responses were given to any single stimulus presentation, the following rules applied: 1) if all responses were correct, then one response was scored as correct and the remaining responses were scored as errors of commission; 2) if at least one response was correct, then it would be scored as such, with remaining responses scored as errors of commission; and 3) if all responses were incorrect, then one response would be scored incorrect with the rest listed as errors of commission.

Social interaction task. The verbal interaction of the hyperkinetic child and his mother has been shown to be distinguishable from that of normal controls on a number of dimensions (Campbell, 1975; Campbell et al., 1977b). The block design and anagram tasks employed by Campbell, however, contain not only a social element but also an achievement aspect since subjects were required to solve a problem either alone or with mother acting as consultant. Humphries et al. (1978) introduced an "Etch-a-Sketch" maze task which, although also an achievement-oriented game, involved the mother and child in a more cooperative venture. Only slight modification of the task for the present study was necessary to allow for potentially more expansive and life-like interaction between mother and child. The "Etch-a-Sketch", a two-handled mechanical drawing toy which is available in most department stores, produces a thin line drawing on a translucent screen when the

left (horizontal) and right (vertical) knobs are turned. While difficult at first, and requiring much verbal interaction, two persons can cooperatively create a design using only one knob each.

The verbal interaction which developed between mother and child when they were left to "create something", was recorded on a Sony tape recorder for later scoring. They were informed by the experimenter that ten minutes would be the length of their task and that he would return at the end of that time. Categories for scoring the observations consisted of an amalgam and extension of the schemas developed by Campbell (1975), Campbell et al. (1977b), and Humphries et al. (1978). See Appendix I for a more complete explication of the categories which are briefly presented below as well as the details of the training given to the two blind, independent raters who coded the interaction. Reliability ratings, determined by calculating the percentage of agreement between the raters, is provided in parentheses for each of the coding categories:

1. Direction: a statement which provides specific guidance to the other participant regarding task completion (maternal = 95 %; filial = 94 %).

2. Explanation: a statement which provides or requests information regarding the operation of the drawing device, the nature of the task, or the intentions of either participant (maternal = 84 %; filial = 89 %).

3. Praise: a statement which conveys approval or positive feedback regarding the task-related

performance of the other participant (maternal = 85 %; filial = 92 %).

4. Criticism: a statement which conveys disapproval or negative feedback regarding the task-related performance of the other participant (maternal = 84 %; filial = 82 %).

5. Impulse-control: a statement which focuses on the correction of the other participant's faulty task performance by suggesting greater or less attention, motor control, interest, manners, etc. (maternal = 85 %; filial = 90 %).

6. Off-task: statements which clearly relate to non-task activities and events (maternal = 98 %; filial = 95 %).

Parent ratings. A ninety-three-item parent questionnaire (Appendix C) has been employed in the evaluation of the efficacy of stimulant medication with children (Conners, 1975). Ten of these items have been shown to be especially responsive to the effects of CNS stimulant medication (Conners, 1973). In the present study, parents were requested to rate their child's behaviour for each of the ninety-three items at the end of each six to eight hour, daily medication period. Later scoring assigned values from 0 to 3 according to the severity of the symptom rating: higher values were assigned to less adaptive functioning. A total disturbance rating as well as a subscale score for the medication-sensitive items were produced.

## Procedure

Preparation of medication. A hospital pharmacist was

supplied with the weight and name of each child as well as a table of administration sequences for the three drug conditions: placebo; Ritalin .3 mg/kg; and Ritalin 1.0 mg/kg. The administration sequences for drug conditions were completely counterbalanced with the aid of a Latin square procedure (Winer, 1971) and are shown in Appendix J. Individual drug preparations were obtained by crushing 10 mg tablets of active medication and or placebo, and placing the powder inside an opaque gelatin capsule. The mg/kg drug ratios were accurate to within 2.5 mg. For consistency, the same number of tablets were placed within each capsule, regardless of dosage strength. That is, if a child's higher dose of Ritalin required three-10 mg tablets, and the lower dose only one tablet, then two additional placebo tablets would also be crushed and placed within the same capsule as the one tablet of Ritalin. The appropriate daily medications were placed within clearly labelled containers which directed the parent to administer medication "A" on the first day, medication "B" on the second day, and medication "C" on the third day. All medications were taken one-half hour before breakfast, and one hour before testing at the clinic.

Since children in this study were already taking medication, no break in their current regime was planned, except that on the three test days, only the experimental medication was administered. Several sources suggest that there is no appreciable accumulation of Ritalin within the body from one

administration to the next (Katz et al., 1975; Kinsbourne et al., 1977).

Laboratory testing. Each child was seen at the clinic at the same time on each of the three consecutive test days, approximately one hour after administration of medication by the parent at home. Upon arrival at the clinic, the child was escorted into the playroom and asked to sit at a desk upon which were located the two telegraph keys (Appendix G). A television monitor was located directly in front of the child at a distance of one metre. Once the child was seated the following instructions were given:

> For the next little while, you will be able to try out the job of air-traffic controller. I'm sure you have seen movies on t.v. that show how men have to watch the radar for enemy airplanes. Your job will be to listen to what goes on and to look at this t.v. set to find out when an airplane is overhead (the two-minute demonstration segment of the video tape will then be started). As you can see, sometimes you will see a bunch of dots that are all the same size (pointing to the monitor). That means that there is no aircraft present and so you will have to signal the men in our planes by pressing this "No Aircraft" button. But at other times, you will notice that one of the dots on the screen is larger than the rest (again pointing to the monitor) and then you will know that an airplane is coming. You will then have to press this "Aircraft Present" button. Now you try it. Do you understand how it all works? Fine. I"ll turn the lights back on when you are all done. (Further explanation was provided as needed).

After turning out the lights, the seventeen minute video sequence was then initiated by the experimenter. For

the remainder of the attention task, the experimenter remained seated approximately three metres behind the child. Attempts by the child to leave his seat were responded to by the experimenter with the verbal direction: "Please stay seated until the lights come on". The first direct question was answered and was followed by the direction: "I cannot answer any more of your questions until the lights are turned on again". Further questions were ignored.

At the termination of the tape, the child was asked to escort his mother into the playroom from the waiting room. The tape recorder was started before the subject returned. The child and his mother were asked to sit side-by-side at the table in the positions indicated by the labels below the two knobs on the "Etch-a-Sketch": "mother" and "son". The position of parent and child was counterbalanced across subjects, but maintained within subjects for all three testing sessions. The following instructions were given:

> As you can see, the name of this game is "Etch-a-Sketch". Each of you will have your own knob to turn. Use the hand that you write with (the experimenter demonstrated the function of each knob). For the next ten minutes I would like the two of you, using your own knobs, to create something together. I will return at the end of ten minutes to see how you're getting along. Do you have any questions?

After answering all questions, the experimenter left the experimental room to take his position in the observation room behind the one-way mirror.

Identical procedures were followed for subsequent test days with the exception that instructions to subjects were modified to take into account their familiarity with the tasks.

Statistical Analysis of Results

Since Ritalin is known to effect individuals differentially (Sprague & Sleator, 1975, 1977), a repeated measures design was employed, using each subject as his own control for all three drug-dosage conditions. In order to control for the confounding of dosage level with testing order, a Latin square design with repeated measures (plan 8, Winer, 1971, p. 723) was adopted. Two different Latin squares were selected to determine the order of administration of the three drug conditions for the twelve subjects; two subjects were randomly assigned to each row of the two squares. Between subject variation was attributed to drug level and order of administration. Separate analyses of variance were conducted for each of the three scores derived from the attention task: accuracy; errors of omission; and errors of commission. Further separate analyses were conducted for each of the categories of verbal interaction obtained on the measure of mother-child social behaviour as well as the two measures of parent ratings. A posteriori comparisons of means for all significant F tests were conducted following the procedure outlined by Winer (1971) for the Tukey (a) test.

# CHAPTER III

## RESULTS

The design of this experiment permitted the observation of each subject under the three dosage conditions (placebo, Ritalin .3 mg/kg, and Ritalin 1.0 mg/kg) for seventeen dependent measures. Thus, the effect of medication could be discerned for every subject by reference to performance on the three attention task scores, twelve categories of parent-child verbal interaction, and two varieties of parent ratings of child behaviours. The means and standard deviations for each variable under the three medication conditions are shown in Table 1.

For clarity, each of the seventeen dependent variables are examined sequentially below. A separate analysis of variance, employing a Latin square design with repeated measures (plan 8, Winer, 1971, p. 723) was used to examine drug effects for each dependent measure. Following the example of Sprague and Sleator (1975), descriptive data on individuals' responses to medication are also provided. That is, since group statistics often mask fluctuations in the responses of individuals, the percentage of subjects who

TABLE 1

MEANS AND STANDARD DEVIATIONS FOR ALL DEPENDENT MEASURES UNDER EACH MEDICATION CONDITION

| | Placebo | | Low | | High | |
|---|---|---|---|---|---|---|
| Dependent Measure | M | SD | M | SD | M | SD |
| Attent. Correct | 143.67 | 36.54 | 158.08 | 24.44 | 157.50 | 28.88 |
| Attent. Omission | 26.33 | 24.22 | 13.42 | 19.92 | 19.67 | 26.86 |
| Attent. Commission | 6.67 | 8.03 | 3.83 | 4.00 | 3.25 | 4.62 |
| M's Direction | 37.15 | 20.11 | 31.03 | 22.80 | 34.60 | 25.35 |
| S's Direction | 37.37 | 24.89 | 44.29 | 26.89 | 36.63 | 29.61 |
| M's Explanation | 36.48 | 13.22 | 41.48 | 17.67 | 47.72 | 26.84 |
| S's Explanation | 39.20 | 24.35 | 37.16 | 22.74 | 37.59 | 25.66 |
| M's Praise | 0.88 | 1.16 | 1.97 | 2.82 | 2.23 | 3.02 |
| S's Praise | 0.58 | 0.99 | 0.28 | 0.70 | 0.23 | 0.41 |
| M's Criticism | 4.26 | 4.15 | 3.30 | 2.30 | 3.21 | 2.68 |
| S's Criticism | 1.33 | 1.64 | 2.83 | 4.13 | 1.45 | 3.82 |
| M's Off-Task | 1.11 | 2.22 | 3.76 | 11.32 | 0.18 | 0.61 |
| S's Off-Task | 3.13 | 6.10 | 5.64 | 19.23 | 0.30 | 1.04 |
| M's Impulse Control | 10.93 | 11.10 | 4.63 | 6.74 | 3.78 | 2.87 |
| S's Impulse Control | 0.18 | 0.41 | 0.29 | 0.72 | 0.87 | 2.11 |
| Sub Total Ratings | 9.00 | 6.02 | 5.25 | 6.86 | 3.33 | 4.12 |
| Total Ratings | 31.83 | 24.43 | 21.17 | 18.71 | 16.83 | 18.58 |

responded with peak performance to each of the drug conditions is presented for each dependent variable. Peak or optimal performance is defined as the best score achieved according to hypotheses.

Attention

Earlier it was posited that attention, as measured by number of correct responses, omissions and commissions given to the "radar task", would benefit from Ritalin in a non monotonic fashion. That is, while a low dose would produce superior results to placebo, a high dose would lead to a decrement in performance relative to placebo.

Correct. Table 2 reveals that no significant differences existed in the number of targets correctly identified by subjects across the three medication levels ($F(2/12) = 2.88$, $p > .05$). In fact, there was present a significant interaction effect between the square to which particular subjects were assigned and the day on which testing occurred ($F(2/12) = 4.02$, $p < .05$). The dose response relationship depicted in Figure 2 illustrates that although significant differences were not present between the three dosage levels, both the low and high dosages produced a similar degree of improvement of attention relative to the placebo condition. As Figure 3 demonstrates, optimal enhancement of performance occurred for only 8.33 % of the subjects under placebo conditions, while low and high doses of Ritalin optimally

TABLE 2

ANALYSIS OF VARIANCE FOR ATTENTION CORRECT

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Square (C) | 1356.69 | 1 | 1356.69 | 0.77 |
| Groups within C | 11839.22 | 4 | 2959.81 | 0.46 |
| Subjects within groups | 10599.50 | 6 | 1766.58 | |
| Days (A) | 542.17 | 2 | 271.09 | 0.98 |
| Drug level (B) | 1598.17 | 2 | 799.09 | 2.88 |
| A x C | 2225.06 | 2 | 1112.53 | 4.02* |
| B x C | 61.06 | 2 | 30.53 | 0.11 |
| Residual | 486.89 | 4 | 121.72 | 0.44 |
| Error | 3324.00 | 12 | 277.00 | |

* $p < .05$

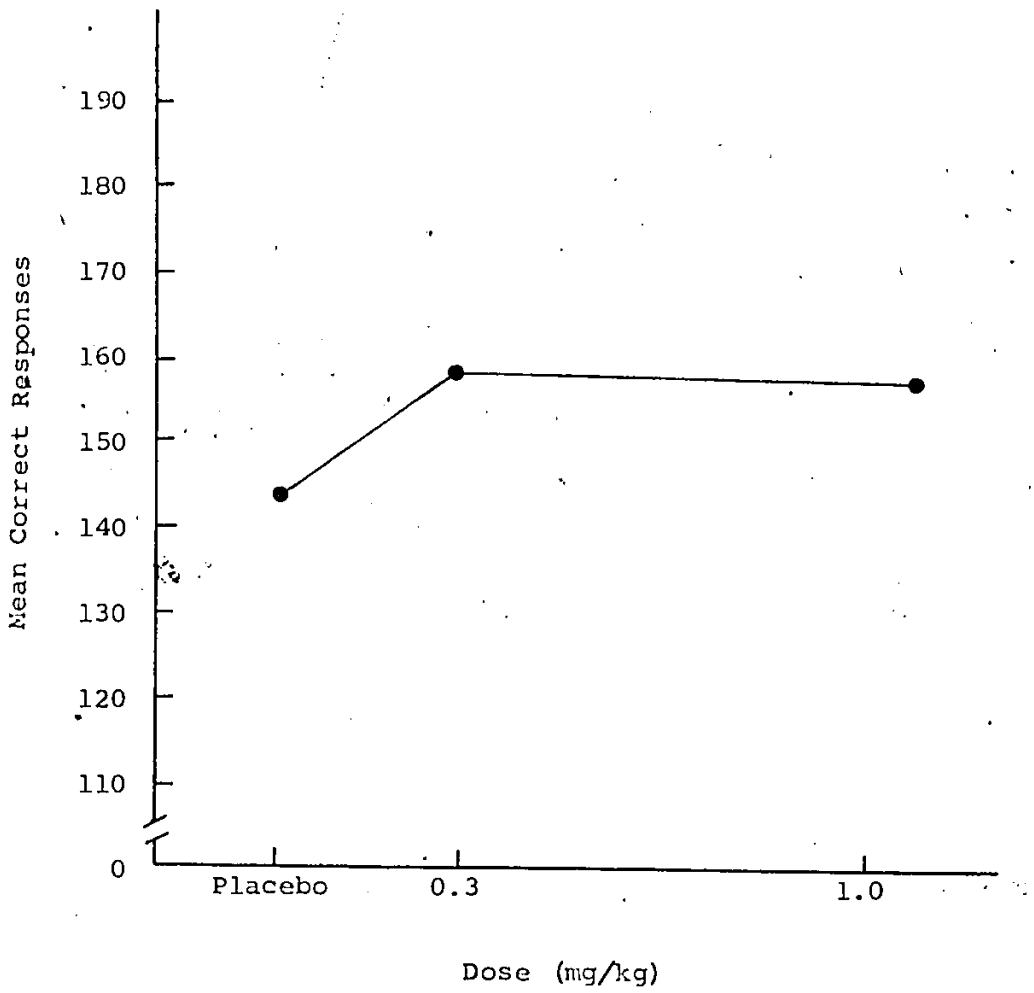



Figure 2. Dose response curve for Attention Correct scores.

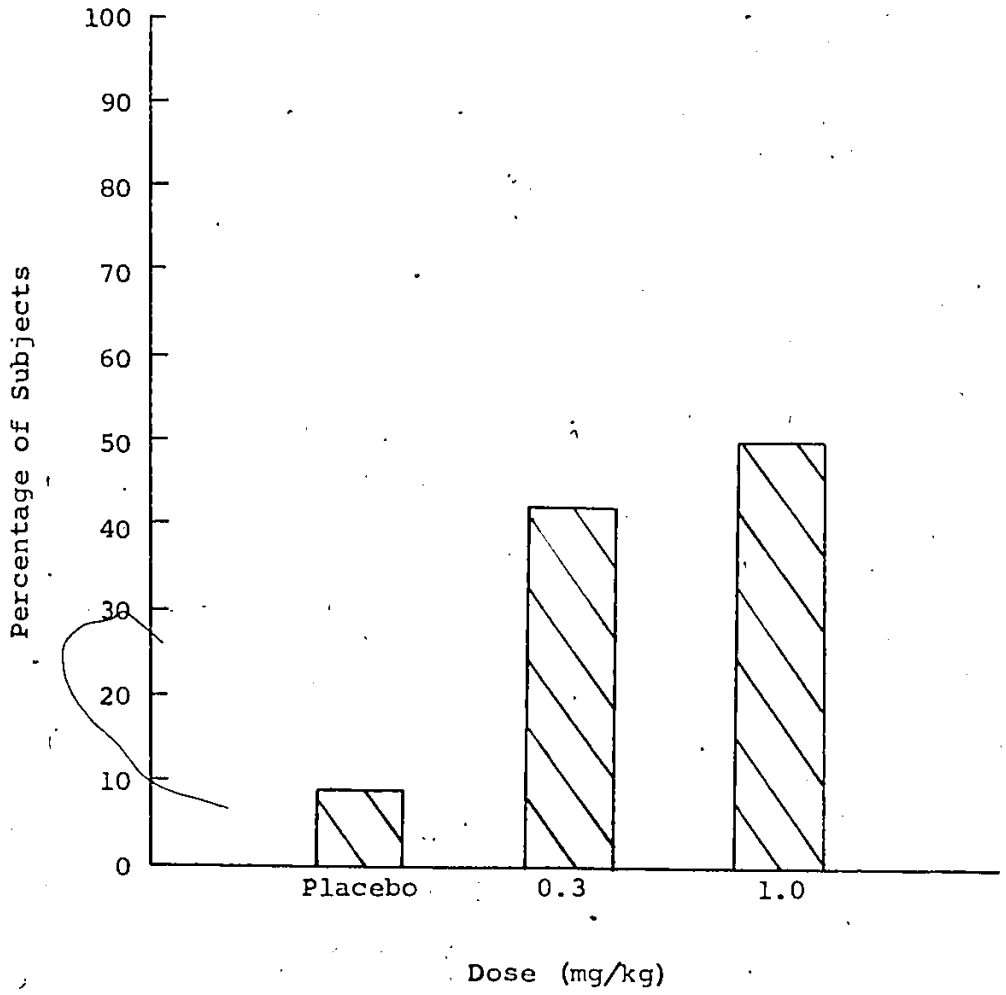



Figure 3. Percentage of subjects showing optimal enhancement of Attention Correct for each drug condition.

benefitted 41.67 % and 50.0 % of subjects respectively[7].

Errors of omission. Again contrary to predictions, both levels of active medication reduced the number of omitted responses relative to placebo (Figure 4). However, as Table 3 indicates, the overall relationship observed failed to achieve a level of significance which would permit further analysis of drug effect ($F(2/12) = 1.58$, $p > .05$). Of interest though, Figure 5 shows that only 16.67 % of subjects performed optimally under placebo conditions, whereas both low and high dosage levels of active medication resulted in peak performance for 41.67 % of the subjects.

Errors of commission. No support was gained for the hypothesis that medication affects number of impulsive responses made by hyperactive subjects ($F(2/12) = 2.0$, $p > .05$), as shown in Table 4. Figure 6 indicates though, that despite the lack of general drug effect, both low and high levels of Ritalin appear to equally reduce impulsive responding relative to placebo. The number of subjects benefitting optimally at each dosage level is graphically portrayed in Figure 7: 16.67 % with placebo, 33.33 % with the low dose, and 50 % under the high dosage condition.

[7] Figure 3 shows the percentage of subjects who attained their peak performance under each dosage level. When ties between two dosage levels occurred for a specific subject, then one half of a subject was counted for each dosage condition; when a tie occurred across three dosage levels, then one third of a subject was assigned to each condition. Failure of totals to add up to 100 % is due to rounding off errors in calculations of part subjects.

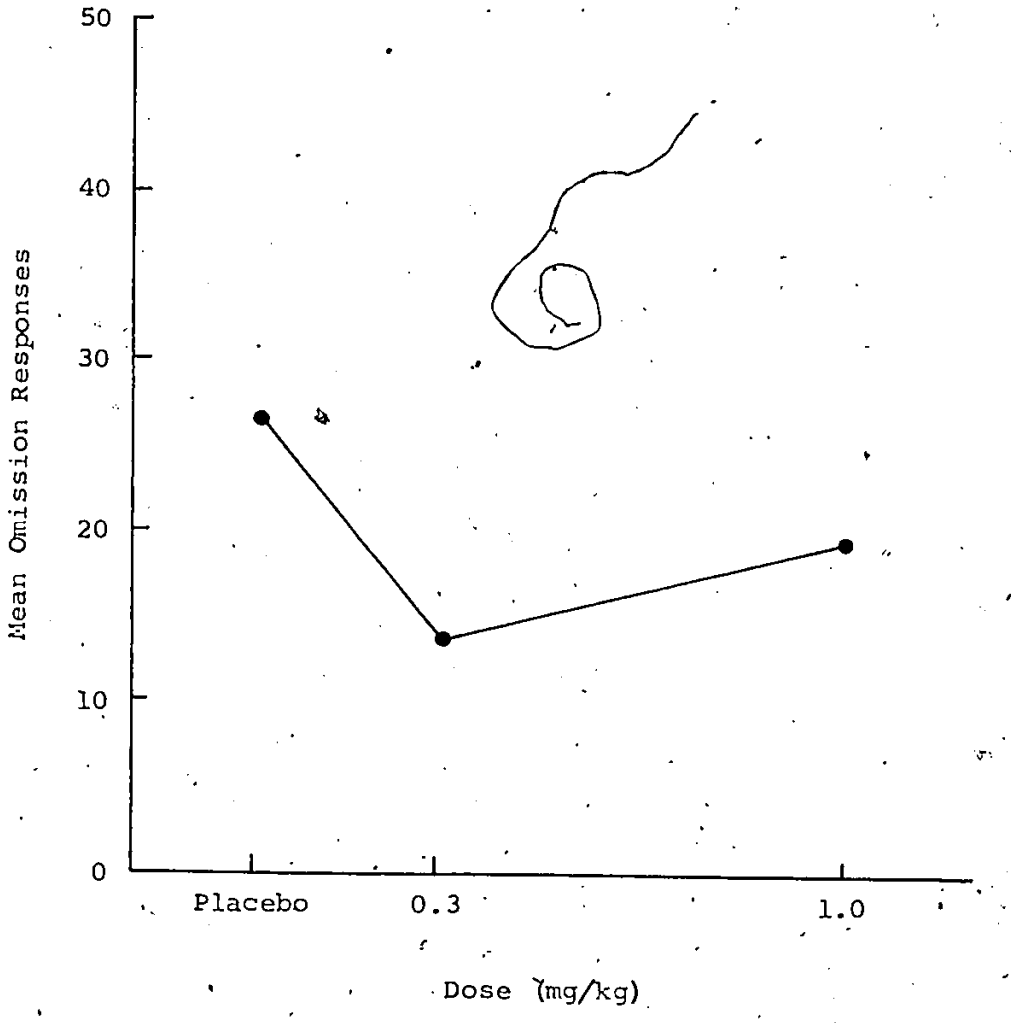



Figure 4. Dose response curve for Attention Omission scores.

TABLE 3

ANALYSIS OF VARIANCE FOR ATTENTION OMISSIONS

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Square (C) | 756.25 | 1 | 756.25 | 0.66 |
| Groups within C | 4617.56 | 4 | 1154.39 | 1.08 |
| Subjects within groups | 6441.17 | 6 | 1073.53 | |
| Days (A) | 500.72 | 2 | 250.36 | 0.79 |
| Drug level (B) | 1001.39 | 2 | 500.70 | 1.58 |
| A x C | 1338.17 | 2 | 669.09 | 2.11 |
| B x C | 54.17 | 2 | 27.09 | 0.09 |
| Residual | 1239.89 | 4 | 309.97 | 0.98 |
| Error | 3804.33 | 12 | 317.03 | |

* $p < .05$

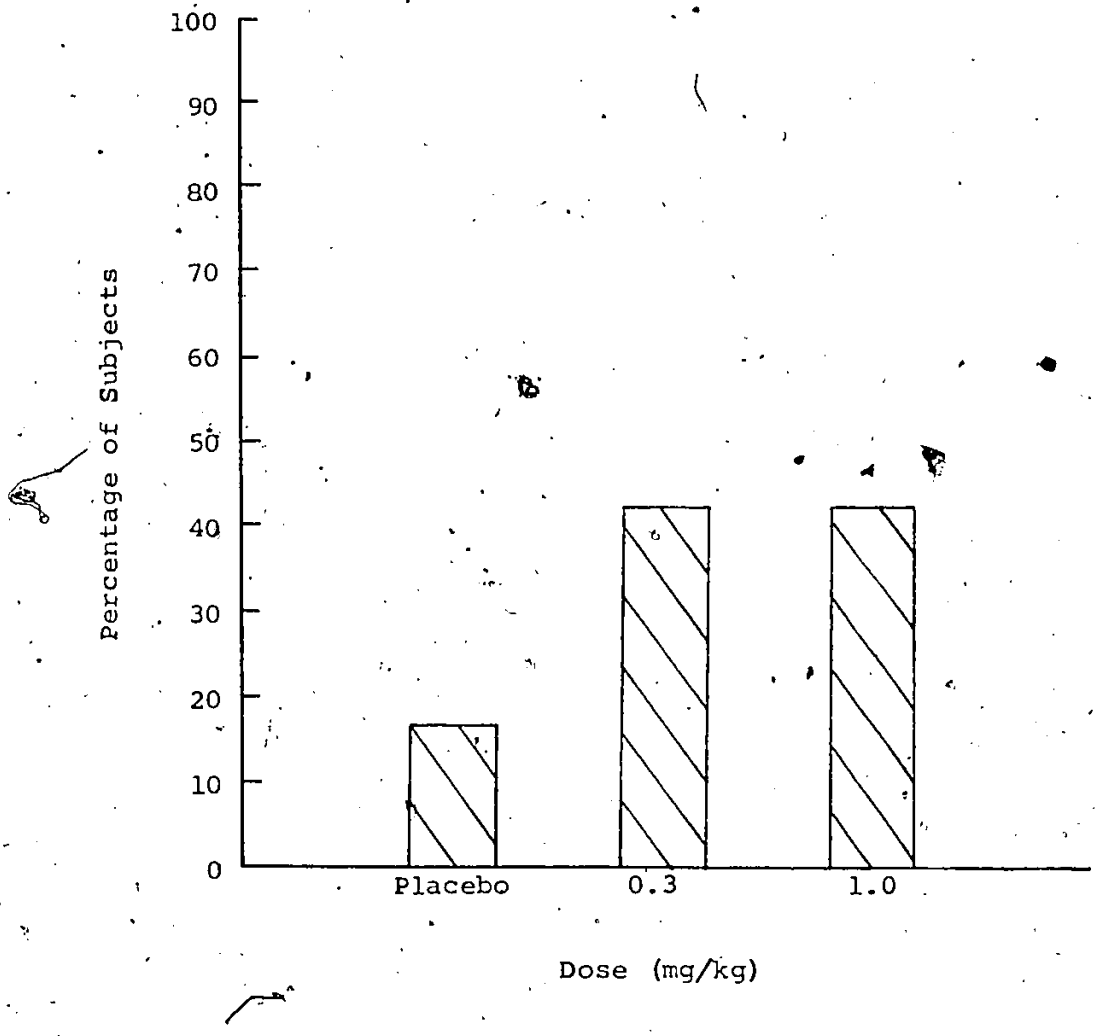



Figure 5. Percentage of subjects showing optimal enhancement of Errors of Omission for each drug condition.

TABLE 4

ANALYSIS OF VARIANCE FOR ATTENTION COMMISSIONS

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Square (C) | 132.25 | 1 | 132.25 | 2.96 |
| Groups within C | 178.67 | 4 | 44.67 | 0.85 |
| Subjects within groups | 316.50 | 6 | 52.75 | |
| Days (A) | 144.67 | 2 | 72.34 | 3.62 |
| Drug level (B) | 80.17 | 2 | 40.09 | 2.00 |
| A x C | 78.00 | 2 | 39.00 | 1.95 |
| B x C | 8.17 | 2 | 4.09 | 0.20 |
| Residual | 20.33 | 4 | 5.08 | 0.25 |
| Error | 240.00 | 12 | 20.00 | |

* $p < .05$

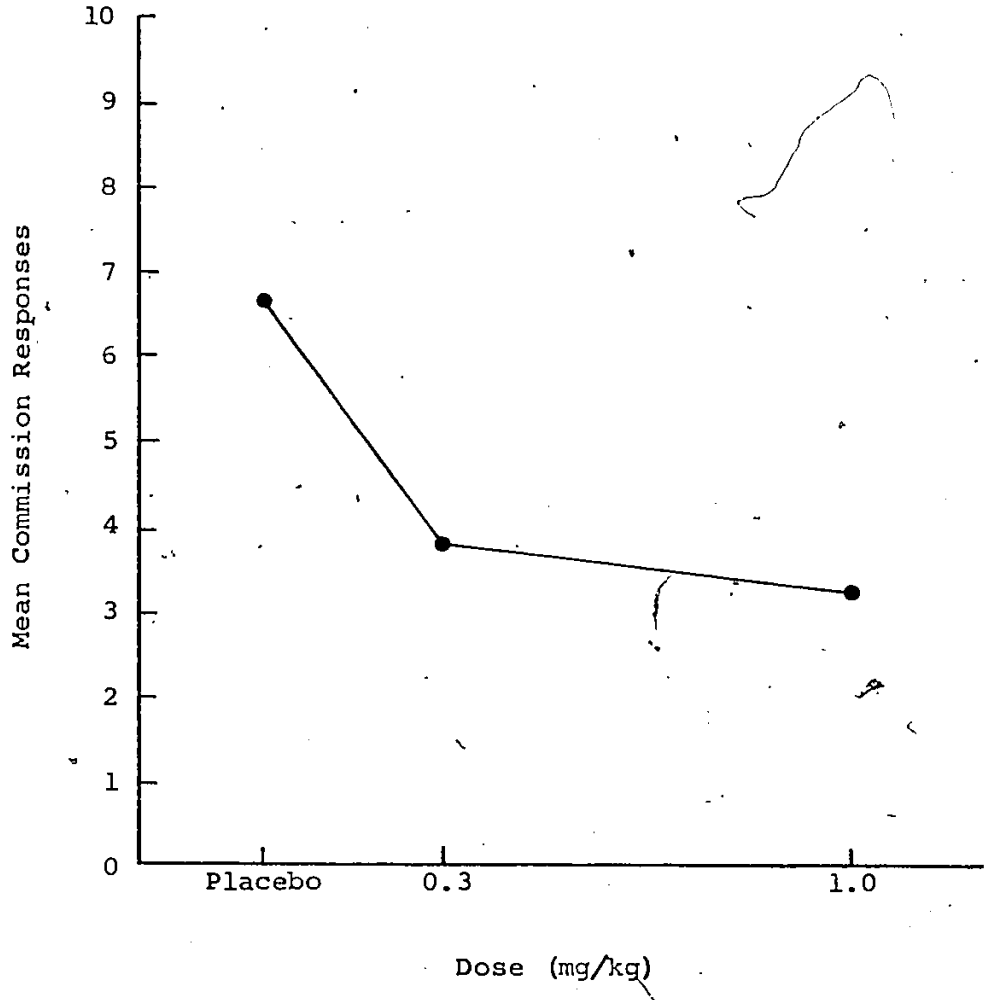



Figure 6. Dose response curve for Attention Commission scores.

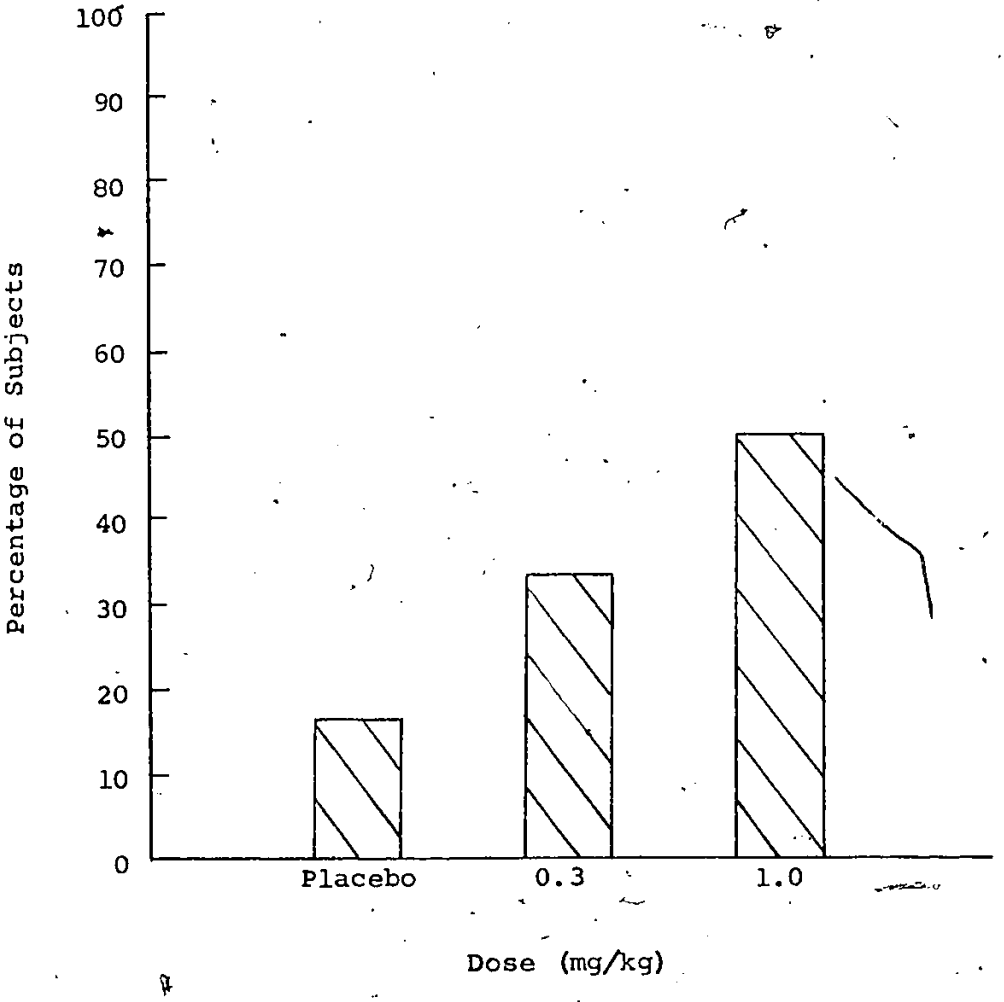



Figure 7. Percentage of subjects showing optimal enhancement of Errors of Commission for each drug condition.

A multiple analysis of variance was performed on the best combination of attention scores: no significant relationships emerged.

For individuals, it appears that placebo optimally benefits attention for a few subjects whereas both low and high dosage conditions tend to optimally enhance almost equal numbers for each of the three attention measures. However, contrary to hypotheses, comparison of group responses on the three scores failed to support a general benefit of medication for attention in hyperkinetic children.

Mother-Child Interaction

Social behaviour was viewed as being affected by medication differently than attention. That is, while performance should improve under low medication relative to placebo, maximum benefit should be observed under high dosage conditions.

Mother's direction. Task-related comments from mothers to sons did not vary significantly, relative to medication condition ($F(2/12) = 0.33$, $p > .05$; Table 5). As depicted in Figure 8, mothers did offer less direction under medication than placebo conditions, however, the high dosage level was generally less effective than the low. Figure 9 reveals that both the low and high dosage conditions resulted in optimal responding for 41.67 % of mothers, while placebo was best for 16.67 %.

TABLE 5

ANALYSIS OF VARIANCE FOR MOTHER'S DIRECTIONS

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Square (C) | 1086.80 | 1 | 1086.80 | 0.99 |
| Groups within C | 4401.06 | 4 | 1100.27 | 1.03 |
| Subjects within groups | 6387.84 | 6 | 1064.64 | |
| Days (A) | 279.85 | 2 | 139.93 | 0.41 |
| Drug level (B) | 226.55 | 2 | 113.28 | 0.33 |
| A x C | 76.30 | 2 | 38.15 | 0.11 |
| B x C | 317.05 | 2 | 158.53 | 0.47 |
| Residual | 612.53 | 4 | 153.13 | 0.45 |
| Error | 4069.51 | 12 | 339.13 | |

* $p < .05$

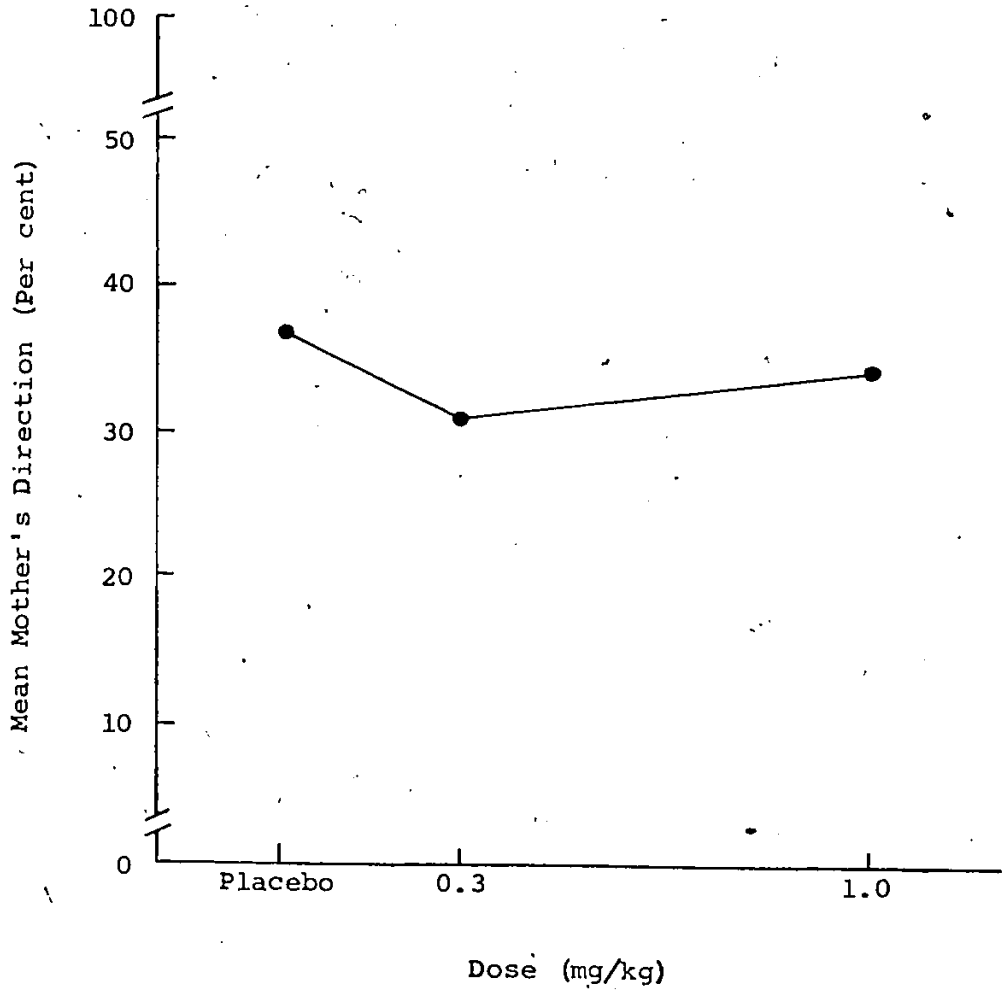



Figure 8. Dose response curve for Mother's Direction scores.

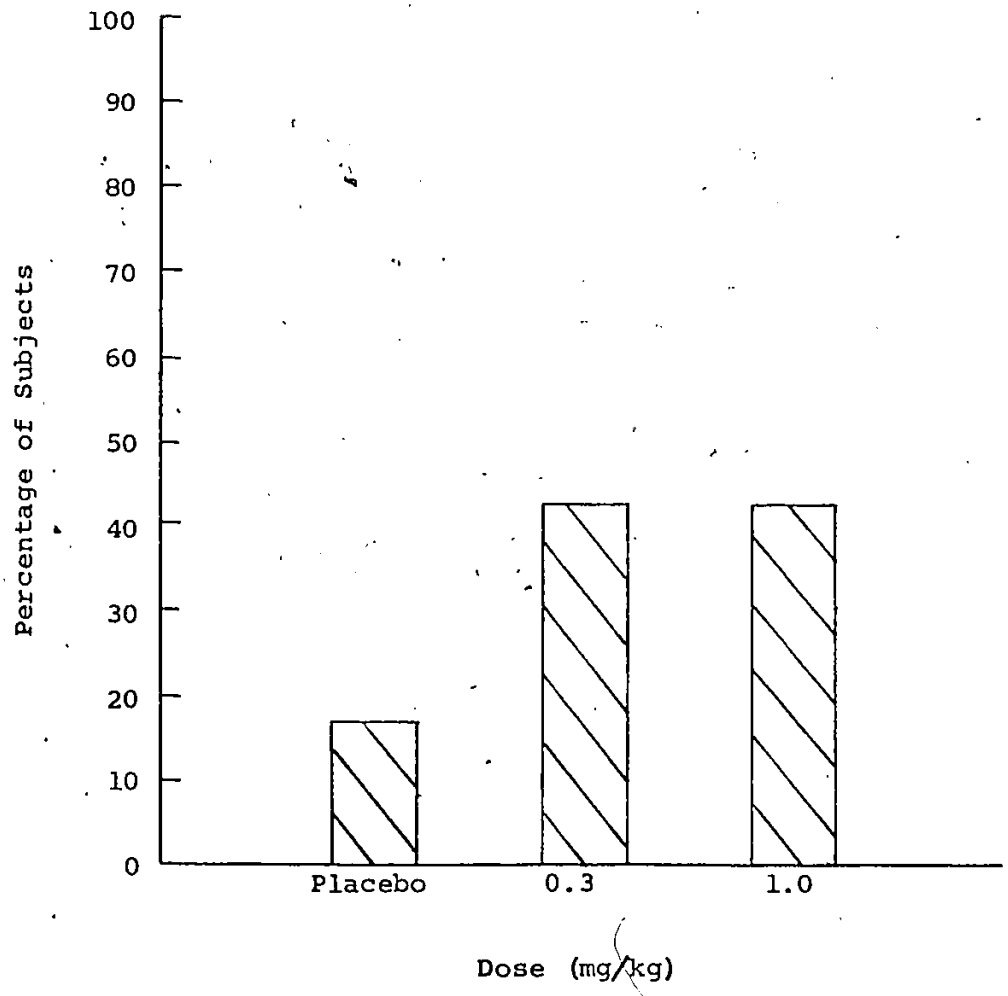



Figure 9. Percentage of subjects showing optimal enhancement of Mother's Direction for each drug condition.

Son's direction. Figure 10 shows that increasing the dosage strength of medication did not similarly increase subjects' directiveness in interaction with their mothers; although the low dose increased son's directions slightly, relative to placebo and high dose conditions. No significant drug effect was observed for son's directiveness with his mother ($F(2/12) = 1.43$, $p > .05$; Table 6). An interaction between the day of testing and Latin square assignment was present, though ($F(2/12) = 4.41$, $p < .05$). Although there was a failure to support the hypothesis of significant increase of son's directions with increasing strength of medication, Figure 11 is suggestive of a specific drug effect for individual subjects. That is, while 8.33 % of subjects responded with greatest directiveness under placebo, 45.83 % of subjects responded optimally under each of the active medication conditions.

Mother's explanation. Although a rather convincing trend is depicted in Figure 12, suggesting that mothers' explanations increase with increased strength of medication, the analysis of variance (Table 7) failed to support a significant difference between the three dosage levels ($F(2/12) = 2.15$, $p > .05$). On an individual level, there was observed a tendency for medication, particularly the highest dosage level, to optimally benefit the performance of the greatest number of subjects (Figure 13): 8.33 % for placebo, 33.33 % for the low dosage level, and 58.33 % for the high.

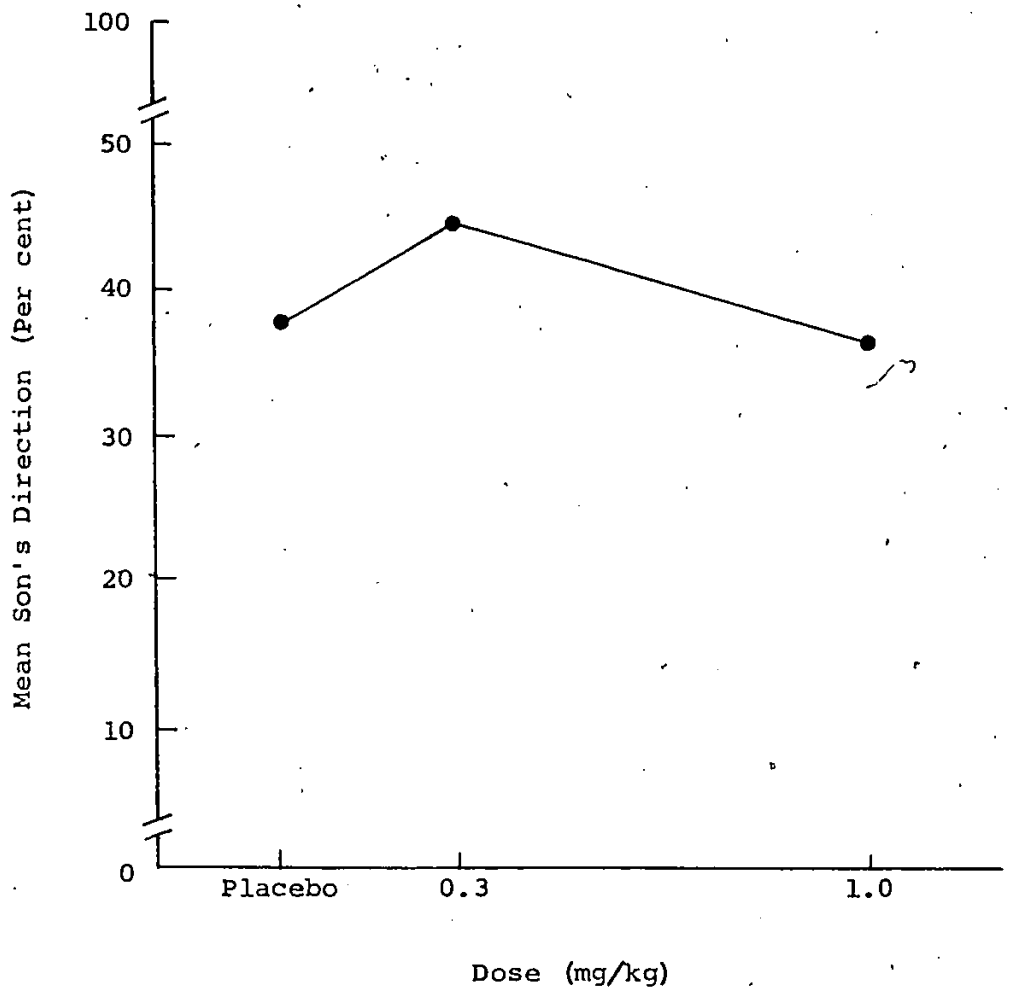



Figure 10. Dose response curve for Son's Direction scores.

TABLE 6

ANALYSIS OF VARIANCE FOR SON'S DIRECTIONS

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Square (C) | 1523.60 | 1 | 1523.60 | 0.47 |
| Groups within C | 12873.10 | 4 | 3218.28 | 3.22 |
| Subjects within groups | 5995.05 | 6 | 999.18 | |
| Days (A) | 89.44 | 2 | 44.72 | 0.30 |
| Drug level (B) | 429.13 | 2 | 214.57 | 1.43 |
| A x C | 1322.43 | 2 | 661.22 | 4.41* |
| B x C | 225.29 | 2 | 112.65 | 0.75 |
| Residual | 586.24 | 4 | 146.56 | 0.98 |
| Error | 1798.14 | 12 | 149.85 | |

* $p < .05$ .

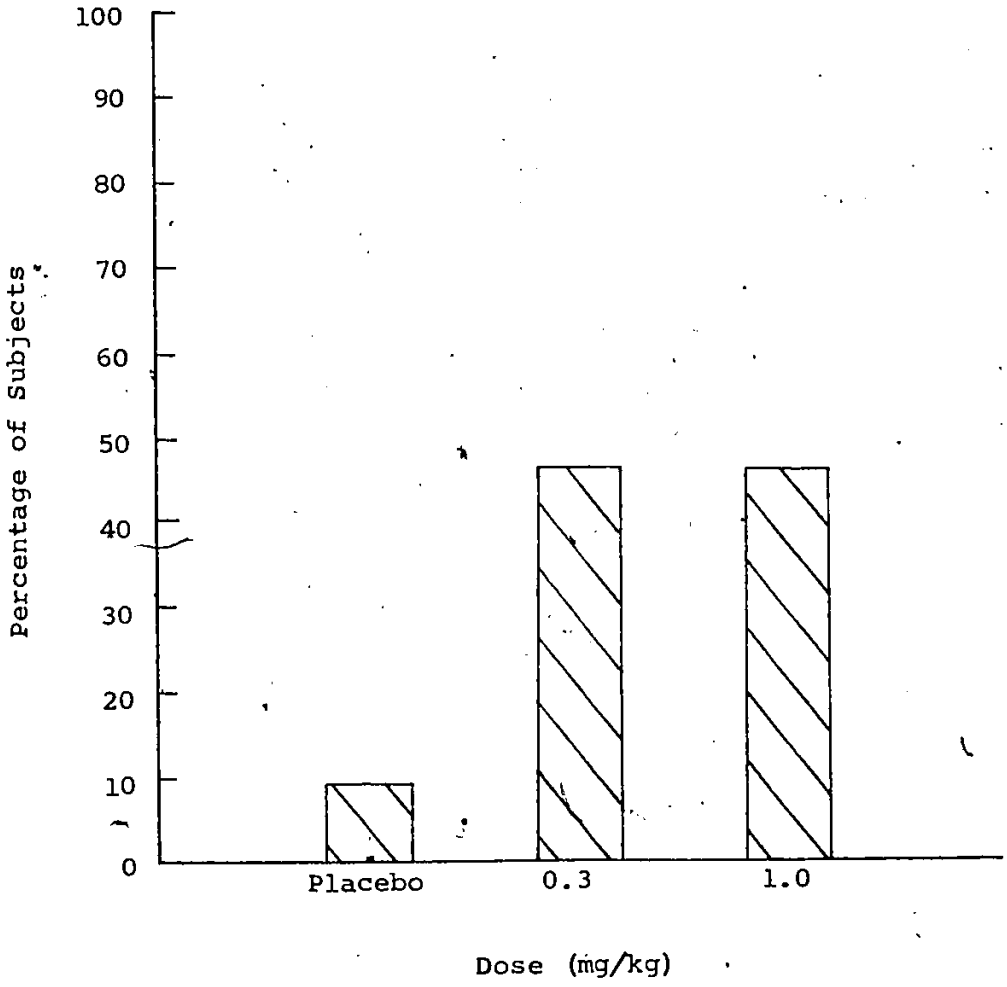



Figure 11. Percentage of subjects showing optimal enhancement of Son's Direction for each drug condition.

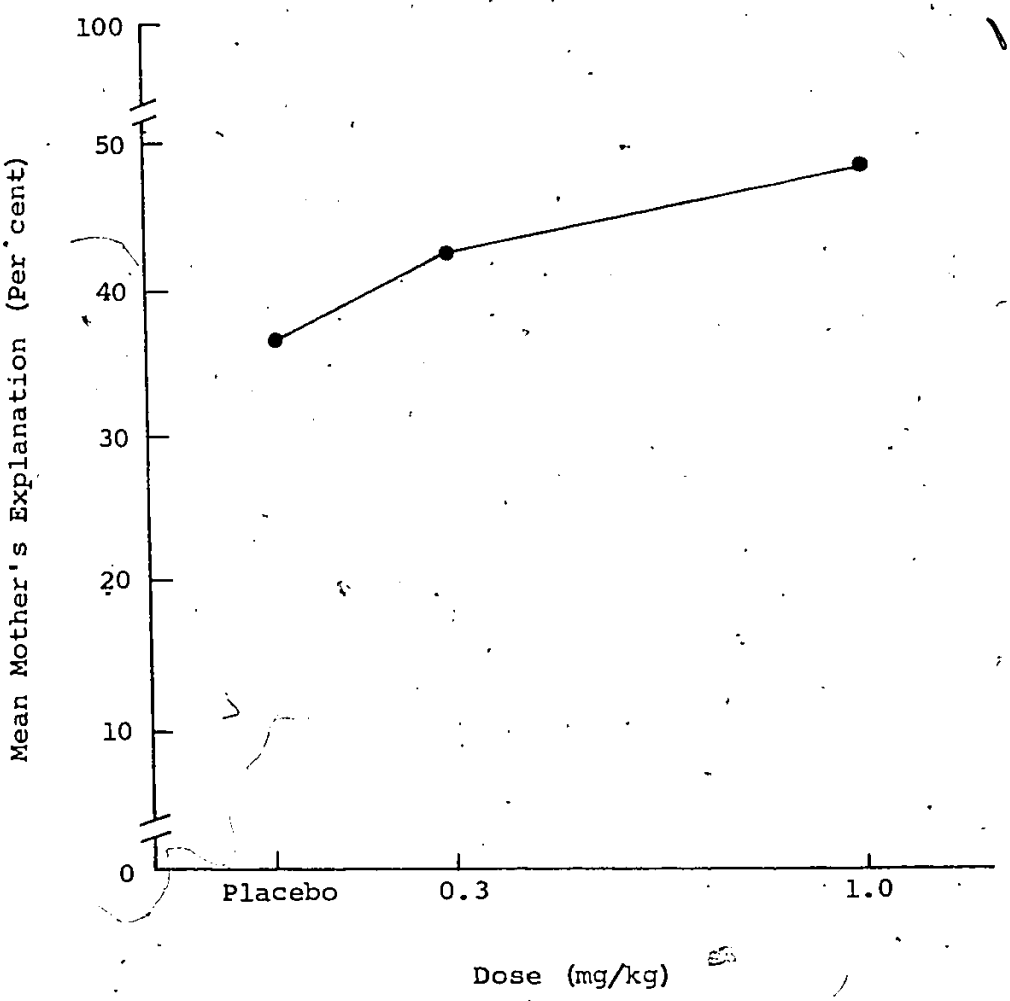



Figure 12. Dose response curve for Mother's Explanation scores.

TABLE 7

ANALYSIS OF VARIANCE FOR MOTHER'S EXPLANATIONS

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Square (C) | 652.80 | 1 | 652.80 | 0.47 |
| Groups within C | 6101.00 | 4 | 1525.25 | 4.39 |
| Subjects within groups | 2084.58 | 6 | 347.43 | |
| Days (A) | 6.79 | 2 | 3.40 | 0.00 |
| Drug level (B) | 760.25 | 2 | 380.13 | 2.15 |
| A x C | 805.60 | 2 | 402.80 | 2.28 |
| B x C | 230.05 | 2 | 115.03 | 0.65 |
| Residual | 1278.[illegible] | 4 | 319.57 | 1.81 |
| Error | 2123.49 | 12 | 176.96 | |

* $p < .05$

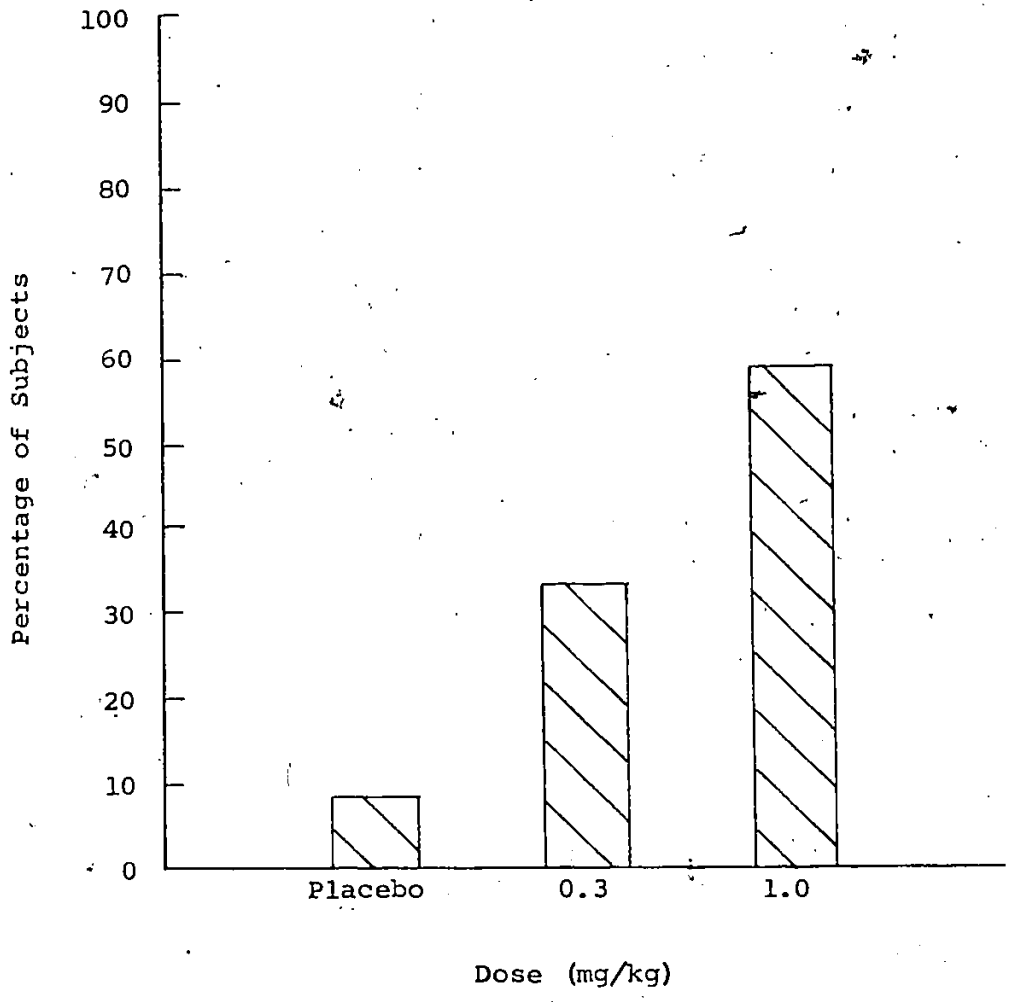



Figure 13. Percentage of subjects showing optimal enhancement of Mother's Explanation for each drug condition.

Son's explanation. The analysis in Table 8 ($F(2/12) = .03$, $p > .05$) confirms the visual impression of Figure 14, that no significant difference was evident for the effect of medication on the sons' explanations to their mothers. However, both active medications resulted in lower scores than placebo. Placebo resulted in peak performance for 33.33 % of subjects while low and high dosage conditions benefitted 45.83 % and 20.83 % respectively (Figure 15).

Mother's praise. Although mothers tended to deliver greater praise as dosage level of medication increased from placebo (Figure 16), the difference between dosages was not found to be significant ($F(2/12) = 1.90$, $p > .05$; Table 9). There was observed a significant difference in scores between groups of subjects assigned to specific sequences of medication though ($F(4/6) = 5.46$, $p < .05$). On an individual basis, 19.42 % of mothers offered greatest praise with placebo, 44.2 % with the low level of Ritalin, and 36.08 % with the higher level (Figure 17).

Son's praise. Figure 18 suggests that while both medication levels reduce the amount of praise that sons offer their mothers, relative to placebo, the actual difference is a small one. The analysis of variance shown in Table 10 confirms that son's praise was not generally altered by dosage level of Ritalin ($F(2/12) = 0.84$, $p > .05$). Similarly, there does not appear to be a tendency for placebo or either active medication levels to enhance this

TABLE 8

ANALYSIS OF VARIANCE FOR SON'S EXPLANATIONS

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Square (C) | 2131.36 | 1 | 2131.36 | 1.50 |
| Groups within C | 5692.00 | 4 | 1423.00 | 2.00 |
| Subjects within groups | 4269.75 | 6 | 711.63 | |
| Days (A) | 171.62 | 2 | 85.81 | 0.20 |
| Drug level (B) | 27.77 | 2 | 13.89 | 0.03 |
| A x C | 115.99 | 2 | 58.00 | 0.14 |
| B x C | 749.69 | 2 | 374.85 | 0.89 |
| Residual | 1251.51 | 4 | 312.88 | 0.74 |
| Error | 5073.05 | 12 | 422.75 | |

* $p < .05$

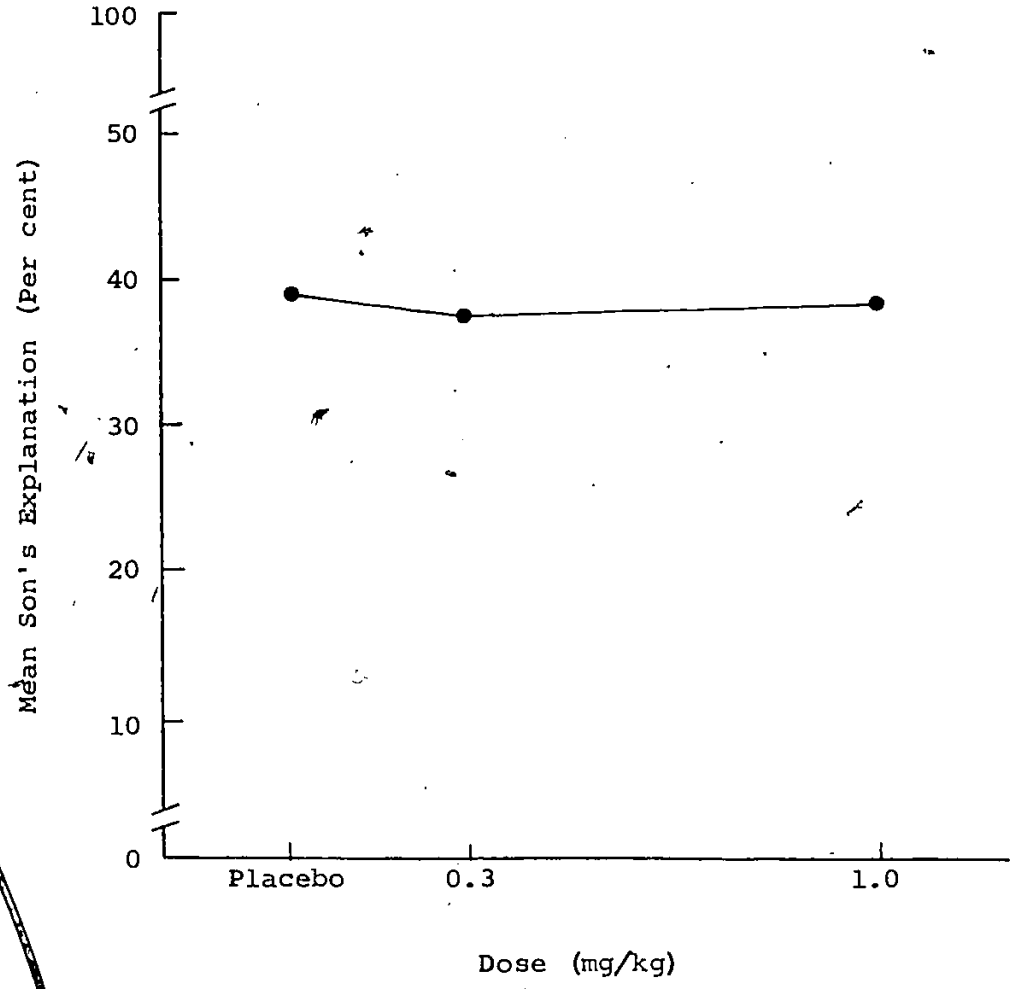



Figure 14. Dose response curve for Son's Explanation scores.

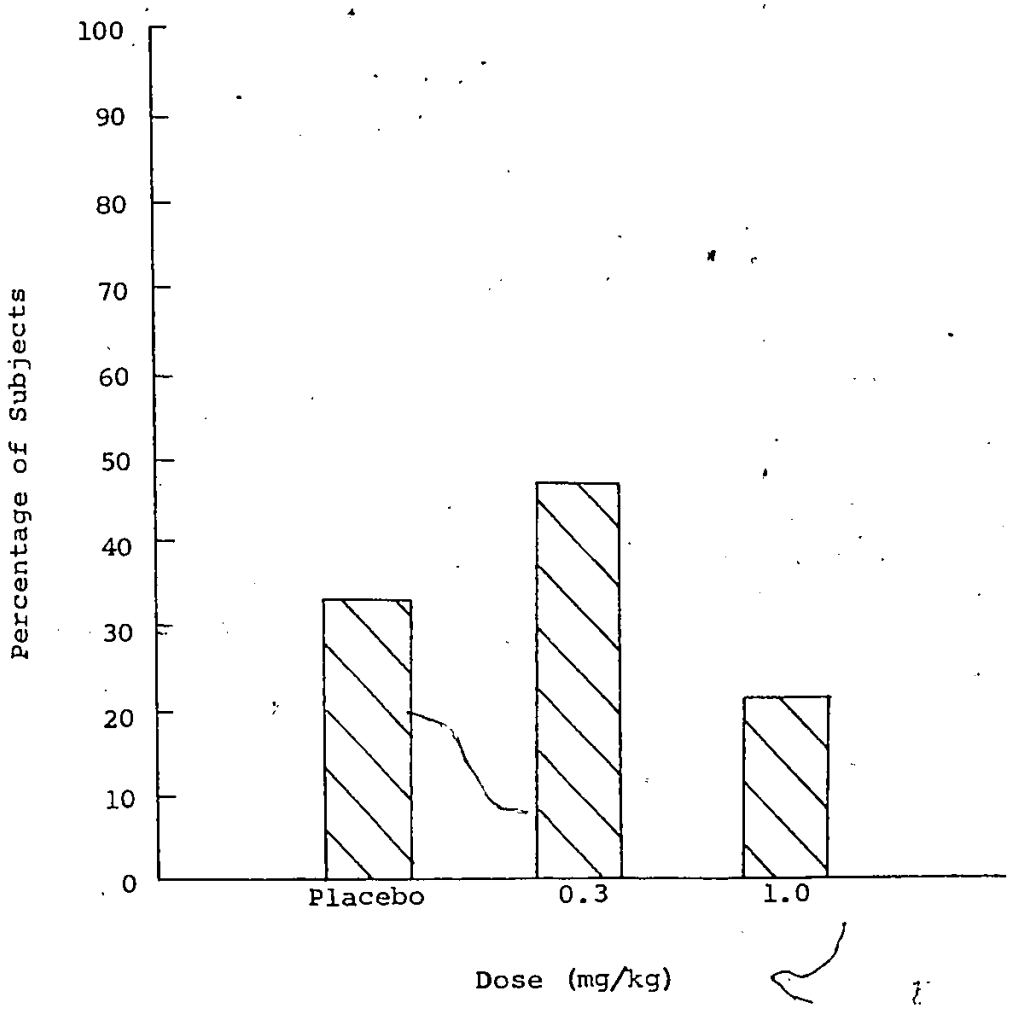



Figure 15. Percentage of subjects showing optimal enhancement of Son's Explanation for each drug condition.

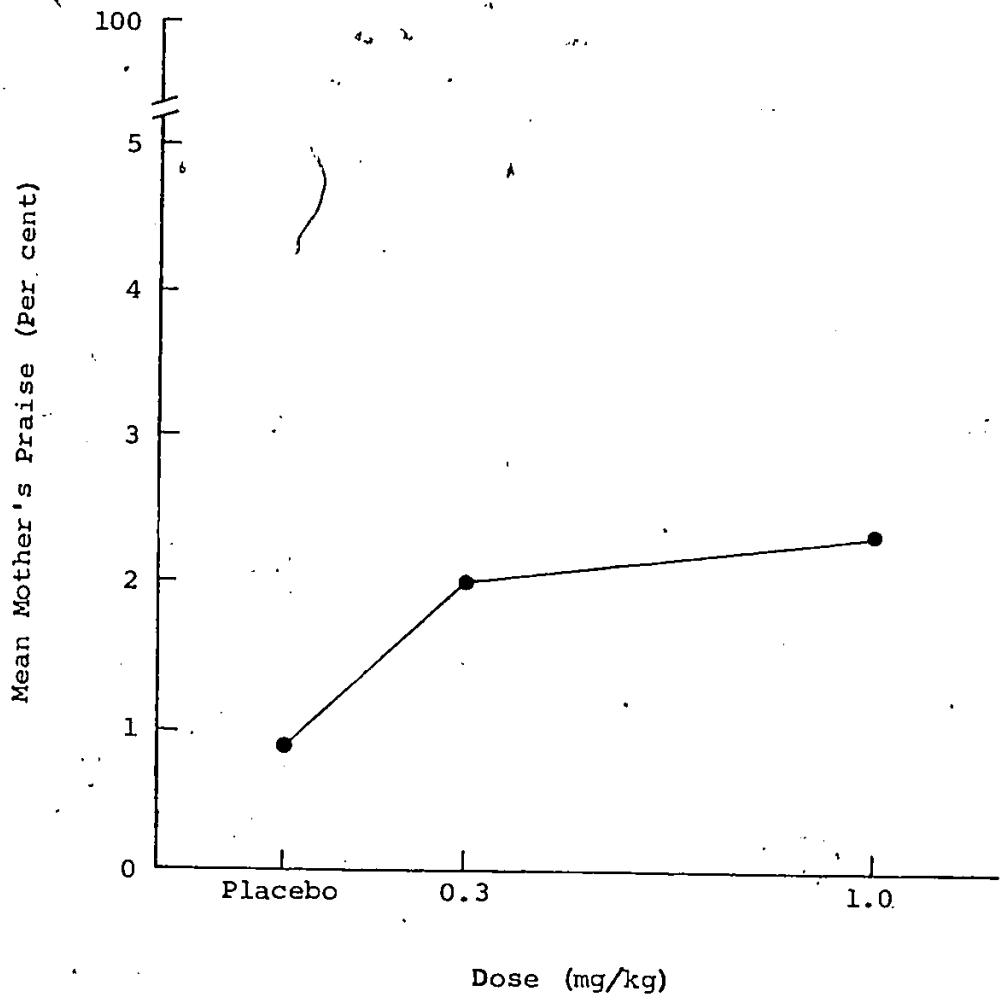



Figure 16. Dose response curve for Mother's Praise scores.

TABLE 9

ANALYSIS OF VARIANCE FOR MOTHER'S PRAISE

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Square (C) | 0.23 | 1 | 0.23 | 0.01 |
| Groups within C | 96.35 | 4 | 24.09 | 5.46* |
| Subjects within groups | 26.46 | 6 | 4.41 | |
| Days (A) | 0.08 | 2 | 0.04 | 0.01 |
| Drug level (B) | 12.16 | 2 | 6.08 | 1.90 |
| A x C | 10.06 | 2 | 5.03 | 1.57 |
| B x C | 3.17 | 2 | 1.59 | 0.50 |
| Residual | 27.74 | 4 | 6.94 | 2.17 |
| Error | 38.32 | 12 | 3.19 | |

* $p < .05$

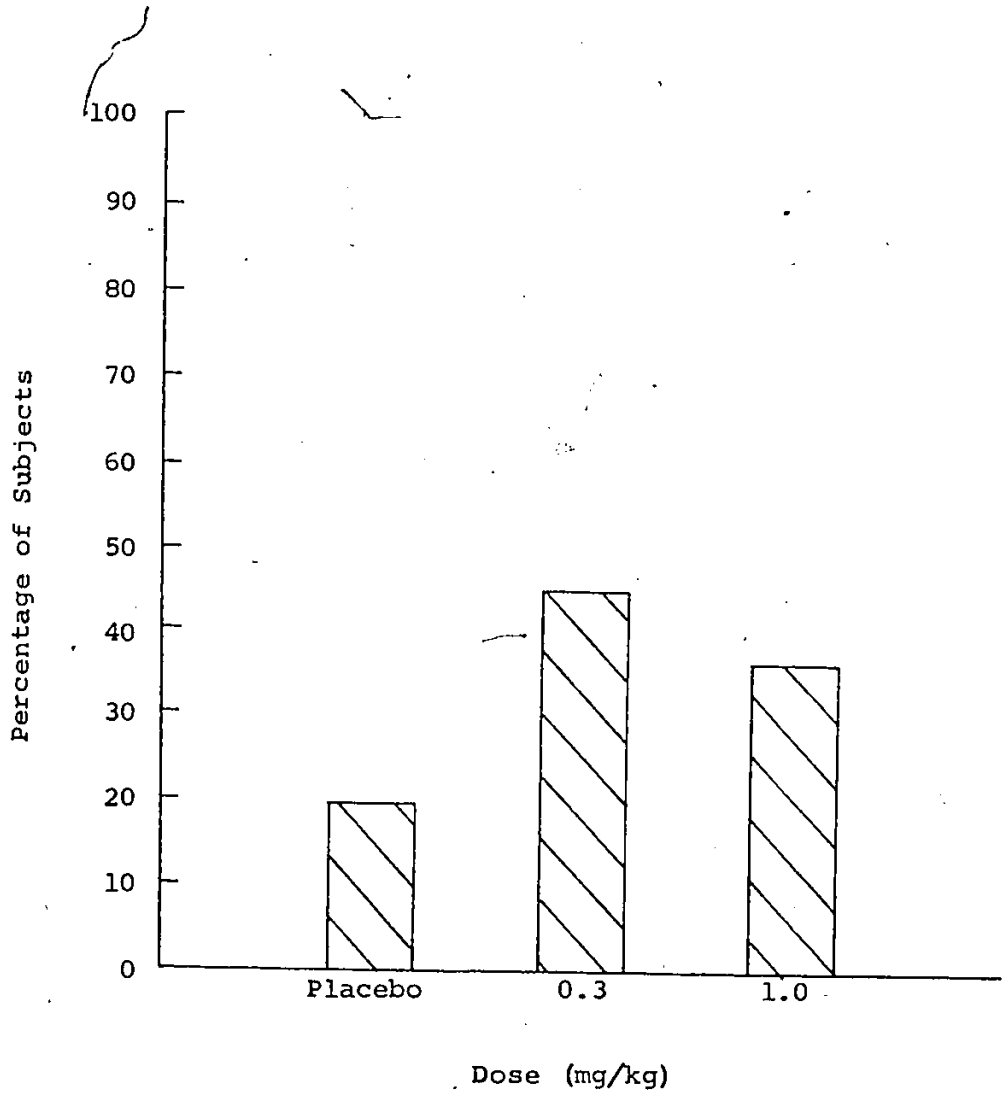



Figure 17. Percentage of subjects showing optimal enhancement of Mother's Praise for each drug condition.

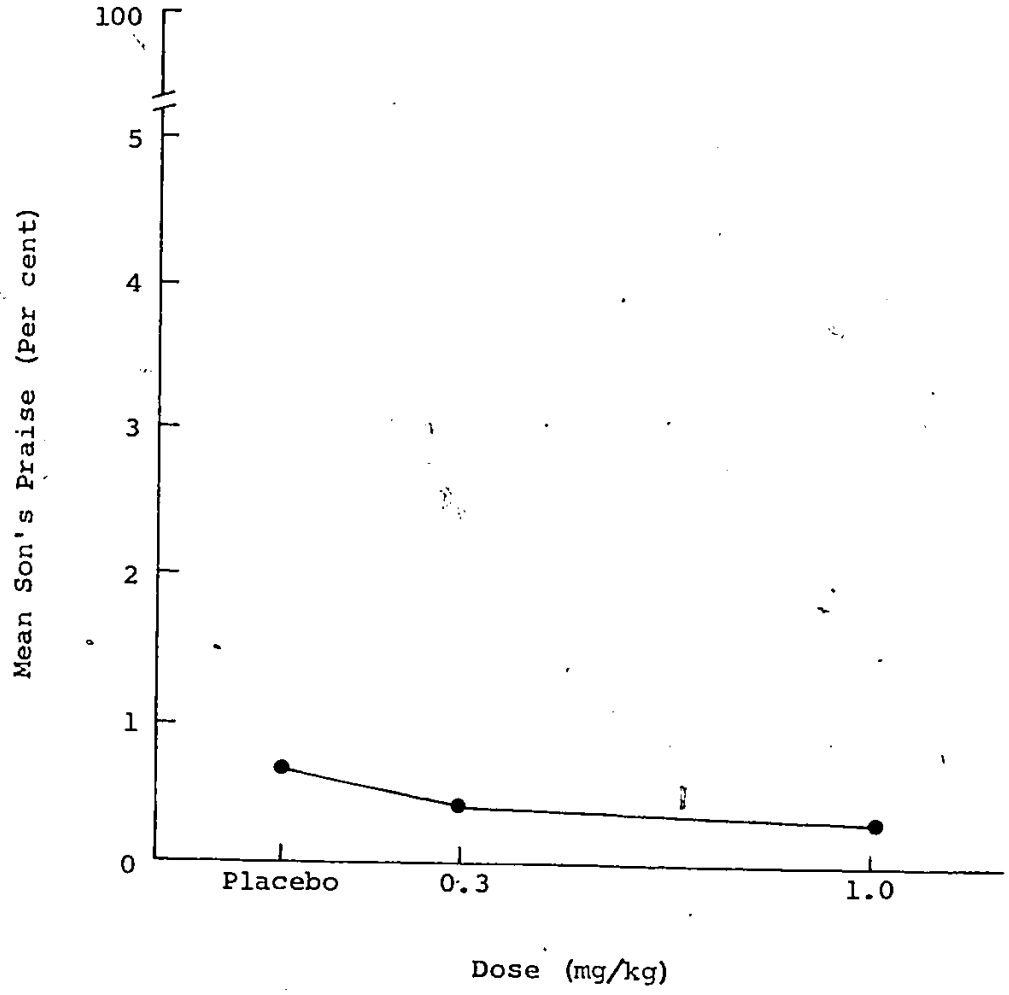



Figure 18. Dose response curve for Son's Praise scores.

TABLE 10

ANALYSIS OF VARIANCE FOR SON'S PRAISE

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Square (C) | 0.32 | 1 | 0.32 | 4.00 |
| Groups within C | 0.32 | 4 | 0.08 | 0.09 |
| Subjects within groups | 5.34 | 6 | 0.89 | |
| Days (A) | 3.31 | 2 | 1.66 | 3.08 |
| Drug level (B) | 0.90 | 2 | 0.45 | 0.84 |
| A x C | 0.59 | 2 | 0.30 | 0.55 |
| B x C | 0.81 | 2 | 0.41 | 0.75 |
| Residual | 0.84 | 4 | 0.21 | 0.39 |
| Error | 6.44 | 12 | 0.54 | |

* $p < .05$

interaction variable for a majority of the subjects: placebo optimally increased praise in 41.67 % of subjects, low dosage increased praise for 33.33 %, while higher dosage optimally influenced 25.0 % (Figure 19).

Mother's criticism. Consistent with predictions, mothers offered less criticism of their sons' performance when the latter received medication (Figure 20), yet the differences between dosage conditions was not significant ($F(2/12) = 0.46$, $p > .05$; Table 11). The low dose of Ritalin seemed to be most effective in reducing maternal criticism for the greatest number (45.83 %), while placebo and the higher dose maximally reduced criticism for almost equal numbers (25 % and 29.17 %, respectively; Figure 21).

Son's criticism. Figure 22 demonstrates that, contrary to predictions, critical comments made by sons increased with the low dose of Ritalin, relative to placebo; and even the high dose did not decrease these criticisms. These differences though, were not found to be significant, as shown in Table 12 ($F(2/12) = 0.85$, $p > .05$). Highest reduction of sons' criticisms was achieved for the most subjects under both placebo and high dosage levels (38.83 % in each), while the low dosage condition offered greatest benefit to 22.17 % of subjects (Figure 23).

Mother's off-task. Mothers' off-task comments were not found to vary as a function of dosage level of Ritalin ($F(2/12) = 0.92$, $p > .05$; Table 13). Figure 24 further

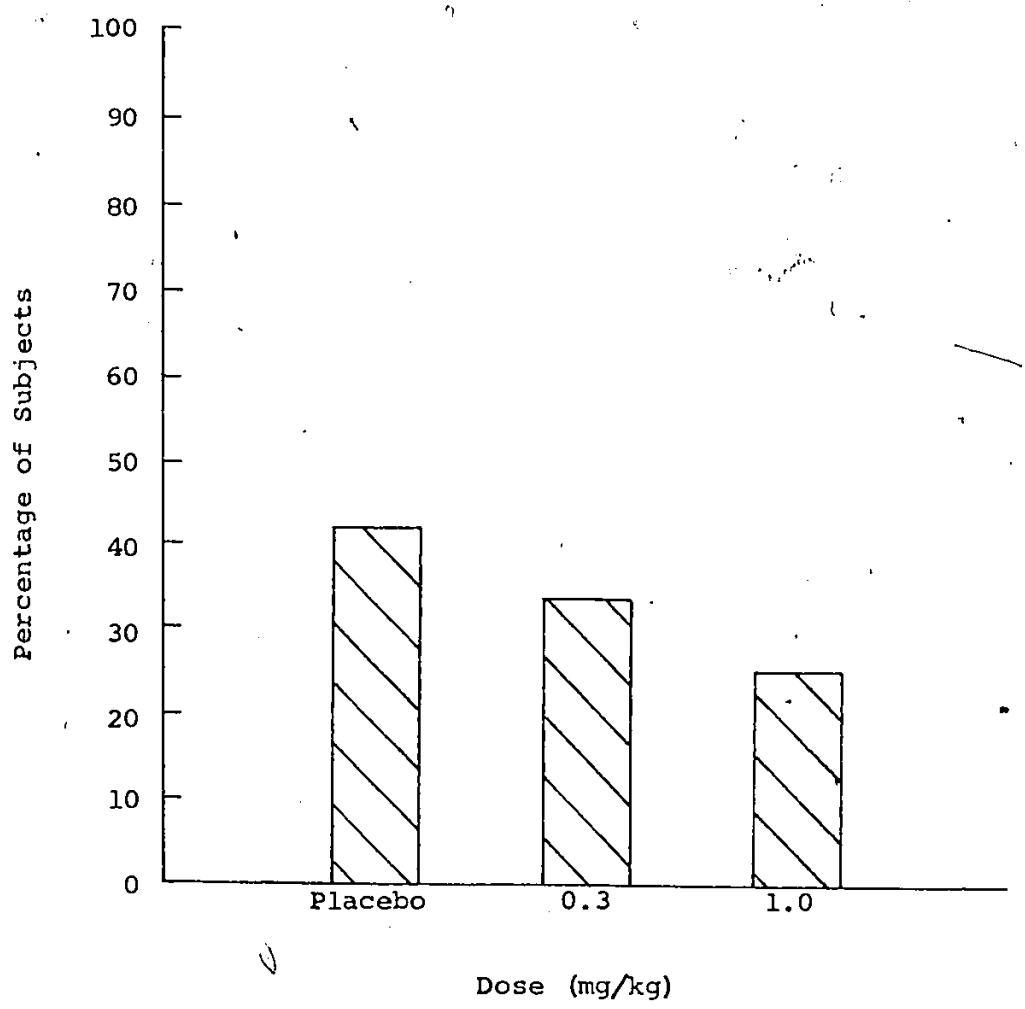



Figure 19. Percentage of subjects showing optimal enhancement of Son's Praise for each drug condition.

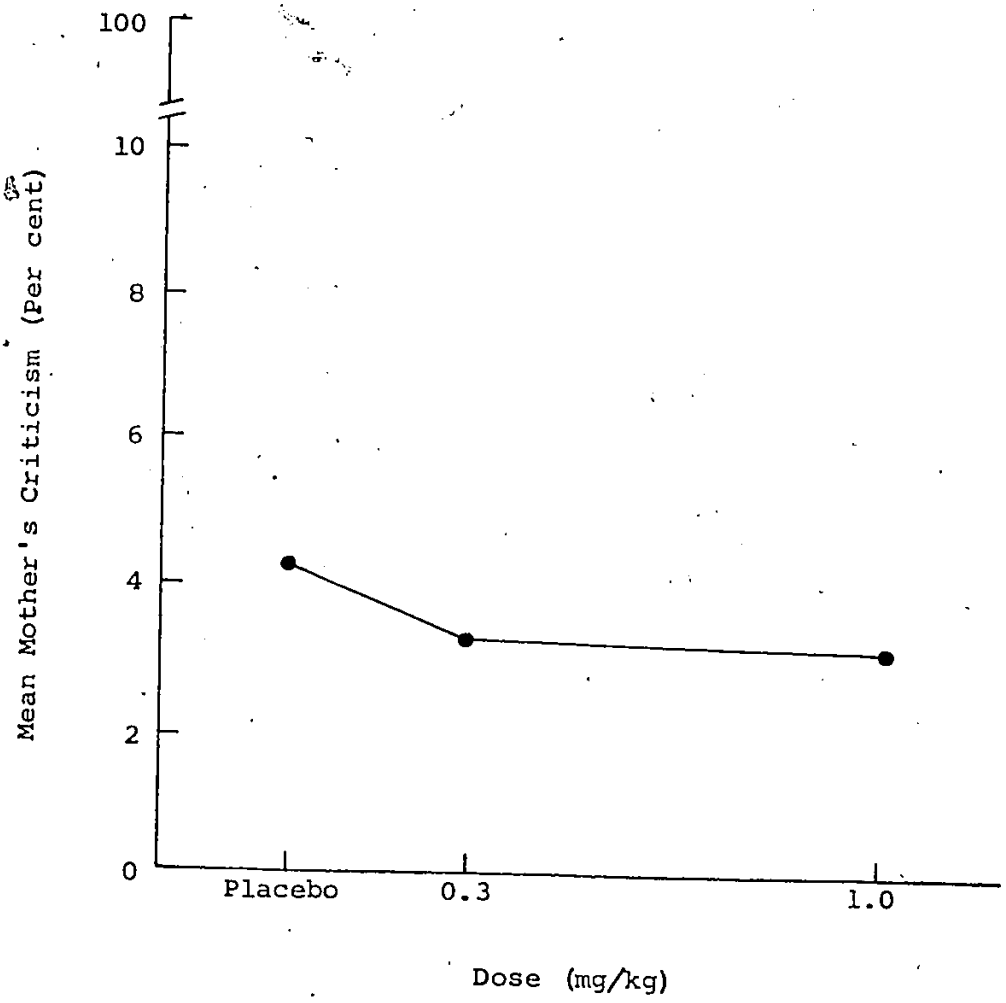



Figure 20. Dose response curve for Mother's Criticism scores.

TABLE 11

ANALYSIS OF VARIANCE FOR MOTHER'S CRITICISM

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Square (C) | 0.64 | 1 | 0.64 | 0.05 |
| Groups within C | 55.30 | 4 | 13.83 | 0.88 |
| Subjects within groups | 94.26 | 6 | 15.71 | |
| Days (A) | 16.76 | 2 | 8.38 | 0.95 |
| Drug level (B) | 8.12 | 2 | 4.06 | 0.46 |
| A x C | 0.70 | 2 | 0.35 | 0.04 |
| B x C | 9.67 | 2 | 4.84 | 0.55 |
| Residual | 43.00 | 4 | 10.75 | 1.22 |
| Error | 105.58 | 12 | 8.80 | |

* $p < .05$

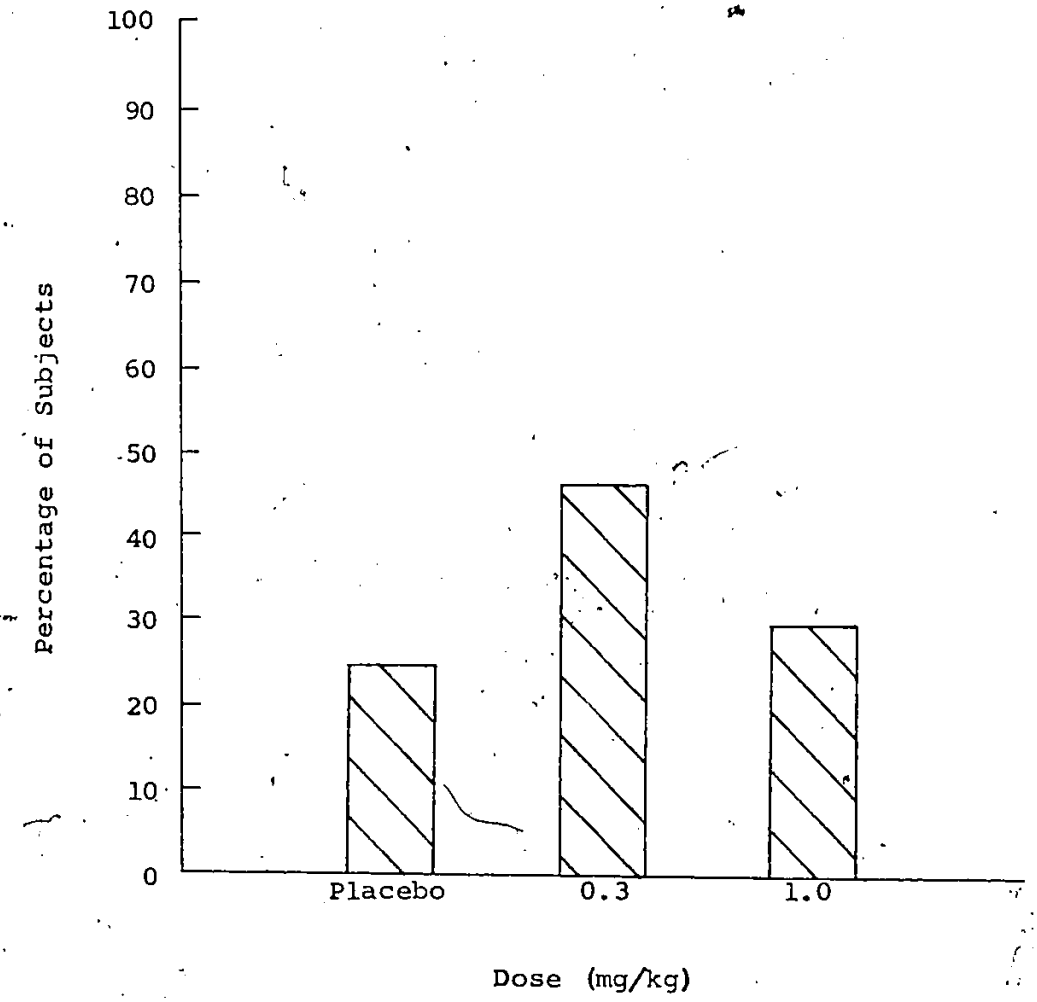



Figure 21. Percentage of subjects showing optimal enhancement of Mother's Criticism for each drug condition.

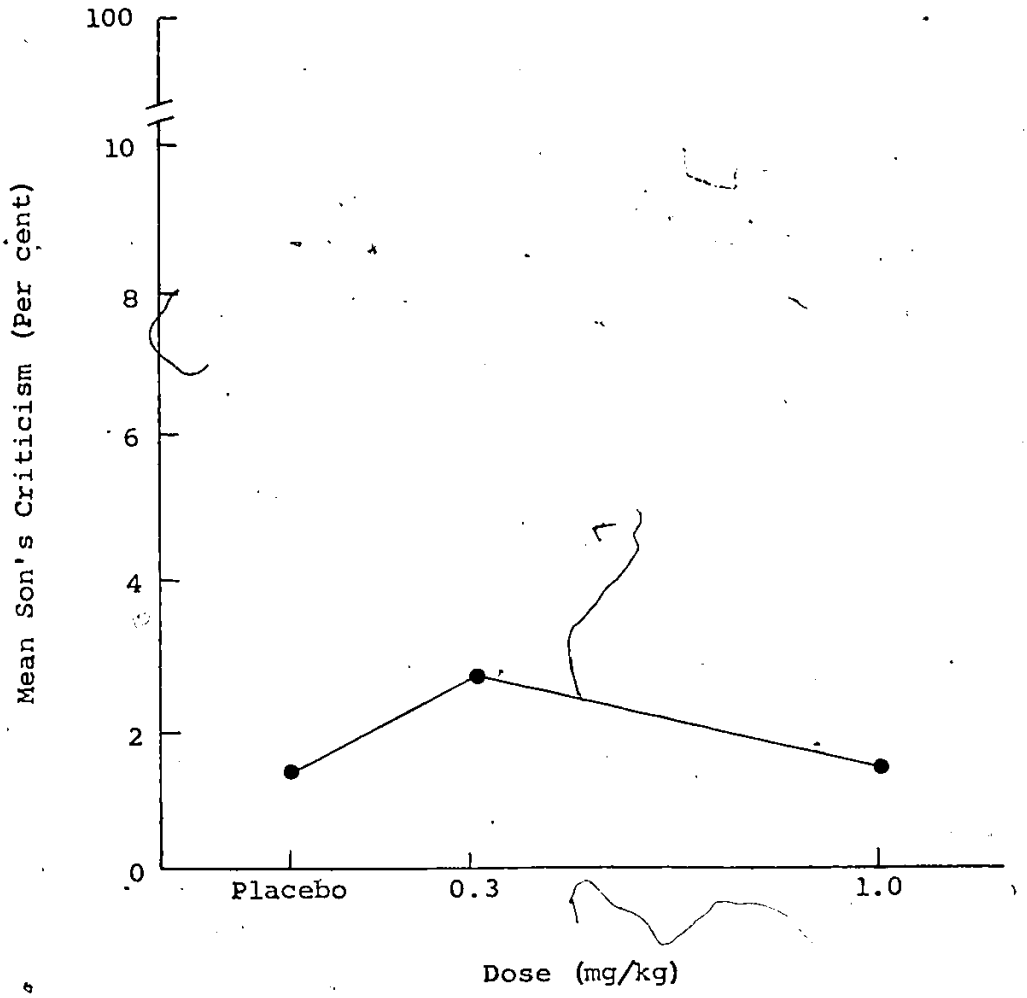



Figure 22. Dose response curve for Son's Criticism scores.

TABLE 12

ANALYSIS OF VARIANCE FOR SON'S CRITICISM

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Square (C) | 13.94 | 1 | 13.94 | 1.56 |
| Groups within C | 35.67 | 4 | 8.92 | 0.45 |
| Subjects within groups | 118.09 | 6 | 19.68 | |
| Days (A) | 9.04 | 2 | 4.52 | 0.46 |
| Drug level (B) | 16.71 | 2 | 8.36 | 0.85 |
| A x C | 3.62 | 2 | 1.81 | 0.18 |
| B x C | 11.72 | 2 | 5.86 | 0.60 |
| Residual | 67.72 | 4 | 16.93 | 1.73 |
| Error | 117.68 | 12 | 9.81 | |

* $p < .05$

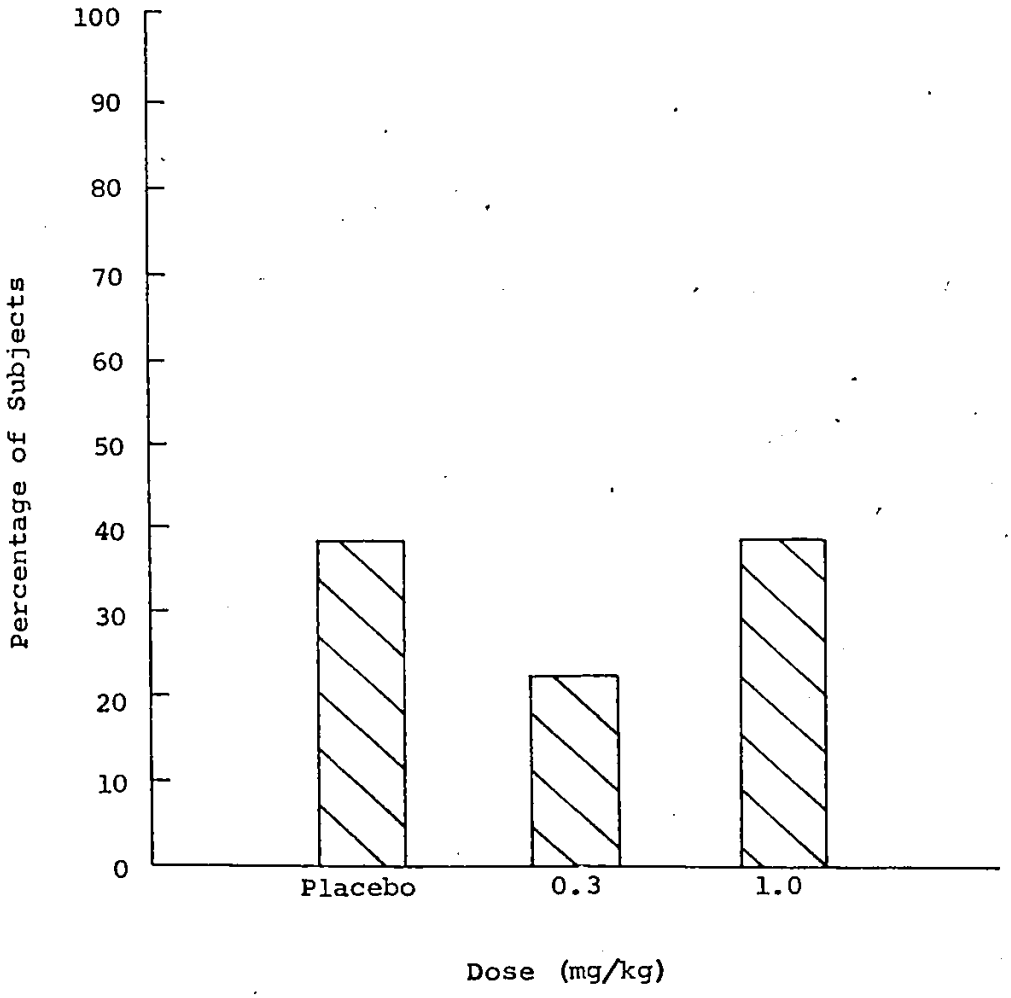



Figure 23. Percentage of subjects showing optimal enhancement of Son's Criticism for each drug condition.

TABLE 13

ANALYSIS OF VARIANCE FOR MOTHER'S OFF-TASK

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Square (C) | 80.70 | 1 | 80.70 | 2.93 |
| Groups within C | 110.02 | 4 | 27.51 | 0.59 |
| Subjects within groups | 282.00 | 6 | 47.00 | |
| Days (A) | 104.72 | 2 | 52.36 | 1.16 |
| Drug level (B) | 82.94 | 2 | 41.47 | 0.92 |
| A x C | 123.83 | 2 | 61.92 | 1.37 |
| B x C | 92.91 | 2 | 46.46 | 1.03 |
| Residual | 131.20 | 4 | 32.80 | 0.73 |
| Error | 541.67 | 12 | 45.14 | |

* $p < .05$

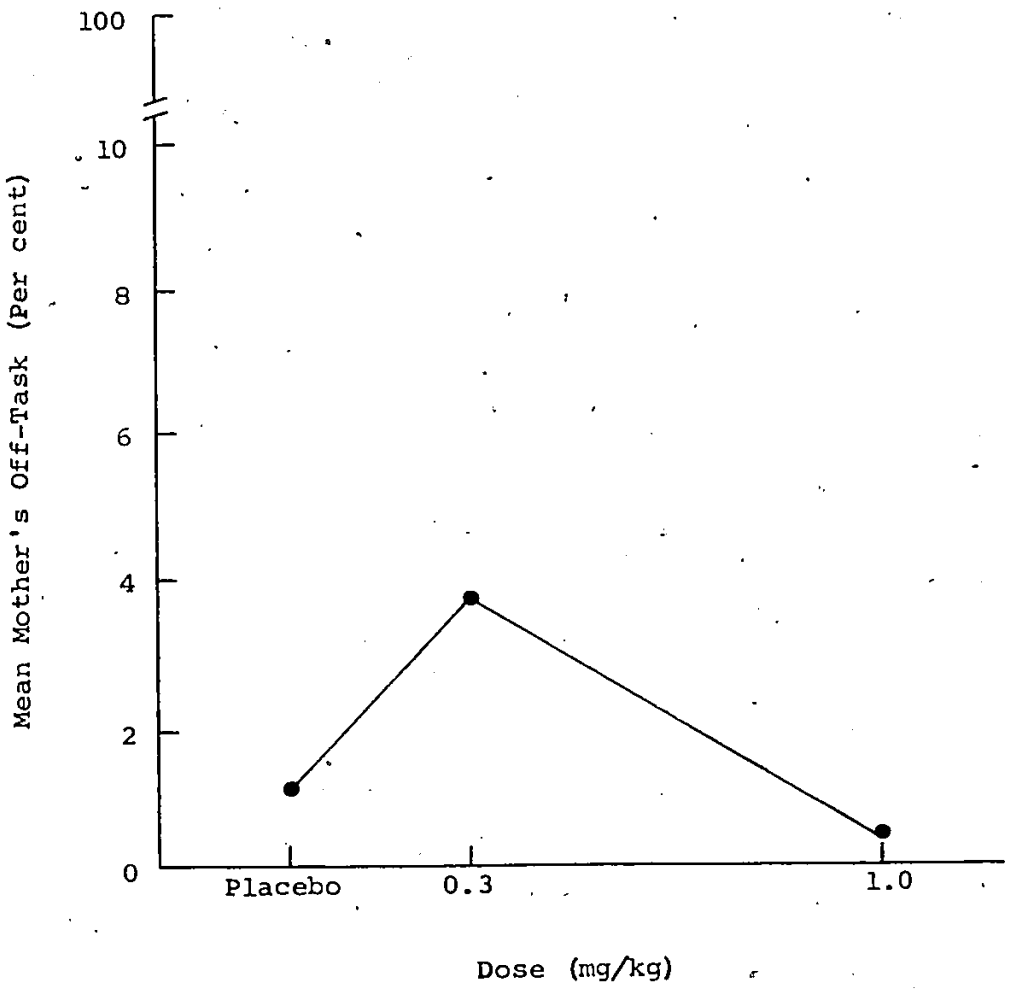



Figure 24. Dose response curve for Mother's Off-Task scores.

fails to suggest a dose response relationship consistent with predictions: that increased dosage level would reduce mothers' off-task remarks. Rather, the low dosage level tended to slightly increase such comments on the part of mothers. Looking only at individual responses, the greatest number of mothers responded optimally when their sons received active medication of either level rather than placebo; placebo benefitted 20.83 %, while low and high dosage conditions resulted in the greatest reduction for 37.5 % and 41.67 % of mothers respectively (Figure 25).

Son's off-task. Figure 26 suggests that a low dose of Ritalin increased non relevant comments by subjects, relative to placebo, while the higher dosage level reduced such interactions. However, Table 14 fails to substantiate this relationship as a significant effect ($F(2/12) = 0.63$, $p > .05$). At the level of individual responses, 25 % of subjects displayed the greatest reduction of off-task comments when receiving placebo as compared to 33.33 % of subjects on the low, and 41.67 % on the higher dose of Ritalin (Figure 27).

Mother's impulse-control. In a direction consistent with hypotheses, increasing the dosage level of Ritalin relative to placebo tended to reduce mothers' suggestions for impulse-control on the part of their sons (Figure 28). Table 15 fails to establish this dose response relationship as statistically significant, however ($F(2/12) = 2.60$, $p > .05$). As Figure 29 depicts, the low dosage of Ritalin tended to

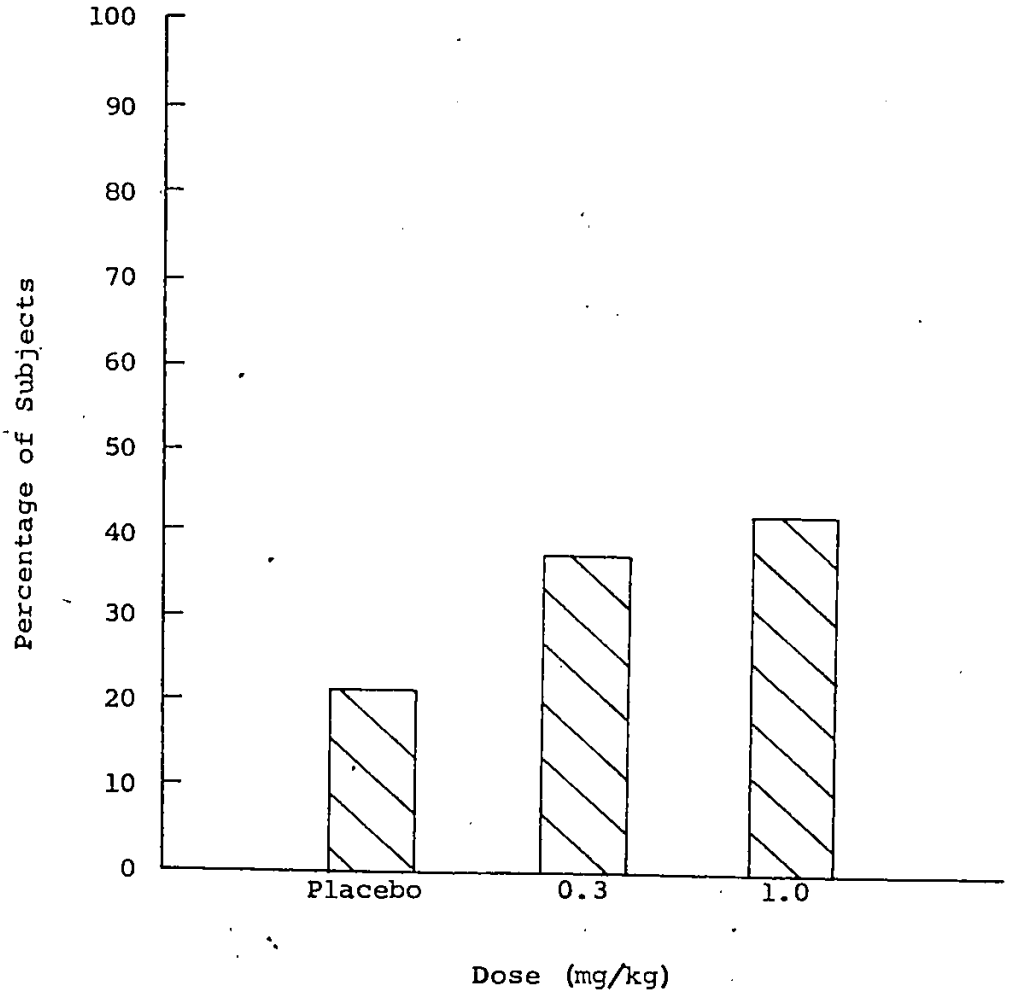



Figure 25. Percentage of subjects showing optimal enhancement of Mother's Off-Task comments for each drug condition.

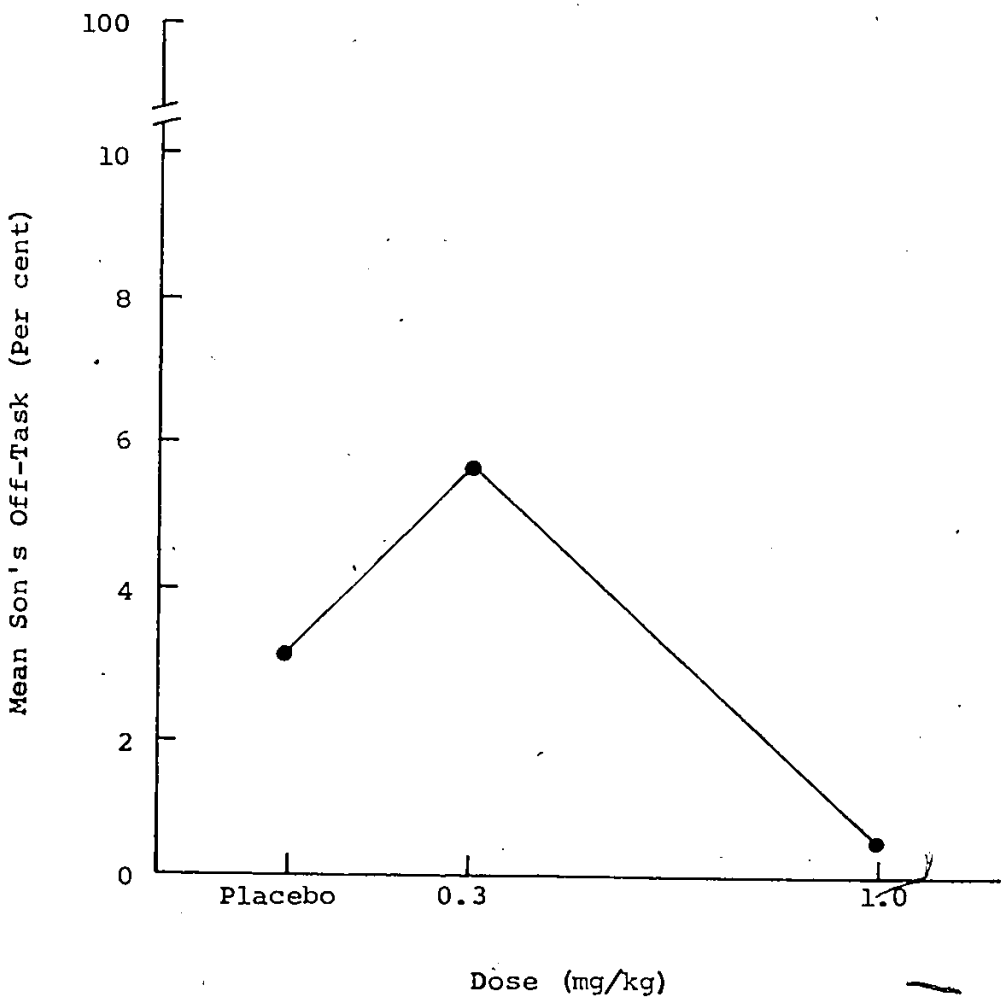



Figure 26. Dose response curve for Son's Off-Task scores.

TABLE 14

ANALYSIS OF VARIANCE FOR SON'S OFF-TASK

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Square (C) | 149.25 | 1 | 149.25 | 1.63 |
| Groups within C | 365.25 | 4 | 91.31 | 0.67 |
| Subjects within groups | 823.18 | 6 | 137.20 | |
| Days (A) | 460.36 | 2 | 230.18 | 1.68 |
| Drug level (B) | 171.41 | 2 | 85.71 | 0.63 |
| A x C | 470.48 | 2 | 235.24 | 1.72 |
| B x C | 212.87 | 2 | 106.44 | 0.78 |
| Residual | 367.11 | 4 | 91.78 | 0.67 |
| Error | 1640.75 | 12 | 136.73 | |

* $p < .05$

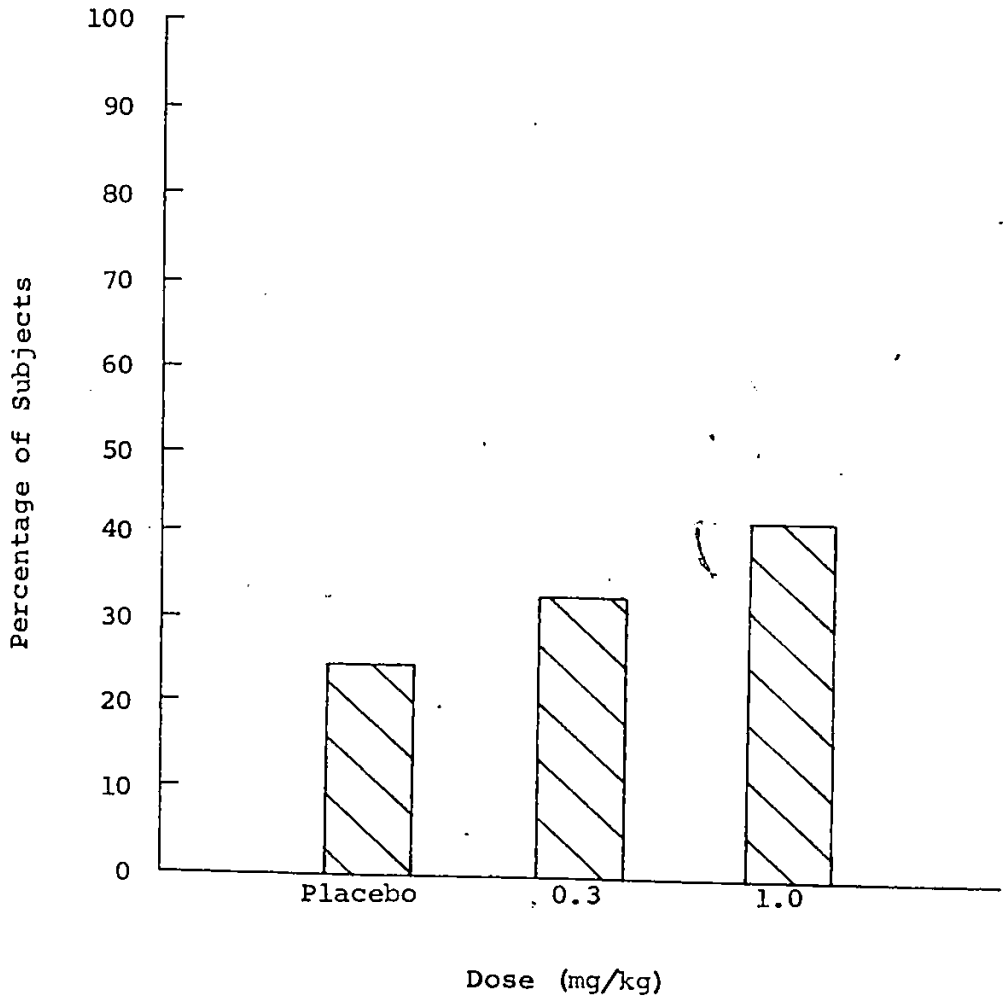



Figure 27. Percentage of subjects showing optimal enhancement of Son's Off-Task comments for each drug condition.

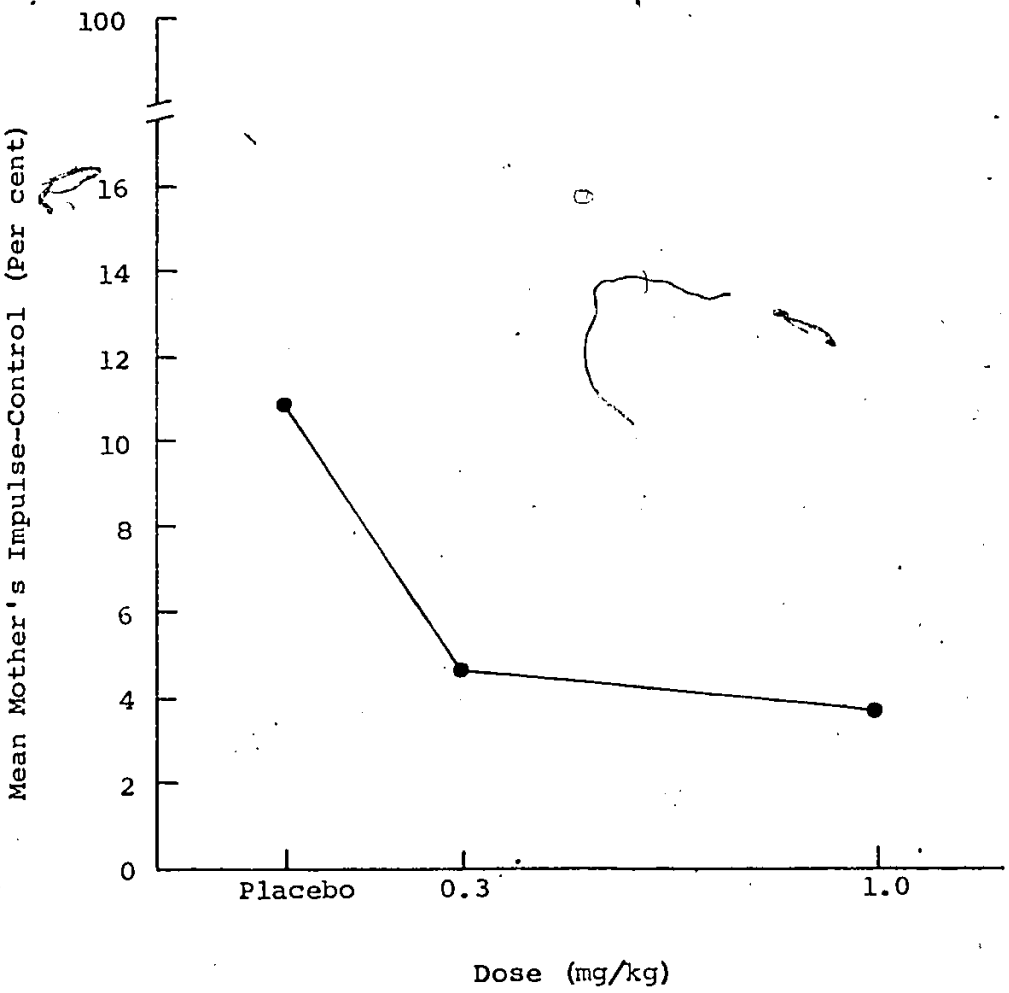



Figure 28. Dose response curve for Mother's Impulse-Control scores.

TABLE 15

ANALYSIS OF VARIANCE FOR MOTHER'S IMPULSE-CONTROL

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Square (C) | 71.97 | 1 | 71.97 | 1.34 |
| Groups within C | 214.86 | 4 | 53.72 | 0.79 |
| Subjects within groups | 405.51 | 6 | 67.59 | |
| Days (A) | 213.65 | 2 | 106.83 | 1.52 |
| Drug level (B) | 366.14 | 2 | 183.07 | 2.60 |
| A x C | 5.44 | 2 | 2.72 | 0.04 |
| B x C | 14.97 | 2 | 7.49 | 0.11 |
| Residual | 175.65 | 4 | 43.91 | 0.62 |
| Error | 844.15 | 12 | 70.35 | |

* $p < .05$

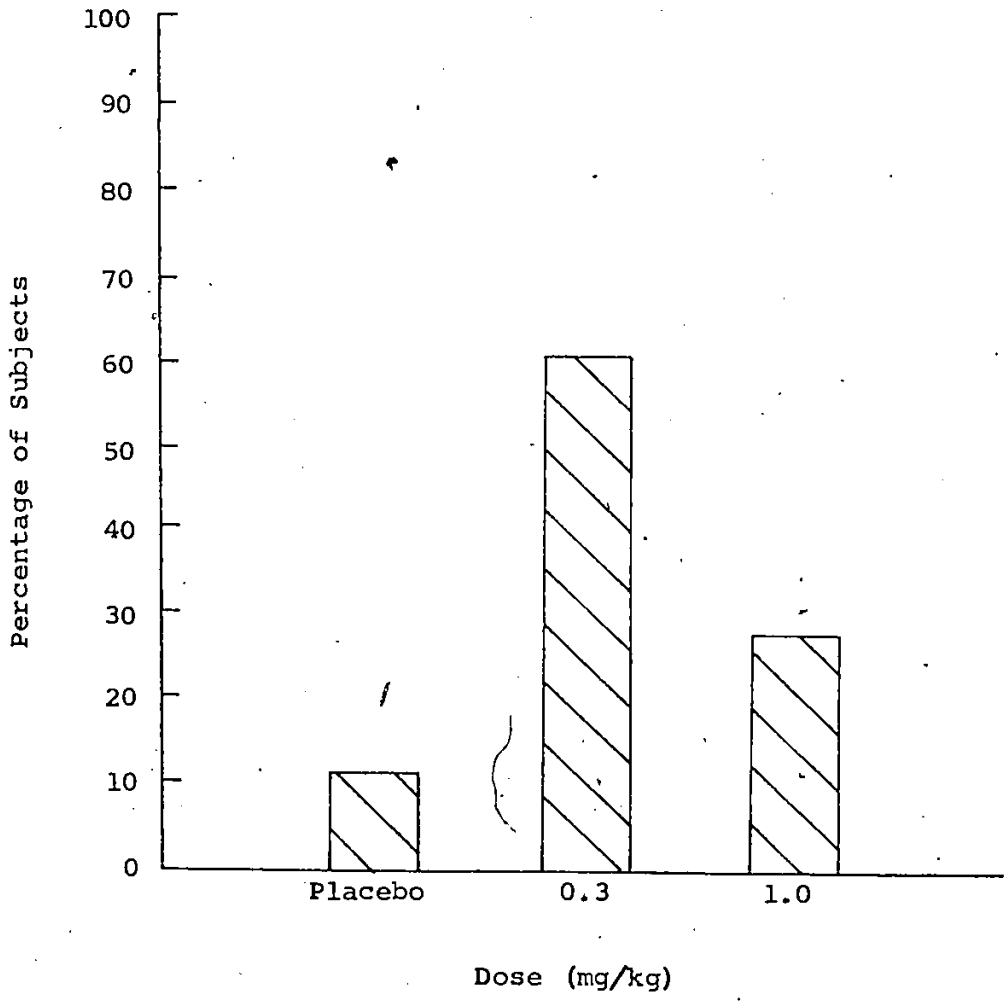



Figure 29. Percentage of subjects showing optimal enhancement of Mother's Impulse-Control suggestions for each drug condition.

yield the greatest benefit for the largest group of mothers (61.08 %), while the high dosage level produced peak performance in 27.75 % of cases, and placebo benefitted only 11.08 %.

Son's impulse-control. Consistent with predictions, subjects gave their mothers more suggestions regarding impulse-control as dosage level of medication was increased from placebo (Figure 30); but the differences observed between medication levels was not found to be significant ($F(2/12) = 0.86$, $p > .05$; Table 16). As Figure 31 reveals, both levels of medication were of greatest benefit to an equal number of subjects (38.83 %), while placebo showed greatest effect with 22.17 % of the children.

No support was gleaned for the hypotheses that increasing the dosage level of Ritalin, relative to placebo, would lead to improved verbal interaction between mothers and their hyperkinetic children. Except for two categories of interaction, though—Son's Praise and Son's Criticism—one, and occasionally both levels of active medication were shown to optimally enhance social interaction for a greater percentage of subjects than placebo.

## Parent Ratings

Both the subscale and total ratings which parents completed on their children's behaviour were predicted to improve with increasing strength of medication, relative to placebo.

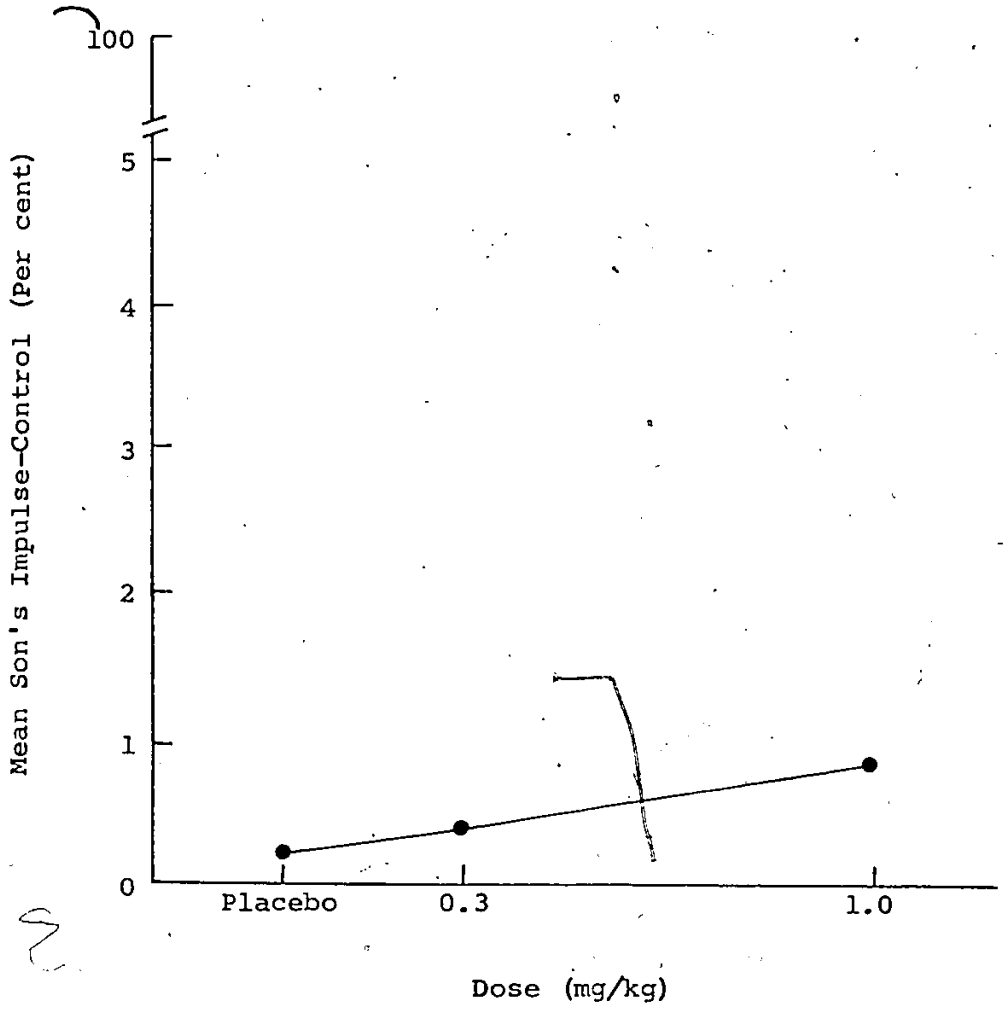



Figure 30. Dose response curve for Son's Impulse-Control scores.

TABLE 16

ANALYSIS OF VARIANCE FOR SON'S IMPULSE-CONTROL

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Square (C) | 3.61 | 1 | 3.61 | 2.47 |
| Groups within C | 5.82 | 4 | 1.46 | 0.93 |
| Subjects within groups | 9.36 | 6 | 1.56 | |
| Days (A) | 0.78 | 2 | 0.39 | 0.20 |
| Drug level (B) | 3.29 | 2 | 1.65 | 0.86 |
| A x C | 2.67 | 2 | 1.34 | 0.70 |
| B x C | 5.87 | 2 | 2.94 | 1.53 |
| Residual | 5.42 | 4 | 1.36 | 0.71 |
| Error | 23.01 | 12 | 1.92 | |

* $p < .05$

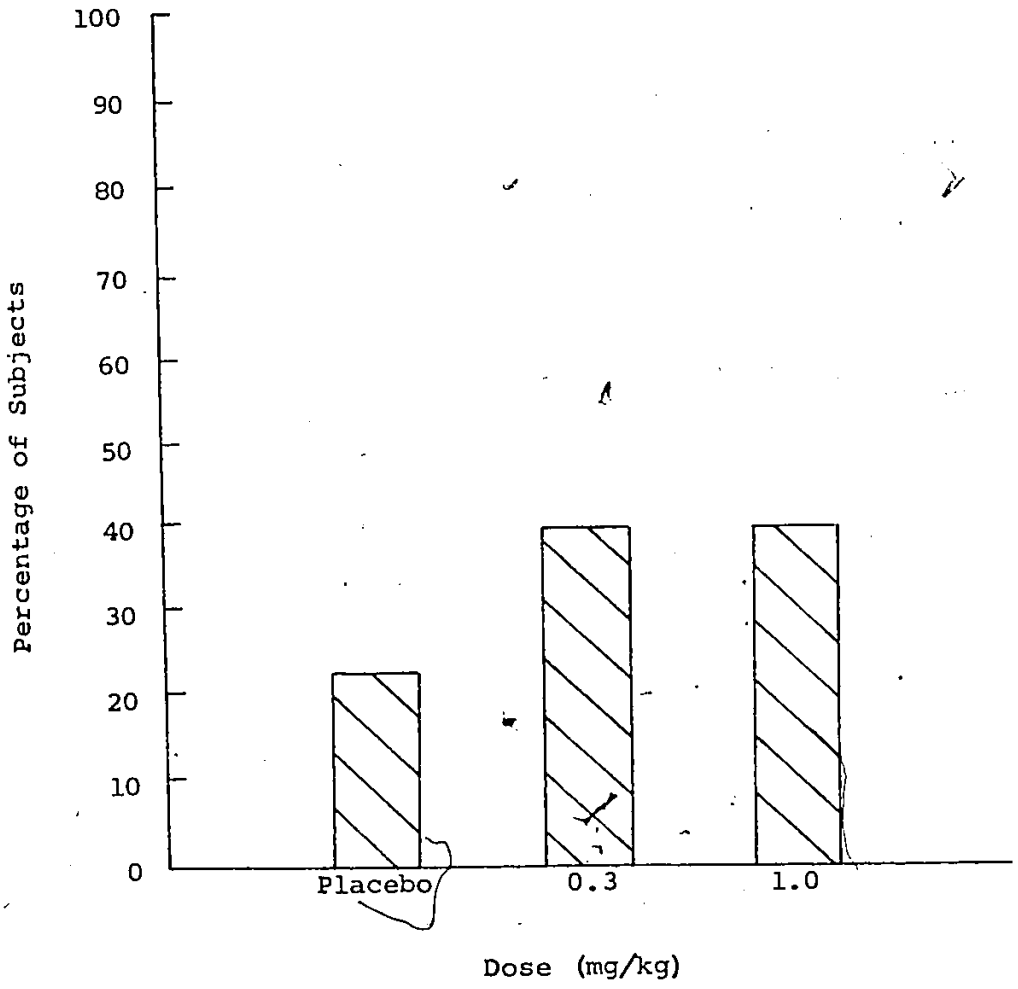



Figure 31. Percentage of subjects showing optimal enhancement of Son's Impulse-Control suggestions for each drug condition.

Subscale ratings. The graphic representation of parents' subscale ratings (Figure 32) suggests that both levels of medication were effective in improving the parent's evaluation of her child's behaviour, relative to placebo, in a direction consistent with hypotheses. Table 17 confirms that a significant difference does exist between the dosage conditions ($F(2/12) = 6.25$, $p < .05$). The Tukey (a) test further reveals that the high dosage level alone was statistically superior to placebo in reducing parents' ratings on the scale's medication-sensitive items ($HSD(3/12) = 4.35$, $p < .05$). The general inferiority of placebo is further suggested by the observation (Figure 33) that only 5.5 % of parent ratings revealed optimal improvement with placebo, whereas low and high dosage levels of Ritalin led to the most substantial increments for 38.83 % and 55.5 % of the parents' ratings, respectively.

Total ratings. Similar to subscale ratings, total parent ratings reflected a general improvement under medication relative to placebo, in the direction of predictions (Figure 34). Table 18 fails to establish that the observed differences resulting from medication strength were significant, though ($F(2/12) = 2.74$, $p > .05$). Again similar to subscale ratings, placebo optimally improved the total ratings of only 12.5 % of parents, while the low dosage level benefitted 37.5 %, and the high dosage condition enhanced 50 % of the cases (Figure 35).

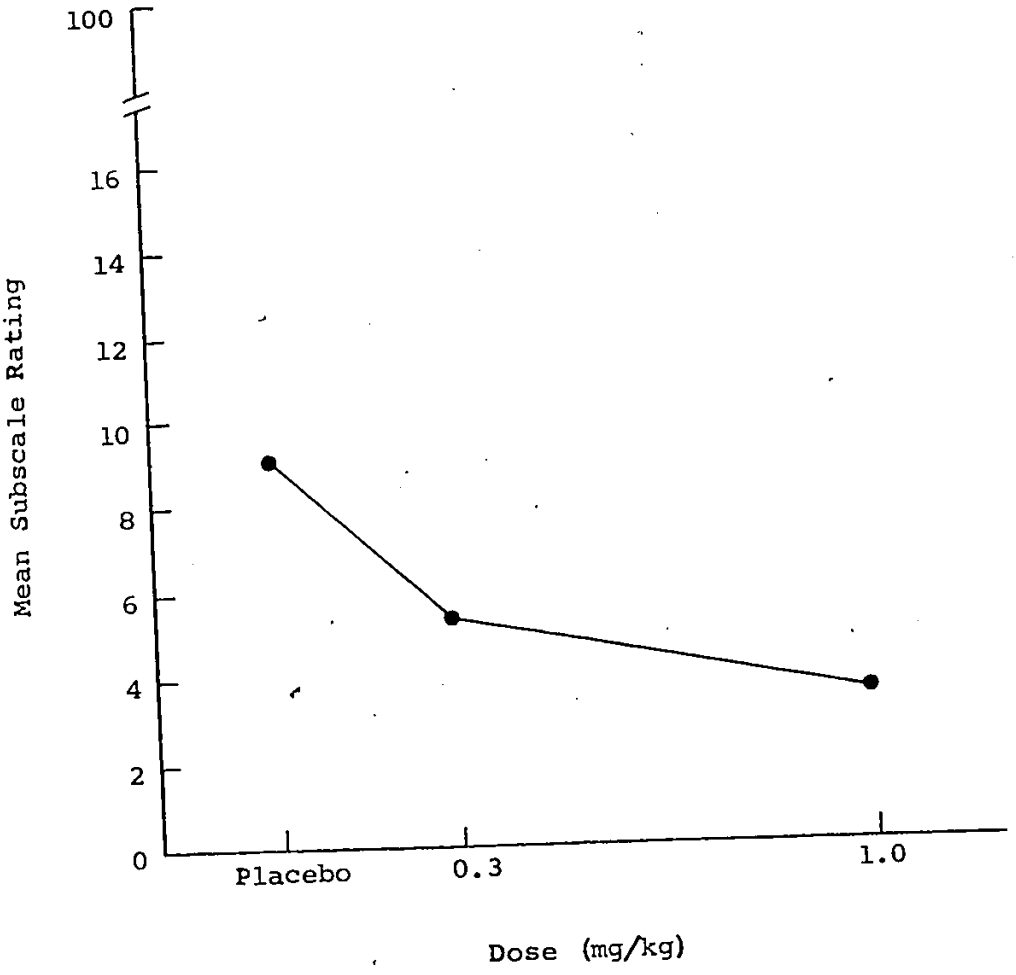



Figure 32. Dose response curve for Subscale Ratings scores.

TABLE 17

ANALYSIS OF VARIANCE FOR PARENT'S SUBSCALE RATINGS

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Square (C) | 26.69 | 1 | 26.69 | 0.48 |
| Groups within C | 221.11 | 4 | 55.28 | 0.62 |
| Subjects within groups | 539.17 | 6 | 89.86 | |
| Days (A) | 1.39 | 2 | 0.70 | 0.04 |
| Drug level (B) | 199.39 | 2 | 99.70 | 6.25* |
| A x C | 31.72 | 2 | 15.86 | 0.99 |
| B x C | 53.39 | 2 | 26.70 | 1.67 |
| Residual | 38.11 | 4 | 9.53 | 0.60 |
| Error | 191.33 | 12 | 15.94 | |

* $p < .05$

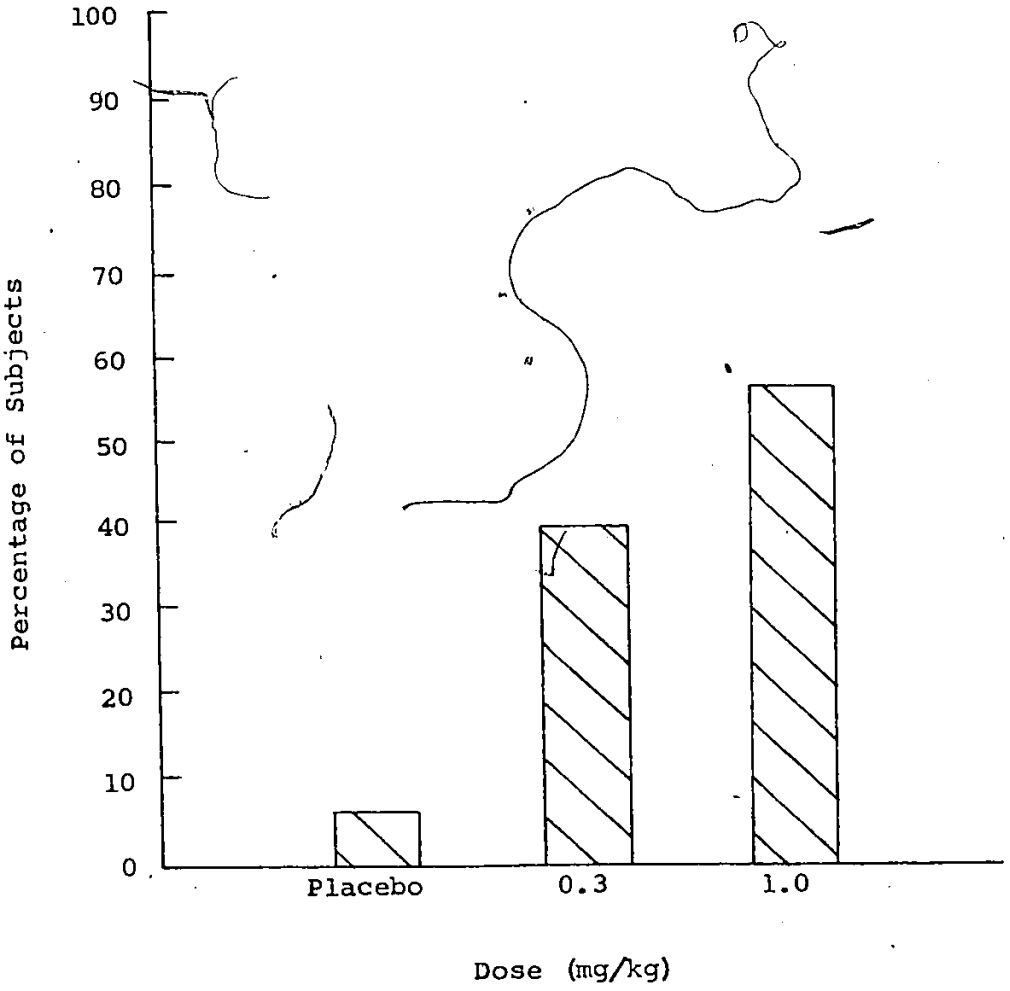



Figure 33. Percentage of subjects showing optimal enhancement of Subscale Ratings for each drug condition.

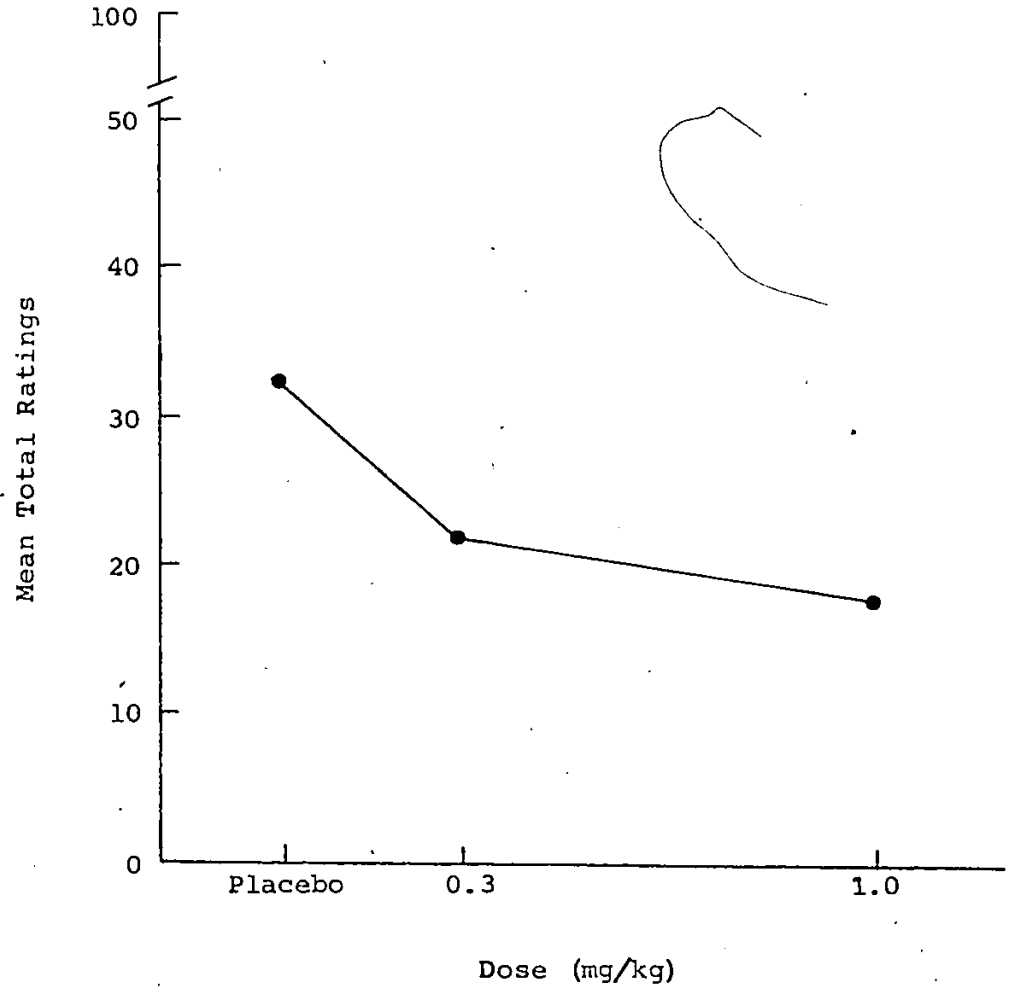



Figure 34. Dose response curve for Total Ratings scores.

TABLE 18

ANALYSIS OF VARIANCE FOR PARENT'S TOTAL RATINGS

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Square (C) | 1.00 | 1 | 1.00 | 0.00 |
| Groups within C | 3067.56 | 4 | 766.89 | 0.70 |
| Subjects within groups | 6595.33 | 6 | 1099.22 | |
| Days (A) | 369.56 | 2 | 184.78 | 0.71 |
| Drug level (B) | 1430.22 | 2 | 715.11 | 2.74 |
| A x C | 208.67 | 2 | 104.34 | 0.40 |
| B x C | 434.00 | 2 | 217.00 | 0.83 |
| Residual | 406.22 | 4 | 101.56 | 0.39 |
| Error | 3132.67 | 12 | 261.06 | |

* $p < .05$

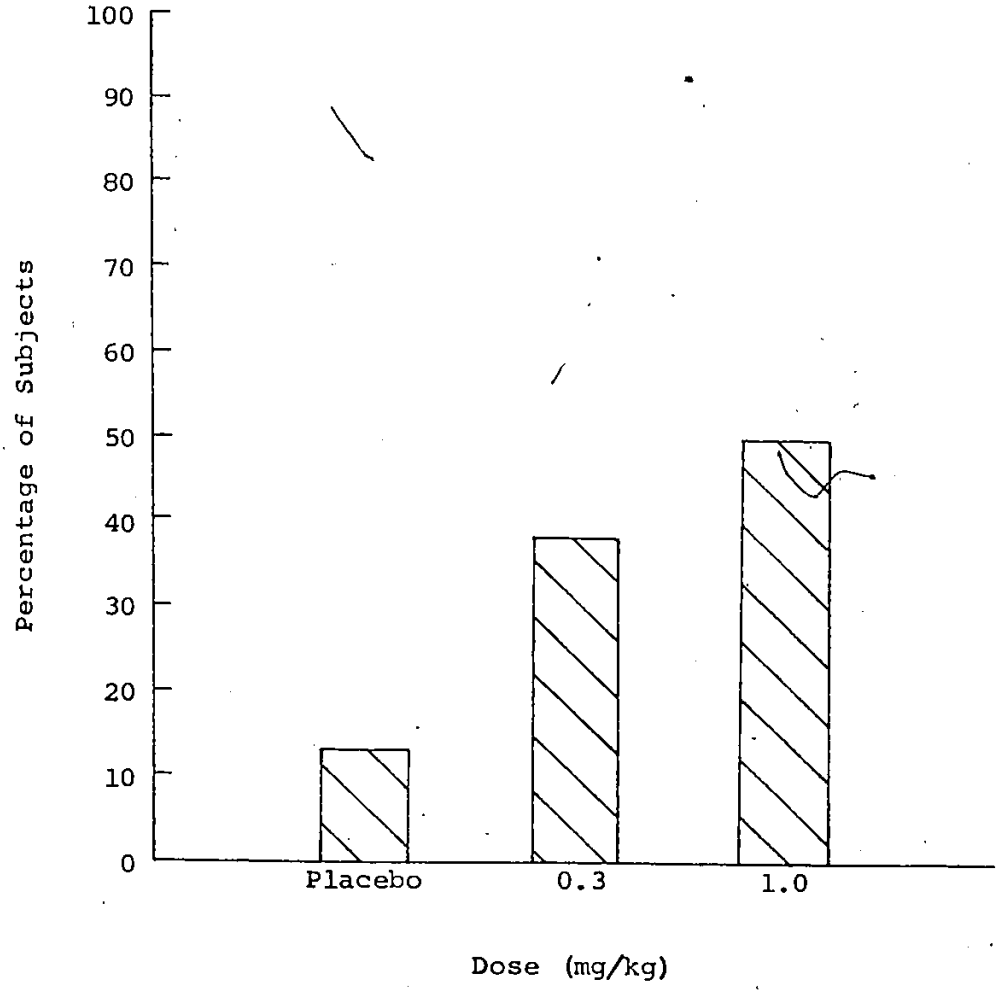



Figure 35. Percentage of subjects showing optimal enhancement of Total Ratings for each drug condition.

Although subscale and total parent ratings tended to improve relative to placebo as dosage strength increased from low to high levels, only the subscale of medication-sensitive items was found to change significantly; and then only the high dosage condition was found to alter parents' ratings in a statistically significant way. Individual response patterns for both sets of scores were quite similar, with active medication leading to optimal improvement for larger groups of subjects than placebo.

In summary, for three measures of attention, twelve categories of mother-son verbal interactions, and two varieties of parent ratings of child behaviours, medication was found to significantly affect only the subscale parental ratings. However, when individual rather than group responses were examined for each variable, it was found that active medication more often improved the performance of a greater number of subjects than no medication; even here though, there seemed little to suggest the superiority of one dosage level of active medication over the other. However, this observation does not suggest that groups of subjects, or even a single subject, responded in a consistently optimal fashion under any of the drug conditions for all dependent measures. Thus, for some measures a subject received greatest benefit from placebo, while for other measures, one of the active medications resulted in peak performance for him.

# CHAPTER IV

## DISCUSSION

Until recently, contributors to the literature concerned with the psychopharmacological treatment of hyperkinetic children have neglected a primary question: what are the specific effects for selected target behaviours of increasing the dosage level of CNS stimulant medication? Following the challenge of Sprague and Sleator (1975, 1977), this study was designed to explore the differential effects of a low (0.3 mg/kg) and high dose (1.0 mg/kg) of Ritalin, relative to placebo, for the hyperkinetic child's attention skills, the quality of his social interaction with his mother, and the mother's perception of his behaviour. A Latin square design with repeated measures permitted the observation of each child under all double-blind drug conditions for seventeen dependent measures.

The accumulation of data supporting specific dose response relationships for different target behaviours would have important implications for the design of clinical guidelines to aid in the pharmacological management of hyperkinetic children. The extent to which the results of this study contribute to the development of such principles is discussed

below, together with a consideration of the various factors which render this study a starting point for investigation rather than a definitive treatise. Procedures and strategies for continuing the research project are also explored.

General Comments

Generally, this research failed to gather statistically convincing evidence to support the well-documented claim that Ritalin produces beneficial changes in both attention skills and social interaction behaviours for hyperkinetic youngsters. Thus, there can be no persuasive argument for extending Sprague and Sleator's (1977) observed dose response relationships of Ritalin with hyperkinetic children to the present sample and the specific target behaviours examined. However, the presence of consistent trends throughout the present data, which taken individually are of no statistical import, argues against accepting the alternate set of hypotheses: that no relationship exists between dosage level of medication and performance on specific behavioural indices.

Attention

A deficiency in selective attention has been suggested as the hallmark of hyperkinesis (Cohen and Douglas, 1972); the hyperkinetic child is thus prone to inappropriate, impulsive responding in situations which require sustained and focussed attention (Douglas, 1972). Vigilance, or continuous

performance tasks, which demand of subjects that they remain persistently watchful for specific stimuli over lengthy periods of time, have been used with high efficiency in discriminating hyperkinetic from normal youngsters, as well as in demonstrating the benefit which Ritalin has for attentional deficits in the former group of children (Anderson et al., 1973; Sykes et al., 1971; Sykes et al., 1972). The novel, continuous performance measure utilized in the present study permitted an evaluation of how well the child was able to focus his attention (Attention Correct score), how much difficulty the child experienced in maintaining his focus of attention (Error of Omission score), and finally, how well the child inhibited impulsive responses (Errors of Commission score) as a consequence of various medication conditions.

Unexpectedly, since all subjects included for study had reportedly been positively responsive to Ritalin in the past, medication condition was not found to significantly affect scores on any of the attention measures. Three alternate, but not necessarily independent explanations for the lack of drug effect reasonably fit the data, and thus will be discussed.

While it was felt that the present continuous performance measure met the requirements of a vigilance task (Anderson et al., 1973), and thus would be successful in demonstrating the benefits to attention for hyperkinetic children given Ritalin, no normative data was available prior

to the study to document the predictive validity of the task in identifying attention deficits for this group of youngsters, relative to normal controls. Inspection of the raw data (Appendix K) reveals that while some subjects showed considerable difficulty in correctly identifying target stimuli, others attained almost perfect scores, even under placebo; neither intelligence nor age (Appendix E) of subjects explains the variability in scores. For some subjects, then, the task may represent a minimal challenge to their skills, and thus needs to be modified as has been done with PAL tasks (Kinsbourne et al., 1977); or alternately, as we have been discussing, the task may not tap the attention deficits of hyperkinetic youngsters. In the absence of statistically significant effects, however, the present data do not enable a satisfactory test of these two alternatives.

With regard to task difficulty, several researchers have noted that significant benefits accrued from medication are only discernible when tasks present a suitable challenge to subjects (Klein & Gittleman-Klein, 1975; Schliefer et al., 1975; Sprague & Sleator, 1977). In the same vein, Zentall and Zentall (1976) have shown that medication is not required by hyperkinetic subjects when tasks are of high stimulation or interest value. For example, in the present study, all parents of subjects admitted during the initial interview

that there were specific activities or occasions in which their sons appeared controlled and attentive without medication: reading for some, a favourite television programme for others, or assembling models for yet another subject. During the course of the research, only one subject, during his placebo day, demonstrated almost total disinterest in the attention task. Parenthetically, several requests have been received by parents following the study for their children to be examined again on another occasion since they (the sons) enjoyed the task so much. Further, comments by subjects immediately following the testing suggested that the audio soundtrack resembling the talk of air-traffic controllers made the task especially lifelike and enjoyable. This realistic quality was a major distinguishing feature of this particular continuous performance measure from those characteristically employed by others in the field (Sykes et al., 1972). Thus, the attention task utilized was probably not of sufficient difficulty for at least some of the subjects, and most probably was experienced as highly stimulating and enjoyable to the majority, thus rendering the effects of medication less pronounced.

A second source of error already alluded to is the selection of subjects for the study. If a sufficient proportion of the sample consisted of aversive responders to medication, rather than all being favourable responders as initially thought, then it would be expected that performance of

these subjects would deteriorate under active medication conditions, relative to placebo, and hence would tend to nullify any group effect which medication might exert in their absence. Between subject variability certainly was present, particularly for Attention Correct scores (Table 2). The significant interaction between day of testing and Latin square assignment can only be interpreted meaningfully as extreme variation on the part of a few subjects, not attributable to drug effect. More direct evidence to support the presence of non Ritalin-responsive subjects was present in the breakdown of number of subjects showing optimal performance under each medication condition (Figures 3, 5 and 7). When these figures are averaged over the three measures, placebo benefitted 13.89 % of subjects optimally, while the low and high dosage levels of Ritalin resulted in peak performance for 38.89 % and 47.22 % respectively. While the figures do not represent uniform groups of subjects across all three indices of attention, they do suggest that at least some subjects do not benefit from medication of either level in a consistent fashion. Sprague and Sleator (1977) similarly reported that for their measure of learning performance, 10 % of subjects demonstrated greatest enhancement under placebo rather than active medication. Kinsbourne et al. (1977) observed that up to 30 % of children referred for hyperactivity respond aversively to stimulant medication, and further that they cannot be reliably discriminated prior to a double-blind

drug assessment. While subjects in the present study were reported by parents and clinicians to be drug responsive, the unreliability of such reports has been documented (Klein & Gittleman-Klein, 1975). Thus, the failure of Ritalin to improve the performance of some subjects on attention scores may be in part attributable to their non responsiveness to medication.

A third factor which is intimately related to both of the preceding issues, experimental task and Ritalin responsiveness, is dosage level of medication. The dose response relationships depicted in Figure 1 (Sprague & Sleator, 1977) represented several hundred data points for each dosage level. As these researchers readily admitted, specific individuals displayed some variance from group means, with the implication that a subject who did not respond at the most commonly beneficial dosage level might have responded optimally at some other dosage of active medication. Following the lead of Sprague and Sleator, the present study used only two disparate strengths of active medication to compare relative to placebo in their effects on attention. This limitation of dosage conditions renders the interpretation of no significant drug effect a difficult matter. Those subjects who showed no benefit of medication, or very slight improvement, may not be aversive responders as previously reasoned. What may have occurred was that for a given subject, the low dose was too low to be effective, while the high dose was in reality an

overdose situation. Swanson et al. (1978) have reported that on a PAL task, the performance of favourable Ritalin responders given either too high or too low a dose resulted in performance which was indistinguishable from that of aversive responders. In a more recent convention report, Swanson (1979) stated that he has examined a group of Ritalin-responsive youngsters who respond to the PAL task at 50 mg of Ritalin in an identical fashion to another group of subjects who received an average of 10 mg. This suggestion that dose responsiveness may be a highly individual matter is further supported by other experimental investigations of drug effect on cognitive and attention functions of hyperkinetic subjects. Campbell et al. (1971) found that subjects who received individually titrated doses of Ritalin, ranging from 5 to 50 mg (mean = 30 mg), demonstrated improved performance on a test of short-term memory, relative to placebo conditions. Dalby et al. (1977) observed PAL to improve for hyperkinetic subjects on a mean titrated dose of only 13.8 mg. Performance on a delayed reaction time task has been shown to improve, relative to placebo conditions, when subjects received individually titrated dosages ranging from 5 to 50 mg, with an average dose of 31.5 mg (Cohen et al., 1971). In two investigations of hyperkinetic children tested on a continuous performance measure (Sykes et al., 1971; Sykes et al., 1972), performance was statistically superior to placebo conditions when subjects received a mean titrated dose of approximately

20 mg in the former study and 31.5 mg of Ritalin in the latter experiment. The results of the last two studies demonstrate that mean effective dosages for highly similar tasks may vary across samples, thus emphasizing the dosage specificity of Ritalin for individuals as a critical variable.

Consistent with the results of the preceding studies, the present research suggested that the higher dosage level of Ritalin (mean dose received = 31.12 mg) was of greatest benefit to the largest number of children for two of the measures of attention—Attention Correct (Figure 3) and Attention Commissions (Figure 7). Since the current research utilized a limited range of standardized dosages rather than titration for each subject, there exists the possibility that at least for some subjects, optimal benefit from medication was not realized, despite their propensity to respond favourably to Ritalin.

In summary, the failure of medication level to yield statistically significant effects for subjects' attention scores likely received contributions from at least three quarters: task difficulty was variable across subjects while stimulation was high; there may have been present a few subjects who were not positive Ritalin responders; and most importantly, the apparent dosage specificity of Ritalin for individuals, together with the limited range of medication levels tested, may have resulted in medication conditions which were insufficient to produce characteristic improvement

for the group as a whole on measures of attention.

Mother-Child Interaction

Investigators have received wise counsel to take account of the role of both parents in the development of childhood behaviour problems (Becker, 1960; Peterson et al., 1959), and yet mothers of hyperkinetic children have received greatest clinical and experimental investigation since they are often most physically involved with the child and his problems, and thus come to the attention of clinics (Millichap, 1959). Research has shown that in interaction with their hyperkinetic child, mothers tend to compensate for their son's problems in selective attention and impulse control by assuming a directive, controlling stance (Campbell et al., 1975, 1977b; Humphries et al., 1978). Humphries et al. have observed further that following the administration of Ritalin to hyperkinetic boys, the interaction between mother and child altered significantly: the sons tended to become less negative in their comments and generally assumed a more directive role in guiding the task performance for themselves and their mothers; as a consequence of the son's improved behaviour, mothers tended to become less directing and generally more positive in the verbal comments to their child. The present investigation permitted the observation of mother-child verbal interaction under three medication conditions (placebo, Ritalin 0.3 mg/kg, and Ritalin 1.0 mg/kg) during the

completion of a non achievement-oriented task. Parallel codes were scored for both mother and child for the following variables: Directions, Explanations, Praise, Criticism, Off-Task comments, and Impulse-Control suggestions.

Contrary to predictions and all expectations, Ritalin failed to differentially affect the social interaction variables observed for mothers and their sons. When discussing possible explanations for lack of drug effect on attention measures, three interrelated issues were presented: task requirements, drug responsiveness of subjects, and the limited selection of medication conditions. The observation of further ineffectivenss on the part of medication to produce expected changes in a second distinct set of dependent measures argues against the task requirements being assigned full responsibility for the lack of significant results.

In designing the parent-child interaction task, an attempt was made to fashion a cooperative, non competitive game which would bear some relationship to measures previously employed. Humphries et al. (1978) commented that the choice of the Etch-a-Sketch task was prompted by a recognition that previous researches had failed to engage both parent and child mutually in a joint task; the task was always viewed as the son's, with the mother free to adopt her own perspective as to her role. In order to create an even more cooperative, lifelike task, the present procedure presented the Etch-a-Sketch apparatus with only the directive to "create something

together". In so doing, a highly artificial situation may have been unintentionally created for subjects. As Appendix E reveals, only two of the subjects fell within the "middle-class" in terms of assigned status. Their unfamiliarity with the task requirements was suggested immediately by their response to task instructions: only four parents and their children knew what the function and purpose of an Etch-a-Sketch was (including two class IV and two class III subjects); all mother-son pairs asked questions regarding the directive "create". Thus, the typical homelike situation was not presented and hence, uncharacteristically restrained behaviour could be expected on the part of the child (Zentall and Zentall, 1976), and perhaps mothers as well. Consistent with this view, only one subject got up from the table during the task to explore the room, although reports of such "up-and-away" behaviour were frequent in the reports of mothers during the initial interview.

Beyond the unreality of the situation for subjects, the task was, by design, low in achievement focus. Of relevance here, Kaplan (1970) observed that when mothers of speech-disordered children were engaged in an interaction task with their speech-symptom child or a normal sibling, differential treatment of the index child was only present during "task-oriented" games rather than during a "permissive" exploratory activity. With hyperkinetic children and their mothers, Humphries et al. (1978) observed mothers to exert

greater control over their children for a difficult than an easy task, and that while benefit of medication in both mother and child behaviours was displayed for both tasks, its affect was greater for the difficult measure. However, even for the easy task, subjects were presented with instructions to "try to make as few mistakes as possible" (p. 16), while being directly observed and timed with a stop-watch by the experimenter. It seems more than a small possibility that the relative lack of achievement focus in addition to the unfamiliarity (novelty) of the situation, may have contributed to the prevention of significant benefits of medication on mother-child interactions.

While none of the parent-child measures revealed significant drug effects, both medication levels were observed to improve performance relative to placebo in six of the twelve categories. Five of these six cases of improved scores on active medication occurred for mother's behaviours rather than son's. It is interesting to speculate that mothers may have sensed a slight improvement in the quality of their son's behaviour which was not detected in the categories employed for this study, and reacted by changing their behaviour in a less controlling direction.. Such an observation must remain speculative, however, since aside from the formal categories employed to rate verbal interaction, the experimenter attempted to guess the drug condition of each subject on each of the three days of testing. While for some subjects accurate

estimates of drug versus placebo were made, for the majority the clinical judgement fared no better than chance.

Lengthy discussion of whether subjects chosen for study were favourable Ritalin responders has been included under the consideration of Attention data, and seems to equally apply to Social Interaction measures. Intersubject variation not attributable to drug effect was observed for two categories of parent-child interaction: Son's Direction (Table 6) and Mother's Praise (Table 9). Such variation in scores seems to be related to the inclusion of deviant responders who, given the small sample size, contributed to the lack of significant main effect of medication.

Demonstrating that at least some subjects were not consistently benefitted by active medication, the mean percentages of subjects showing optimal performance under each drug condition were: placebo, 22.55 %; low dosage level, 40.26 %; and high dose, 37.14 %. Once again, these numbers do not represent cohesive groups responding consistently across all variables. This variability of medication response for subjects across categories may represent the presence of aversive responders, yet since subjects were not consistently shown to respond optimally under placebo or any other dosage level, there is the stronger suggestion that subjects were not provided optimal dosage levels of medication. Further, the variability in optimal medication level across subjects suggests that when dose response relationships are established,

they should be drawn for individuals as well as for groups.

In the present study the low dose of medication corresponded to a mean dose across subjects of 9.34 mg, while the high dosage level yielded a mean dose of 31.12 mg. The former dose is close to the mean level of medication received by subjects in their treatment at the clinic prior to the study (mean individually titrated dose = 8.75 mg). Thus, on the average, 40.26 % of subjects responded optimally with their mothers at a dosage level which was consistent with their pre-study dosage level, while 37.14 % of subjects required substantially greater levels of medication to enhance their interaction optimally. While Sprague and Sleator (1975) hypothesized that social behaviour would improve for greatest numbers at high medication levels, this was not the case for the present sample of subjects. Further variation from this prediction is suggested by Humphries et al. (1978) who observed improved mother-child interaction for subjects given an average individually titrated dose of 20 mg. While the varied results may reflect subtle differences in the nature of the target behaviours involved, there is also the suggestion that different samples of subjects may yield different optimally beneficial dosage levels, according to the specific dose responsiveness of subjects withing the sample.

From a clinical perspective, in viewing the interactions of all hyperkinetic-child-mother pairs across drug conditions, the present investigator was impressed with the extreme

variability in the quality of this interaction between rather than within mother-child pairs. Just as individual hyperkinetic children vary widely with respect to clinical picture (Douglas, 1972), there seems to be quite a range in the quality of parent-child relationships from relatively relaxed and congruent to tense and disjointed.

For Mother-Child Interaction data then, it appears that similar problems to those which interfered with drug effect in Attention scores, were also relevant. The novelty and permissiveness of the task was such to mitigate the helpfulness of medication, even for drug-responsive youngsters. Determining whether the present sample contained aversive responders to medication remains a thorny problem owing to the use of limited dosage levels of medication. Similar to observations made from the Attention data, support was suggested for the idea that for individual Ritalin-responsive youngsters, great variation in optimal dosage level exists for improving mother-child interaction.

Unfortunately, owing to the lack of significant drug effects, no definitive statement regarding the quality of the interaction between the hyperkinetic child and his mother is possible. Thus, no support may be provided for the very convincing argument of Humphries et al. (1978) that the mother's directiveness and negativism is an adaptive and temporary response to her child's specific disabilities which is jettisoned for a more positive, supportive

attitude once the child's behaviour improves. In the absence of statistically significant drug-related changes, there were apparent the marked individual differences between mother-child pairs; the sample was far from homogeneous with regard to the quality of the mother-child relationship.

Parent Ratings

The ninety-three item Conners' Parent Rating Scale, to which there is a complementary but shorter teacher's form, has been reliably shown to discriminate hyperkinetic from normal control children (Conners, 1970, 1973). An abbreviated form, or subscale of ten items, has demonstrated sensitivity in detecting changes in medication state of hyperkinetic youngsters (Conners, 1972, 1973; Sprague & Sleator, 1977). In the present investigation, the complete parent form was filled out by the mother six to eight hours following each testing session; thus, Total as well as Subscale scores could be examined across the three medication periods to determine the parent's perception of drug effect on the behaviour of their child.

Improvement of ratings, consistent with the findings of Sprague and Sleator (1977), was observed with increasing dosage strength for both Total and Subscale scores, however, only the latter differences were of statistical significance and then, only the high dosage condition was found to be significantly different from placebo.

The failure of Total ratings to similarly reflect impact of medication may be due to the presence of childhood behaviour and personality problems only indirectly related to the child's overactive, impulsive tendencies. The varied clinical picture of hyperkinetic children is not a new finding, and has presented a major stumbling block in the diagnosis and treatment of this heterogeneous group of children (Douglas, 1972; Ullman et al., 1978).

Even with the finding of improved parental ratings under higher dosage levels, there remains considerable inter subject variability which is masked by group comparison techniques. Across both ratings, the average percentage of subjects showing optimal improvement under each drug condition was: placebo, 9 %; low dosage level, 38.17 %; and the higher dosage, 52.8 %. Thus, for a considerable portion of the subjects, the ratings of parents are most benefitted by higher medication conditions, and there remains a small percentage for whom no drug is viewed as leading to optimal enhancement of behaviour. Again it should be interjected that some variation is to be expected since at any given time for specific activities, the performance of hyperkinetic children is indistinguishable from that of normal youngsters and may neither require nor benefit from the administration of CNS stimulant medication.

There are certain difficulties in interpreting any rating scale data. For example, one parent who had indicated

greatest improvement, in terms of symptom reduction, under the high dosage condition, also confided that she didn't like her son as well that day: he had lost his "spunk"—the quality which was felt to be most characteristic and refreshing. Again, this finding is consistent with the work of Sprague and Sleator (1977) who found that with improved social behaviour at higher dosage levels also came increasing negative side-effects.

While attempts to predict Ritalin responsiveness without benefit of a drug trial have not been encouraging (Kinsbourne et al., 1977), the use of cutoff scores on the Conners' rating scales, corresponding to two standard deviations above the mean of normal samples (Werry et al., 1975), have been suggested as a way of selecting more homogeneous samples, and have been employed by Sprague and Sleator (1977) in this fashion. Cutoff scores tend to be specific to the normative populations from which they are initially derived though, and may vary from one geographic location to another (Trites, 1979). Kinsbourne et al. (1977) reported that of forty-eight children referred to their clinic for hyperactivity, one third achieved a score of greater than fifteen on both parent and teacher forms, one third scored greater than fifteen on the parent scale alone, and the remaining third were rated above fifteen only on the teacher's scale. In the present sample, only two subjects achieved significantly deviant ratings on the abbreviated form under the placebo condition.

However, Swanson et al. (1978) have observed that when strict double-blind conditions prevail, as was the case in the current study, placebo conditions result in scores closer to those produced in active medication conditions than those shown on baseline tests of performance given before drug administration; there is a dampening effect on differences between conditions, possibly attributable to the subject's wariness regarding his being evaluated on medication. Thus, the Conners' ratings completed on subjects under placebo conditions in the current study might have been higher if taken prior to the study as baseline data. Such a reduction of differences between treatment conditions naturally reduces the probability of detecting significant medication effects on the dependent measure. Anecdotal information from the present research supports this view. One mother who was particularly opposed to the use of medication for her child, despite demonstrated benefits prior to the study in terms of improved school achievement and fewer behaviour problems in the home, handed in ratings for her youngster following testing which indicated zero symptoms across the three medication periods. Conversation with this mother following the experimental procedure confirmed that she had chosen not to become involved as usual with her son during the test period, and hence did not report the problematic behaviours which were characteristically presented by him, and which incidentally were present to varying degrees across the testing days, according to the

boy's father.

The results of medication on parent Subscale ratings lends support to Sprague and Sleator's (1977) dose response hypothesis, and the trends apparent in both Subscale (Figure 32) and Total ratings (Figure 34), are consistent with their observation that ratings of social behaviour improve optimally at higher rather than lower dosage levels. The strength of this support, however, is not as convincing as it would have been if the data from Attention measures and the Parent-Child Interaction variables had achieved significance since, for seventeen analyses of variance, one of those would be expected by chance to yield significant results, and perhaps more since within each major area of investigation—Attention variables, Parent-Child Interaction measures, and Parent ratings—the various scores were not independent. Thus, the significant drug effect reported for Parent Subscale ratings loses some of its plausibility on statistical grounds.

Implications for Literature

The present study, while not extending the literature on the effectiveness of medication for hyperkinetic children, contains sufficiently consistent trends to prevent arguing against the usefulness of medication for specific hyperkinetic youngsters. By demonstrating the variability of individuals' responses to dosage level of medication for given target behaviours, this study argues for a cautious

interpretation of Sprague and Sleator's (1975, 1977) observations of the dose response specificity of Ritalin. That is, consistent with the recent report of Swanson (1979), and suggested by earlier studies which employed the titration method to adjust the dosage level of individual subjects, the present data contend that there may be wide differences between individuals regarding the optimal dosage level of medication required to produce identical responses. This diversity should not be surprising in light of the heterogeneity in the clinical picture, history, and etiology presented by the hyperkinetic child (Douglas, 1972). As Ullman et al. (1978) have advised:

> This (heterogeneity) is disappointing, however, in that it is unlikely to translate into any simple tool for the pediatric practitioner with a need to predict drug responding (p. 435).

While group tendencies may be observed in terms of dose response relationships of Ritalin for specific behavioural targets, we must be cautious in the use of group statistical procedures which mask individual variability (Greenberg et al., 1976). It is this variability which is of central concern to clinicians in their management of the individual child and his family.

The failure to demonstrate significant benefits of Ritalin for specific target behaviours of hyperkinetic children also suggests thoughtful appreciation of the observations

of Zentall (1975): that under certain optimal, stimulating conditions, the deficits of hyperkinetic children are not so readily apparent and hence the need for medication is not so great.

Further Research

Sprague and Sleator (1975, 1977) have urged clinical researchers to conduct a systematic evaluation of the dosage specificity which Ritalin seems to exert for certain categories of target behaviours. While the results of the present study did not argue against the existence of such group tendencies, there were suggestions, supported by previous research, that considerable individual variation may exist regarding dosage specific effects of Ritalin for distinct behaviours such as attention functioning and parent-child interactions. The differentiation of group medication tendencies from individual dose response relationships is of central concern to clinicians in their treatment of individual hyperkinetic children, and should thus be pursued.

In the past, the customary practice has been to utilize individually titrated dosage levels of medication in determining the effects of drug generally for one or two dependent measures. Sprague and Sleator (1977) have argued instead for the widespread use of repeated measures designs which would place all subjects under several standardized dosage conditions. However, inconclusive results stemming from the

present research suggest the inclusion of as wide a sample of medication conditions as is feasible, rather than just two or three. The acute trial of medication utilized in the present study, and recommended by Kinsbourne et al. (1977), facilitates the observation of subjects under multiple medication conditions in a rather short span of time and with high reliability and predictive validity for longer-term response to medication. Approximately five medication conditions in addition to placebo are recommended, and keeping in mind the observation of Swanson (1979) of a group of high dosage Ritalin responders, it would be valuable to sample beyond the generally accepted upper limit of 1.0 mg/kg in order not to classify these higher dose responders inappropriately.

In order to escape the problem of attenuated effects between medication conditions resulting from double-blind assessment procedures (Swanson et al., 1978), the use of baseline scores on all dependent measures is recommended. Thus, at initial interview, subjects could be familiarized with all measures and procedures while at the same time baseline data would be secured. Analyses would then be performed on difference scores between baseline and each drug condition.

A major weak point in the current investigation was the small sample size which, although minimally adequate for the statistical design employed, reduced the probability of rejecting the null hypothesis when real drug effects were present (Greenberg et al., 1976). Thus, a sample of twenty

is recommended. Drug responsiveness should be determined more objectively than merely on the basis of clinical and parental ratings which have been found to be poor predictors of drug response. An "external criterion" (Humphries et al., 1978) of favourable drug response, such as facilitation of PAL by Ritalin (Kinsbourne et al., 1977) should be utilized following initial screening, thus insuring greater homogeneity within the sample and the removal of the second major source of confusion in the present study.

Both the continuous performance measure as well as the Etch-a-Sketch task hold promise in demonstrating the beneficial effects of medication, and more specifically, individual dosage specificity of Ritalin for hyperkinetic children, if altered in the direction of greater demand characteristics. The removal of the audio portion of the attention task should serve to reduce the stimulating quality of the measure and thus increase its efficiency in detecting the attention deficits of hyperkinetic children and associated benefits of stimulant medication (Anderson et al., 1978; Sykes et al., 1972). The finding of optimal enhancement of cognitive performance two hours following ingestion of medication (Swanson et al., 1978) would be kept in mind in the arrangement of testing sequences for future research. With regard to the parent-child interaction task, the adoption of instructions more closely parallelling those of Humphries et al. (1978) should permit the extension of their findings to

include effects of medication level on the quality of the parent-child relationship.

Treatment Considerations

Unfortunately, the state of the art does not permit reference to systematic dose response tables in estimating the optimal dose of Ritalin to benefit specific deficits in the behaviour of hyperkinetic children. Owing to the individual variation of medication response noted in this as well as other studies (Humphries et al., 1978; Sprague & Sleator, 1977), it is doubtful if more than general guidelines will be provided to the front-line clinician regarding the selection of appropriate dosage strength for particular subjects. The clinical titration procedure, with the addition of principles of scientific observation, remains necessary in determining for each individual child the optimal drug level. The present design methodology, while not statistically producing results to confirm the benefits of CNS stimulant medication for hyperkinetic youngsters, does suggest that an acute laboratory trial of medication is a viable approach to assessing drug response in children (Kinsbourne et al., 1977). Since the variation in optimum dosage level for individuals may vary widely, an acute trial of medication seems to be necessary as a refinement in clinical procedure in order to expedite the evaluation of clinical response and to avoid unnecessarily prolonged trials of medication which may or may not

be appropriate. Support for this position was found in the present study through the discovery of subjects who had been maintained on inadequate dosage levels of Ritalin for some time; parent ratings improved significantly for some subjects only at dosage levels much different than their previously prescribed medication.

If further research confirms that different target behaviours benefit from different medication levels, then it behooves the clinician to determine a priori which behaviours are in greatest need of repair for each child. Recent literature reports suggest that alternate treatment strategies such as behaviour modification may be more effective than medication for specific target behaviours (Wolraich et al., 1978). The clinician is in need of experimental guidelines to help determine the lowest level of medication which would interact with other treatment stategies to enhance their effectiveness for a given child. The previous reports in the literature that tasks of high stimulation and enjoyment value can reduce the need for medication (Zentall, 1975) provides a second important focus for clinicians: environmental changes may reduce the need for medication in some cases.

# CHAPTER V

## SUMMARY AND CONCLUSIONS

The intent of the present investigation was to test the finding that specific dose response relationships characterize the way in which Ritalin improves the social and attention behaviours of hyperkinetic children. Specifically, it was predicted that attention functioning would benefit optimally from a low dose of Ritalin whereas parent-child interactions as well as parental ratings of their child's behaviour would show optimal enhancement under higher dosage levels of active medication.

Twelve hyperkinetic boys, ages ranging from seven through twelve, who were favourably responsive to Ritalin according to parents and clinicians, were examined in the clinic for changes in attentional skills, verbal interchanges with their mother, and ratings of their social behaviour by mother, as a consequence of receiving varying dosage levels of CNS stimulant medication (placebo, Ritalin 0.3 mg/kg, and Ritalin 1.0 mg/kg).

The attention measure employed consisted of a novel continuous performance task that resembled the job of an air-traffic controller. A record of correct responses was

kept as well as the number of occasions on which the subject failed to spot a target and the number of additional, impulsive responses given. The parent-child interaction task required mother and son to cooperatively create a design during a ten minute period using an Etch-a-Sketch mechanical drawing device. Verbal interactions were recorded and later scored using reliable mother-child categories of verbalizations including: Direction, Explanation, Praise, Criticism, Off-Task remarks, and Impulse-Control suggestions. The ninety-three item Conners' parent rating scale was completed by the mother at the completion of each day of testing; a Subscale rating for drug-sensitive items as well as a Total score was abstracted.

A Latin square design with repeated measures permitted the observation of each subject under all dosage conditions. No main effect of medication was observed on the continuous performance task which was employed, although greater numbers of subjects showed optimal enhancement of performance under high than low or placebo conditions. Similarly, no effect of medication was discernible for any of the categories of parent-child interaction, but medication generally led to optimal enhancement of performance for the greatest number of subjects. Parent ratings on the abbreviated rating scale alone were found to improve relative to placebo conditions for only the high dosage level of Ritalin.

Both the attention as well as social interaction tasks

were of new construction and were considered to present subjects with a highly stimulating, yet undemanding test situation. In retrospect it seems likely that those tasks which emphasize achievement and which place great demands on the subject are more likely to demonstrate beneficial effects of medication. Thus, it is perhaps the case that the currently employed tasks were of insufficient difficulty to adequately evaluate medication effects.

The question was raised regarding the drug responsiveness of the children included for study. Since no objective criterion of medication response was required prior to the present investigation, the lack of definitive medication effects for some subjects could have resulted from either their inability to respond to any level of Ritalin, or due to the restricted number of dosage levels included for study.

The variability in numbers of subjects showing optimal improvement of several dependent measures at different dosage levels argued against viewing the results of the present investigation as confirmation of different dose response relationships of Ritalin for attention and social behaviours. Rather, caution was felt to be warranted; the need to explore further the issue of general versus individual dose reponse relationships was discussed. It was recommended that future research continue to employ acute examination of response to medication, within a repeated measures design, but that a larger sample of dosage levels be included in order to detect

individual variation of favourable medication response to specific target behaviours.

## APPENDIX A

## LETTER TO PARENTS

_____(Date)_____

Dear Mr. and Mrs. _____:

Approximately _____ months ago, we met together at the clinic to talk about _____'s hyperactive behaviour. As a result of our conversation, we decided to try _____ on Ritalin. I am very much interested in following up with you to determine what benefit the medication is having for your boy. Mr. Jim Bambrick, one of our Psychology staff, is conducting follow-up research with all of the hyperactive children who are receiving Ritalin from our clinic, and I thought that this would provide an excellent opportunity for us to see whether Ritalin is benefiting _____, and whether some change in dosage level is required.

Mr. Bambrick will be calling you in a few days in order to speak with you about the follow-up procedure, and also to answer any questions that you might have about what is involved. I know that this information will be helpful to me in providing the best care for your son. I hope that you will be able to contribute to this important work.

Sincerely,

(therapist's signature)

APPENDIX B

RELEASE/CONSENT FORM

I _____, the parent of _____, after receiving an explanation of the rationale and procedures of this study, agree to participate with my son in this investigation of the dosage effects of Ritalin on attention and social behaviour. Further, I give my consent that information will be exchanged with _____, my family physician, and _____, my son's school teacher.

_____
(signature of parent)

_____ (witness) _____ (date)

# PARENT RATING SCALE

Child's Name _____
Date _____

Please rate your child's behaviour over the past eight hours by placing a check mark under the most appropriate column ("Not at all Present"; "Just a Little"; "Pretty Much"; or "Very Much Present") for each of the behaviours listed.

| | Not at all Present | Just a Little | Pretty Much | Very Much Present |
|---|---|---|---|---|
| **Problems of Eating** | | | | |
| 1. Picky and finicky | | | | |
| 2. Will not eat enough | | | | |
| 3. Overweight | | | | |
| **Problems of Sleep** | | | | |
| 4. Restless | | | | |
| 5. Nightmares | | | | |
| 6. Awakens at night | | | | |
| 7. Cannot fall asleep | | | | |
| **Fears and Worries** | | | | |
| 8. Afraid of new situations | | | | |
| 9. Afraid of people | | | | |
| 10. Afraid of being alone | | | | |
| 11. Worries about illness and death | | | | |

| | Not at all Present | Just a Little | Pretty Much | Very Much Present |
|---|---|---|---|---|
| **Muscular Tension** | | | | |
| 12. Gets stiff and rigid | | | | |
| 13. Twitches, jerks etc. | | | | |
| 14. Shakes | | | | |
| **Speech Problems** | | | | |
| 15. Stuttering | | | | |
| 16. Hard to understand | | | | |
| **Wetting** | | | | |
| 17. Bed wetting | | | | |
| 18. Runs to bathroom constantly | | | | |
| **Bowel Problems** | | | | |
| 19. Soiling self | | | | |
| 20. Holds back bowel movements | | | | |
| **Complains of Following Symptoms even though Doctor can find nothing wrong** | | | | |
| 21. Headaches | | | | |
| 22. Stomach aches | | | | |
| 23. Vomiting | | | | |
| 24. Aches and pains | | | | |
| 25. Loose bowels | | | | |

| | Not at all Present | Just a Little | Pretty Much | Very Much Present |
|---|---|---|---|---|
| **Problems of Sucking, Chewing or Picking** | | | | |
| 26. Sucks thumb | | | | |
| 27. Bites or picks nails | | | | |
| 28. Chews on clothes, blanket or others | | | | |
| 29. Picks at things such as hair, clothing, etc. | | | | |
| **Childish or immature** | | | | |
| 30. Does not act his age | | | | |
| 31. Cries easily | | | | |
| 32. Wants help doing things he should do alone | | | | |
| 33. Clings to parents or other adults | | | | |
| 34. Baby talk | | | | |
| **Trouble with Feelings** | | | | |
| 35. Keeps anger to himself | | | | |
| 36. Lets himself get pushed around by other children | | | | |
| 37. Unhappy | | | | |
| 38. Carries a chip on his shoulder | | | | |
| **Overasserts Himself** | | | | |
| 39. Bullying | | | | |

| | Not at all Present | Just a Little | Pretty Much | Very Much Present |
|---|---|---|---|---|
| 40. Bragging and boasting | | | | |
| 41. Sassy to grownups | | | | |
| **Problems Making Friends** | | | | |
| 42. Shy | | | | |
| 43. Afraid they do not like him | | | | |
| 44. Feelings easily hurt | | | | |
| 45. Has no friends | | | | |
| **Problems with Brothers and Sisters** | | | | |
| 46. Feals cheated | | | | |
| 47. Mean | | | | |
| 48. Fights constantly | | | | |
| **Problem Keeping Friends** | | | | |
| 49. Disturbs other children | | | | |
| 50. Wants to run things | | | | |
| 51. Picks on other children | | | | |
| **Restless** | | | | |
| 52. Restless or overactive | | | | |
| 53. Excitable, impulsive | | | | |
| 54. Fails to finish things he starts, short attention span | | | | |

| | Not at all Present | Just a Little | Pretty Much | Very Much Present |
|---|---|---|---|---|
| **Temper** | | | | |
| 55. Temper outbursts, explosive and unpredictable behaviour | | | | |
| 56. Throws himself around | | | | |
| 57. Throws and breaks things | | | | |
| 58. Pouts and sulks | | | | |
| **Sex** | | | | |
| 59. Plays with own sex organs | | | | |
| 60. Involved in sex play with others | | | | |
| 61. Modest about his body | | | | |
| **Problems in School** | | | | |
| 62. Is not learning | | | | |
| 63. Does not like to go to school | | | | |
| 64. Is afraid to go to school | | | | |
| 65. Daydreams | | | | |
| 66. Truancy | | | | |
| 67. Will not obey school rules | | | | |
| **Lying** | | | | |
| 68. Denies having done wrong | | | | |

| | Not at all Present | Just a Little | Pretty Much | Very Much Present |
|---|---|---|---|---|
| 69. Blames others for his mistakes | | | | |
| 70. Tells stories which did not happen | | | | |
| **Stealing** | | | | |
| 71. From parents | | | | |
| 72. At school | | | | |
| 73. Stores and other places | | | | |
| **Fire Setting** | | | | |
| 74. Sets fires | | | | |
| **Trouble with Police** | | | | |
| 75. Gets in trouble with police | | | | |
| **Perfectionism** | | | | |
| 76. Everything must be just so | | | | |
| 77. Things must be done the same way every time | | | | |
| 78. Sets goals too high | | | | |
| **Additional Problems** | | | | |
| 79. Inattentive, easily distracted | | | | |
| 80. Constantly fidgeting | | | | |

| | Not at all Present | Just a Little | Pretty Much | Very Much Present |
|---|---|---|---|---|
| 81. Cannot be left alone | | | | |
| 82. Always climbing | | | | |
| 83. A very early riser | | | | |
| 84. Will run around between mouthfuls at meals | | | | |
| 85. Demands must be met immediately, easily frustrated | | | | |
| 86. Cannot stand too much excitement | | | | |
| 87. Laces and zippers are always open | | | | |
| 88. Cries often and easily | | | | |
| 89. Unable to stop a repetitive activity | | | | |
| 90. Acts as if driven by a motor | | | | |
| 91. Mood changes quickly and drastically | | | | |
| 92. Poorly aware of surroundings or time of day | | | | |
| 93. Still cannot tie his shoe laces | | | | |

APPENDIX D

LETTER TO FAMILY PHYSICIAN

(Date)

Dear Dr. _____:

re: (child's name)

We are attempting to improve our follow-up of children who have been placed on Ritalin here at the clinic. The literature on childhood pharmacology suggests that Ritalin generally tends to improve cognitive functioning in hyperkinetic children at lower dosage levels and social adaptation at higher doses. We would like to determine whether these hypotheses hold for the children that we're now seeing and who are receiving Ritalin.

The study will be conducted over a three-day period during which _____ will receive each of three drug conditions: 1) a placebo; 2) Ritalin .3 mg/kg; and 3) Ritalin 1.0 mg/kg. These dosage levels have been determined by well-controlled studies to be maximally effective for the different target behaviours already mentioned. The medication will be administered in a double-blind fashion and ratings of the child's behaviour by his mother will be obtained, as well as performance on cognitive and social tests here at the clinic. At the end of the testing period, we will have available a sizeable amount of data to determine exactly which behaviours are affected optimally at specific dosage levels. This is especially important in light of recent evidence that higher dosage levels may appear to improve social adjustment, but actually act to disturb school performance.

At the end of the study, you will be provided with not only the information relevant to _____'s performance, which should help in establishing an effective dosage level for him, but also the general results of the study which we hope will be highly illuminating regarding the effects of Ritalin for these hyperkinetic youngsters.

Please call us if you have any comments regarding the

study. Thank you for your cooperation. We would also like to take this opportunity to invite new referrals of hyperkinetic children who you feel would benefit from clinical investigation at this time.

Kindest regards,

John M. Dougan, F.R.C.P. (C)
Director

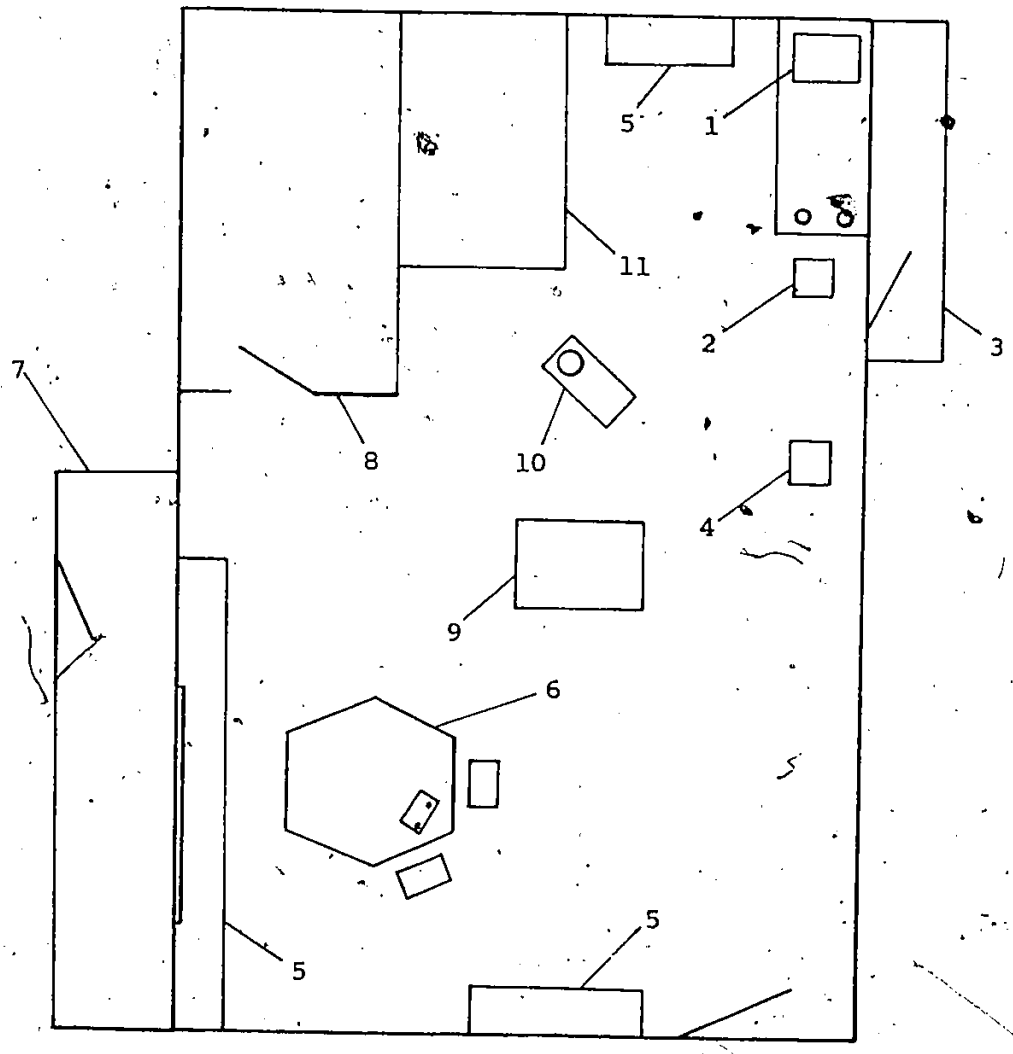
James R. Bambrick, M.A.
Department of Psychology

SUBJECT VARIABLES

| Subject | Age (Months) | Weight (Kg) | Grade | Failures | I.Q. | Koppitz Score | Social Class |
|---|---|---|---|---|---|---|---|
| 1 | 124 | 26.4 | 3 | 2 | 83 | 2 | 5 |
| 2 | 119 | 35.0 | 4 | 0 | 109 | 1 | 4 |
| 3 | 134 | 36.4 | 5 | 1 | 94 | 1 | 3 |
| 4 | 88 | 28.2 | 2 | 0 | 108 | 7 | 5 |
| 5 | 128 | 32.3 | 4 | 1 | 99 | 2 | 5 |
| 6 | 152 | 41.8 | 7 | 1 | 106 | 0 | 4 |
| 7 | 133 | 23.6 | 4 | 1 | 84 | 2 | 4 |
| 8 | 150 | 39.5 | 7 | 0 | 96 | 2 | 4 |
| 9 | 102 | 23.9 | 1 | 2 | 104 | 4 | 3 |
| 10 | 110 | 27.7 | 2 | 2 | 80 | 2 | 4 |
| 11 | 93 | 24.5 | 2 | 1 | 96 | 1 | 4 |
| 12 | 126 | 34.1 | 6 | 0 | 105 | 1 | 4 |
| Mean | 121.6 | 31.1 | - | - | 97.0 | 2.1 | - |
| Standard Deviation | 20.4 | 6.3 | - | - | 10.1 | 1.8 | - |
| Median | - | - | 4 | 1 | - | - | 4 |

APPENDIX F

EXPERIMENTAL ROOM

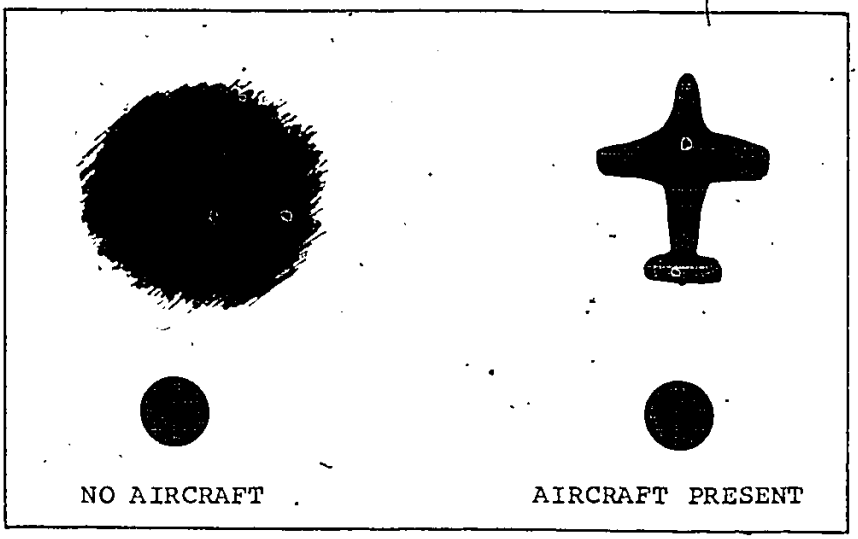


Legend: Experimental Room

1. Video monitor
2. Subject's seat
3. Equipment room
4. Experimenter's seat
5. Toy cupboards
6. Social interaction table
7. Observation table
8. Washroom
9. Audio recording enclosure
10. Rocking horse
11. Sand box

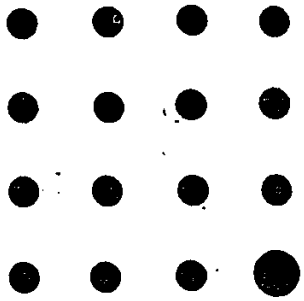
APPENDIX G

TELEGRAPH KEYS

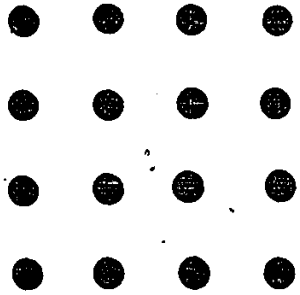


APPENDIX H

RADAR STIMULI



"AIRCRAFT PRESENT"



"NO AIRCRAFT"

# APPENDIX I

## VERBAL INTERACTION CODING

### Coding Procedure

The experimenter and his assistant served as independent coders for the verbal interactions between mothers and sons. All rating was conducted in a blind fashion with respect to drug condition, using the cassette recording of the ten minute mother-child social interaction.

Training to maximize reliability between the raters was carried out using the interaction sequences of a pilot subject and his mother (this hyperkinetic child was put through the experimental procedure prior to the study to observe the utility of the experimental procedures). Together, the two raters listened to the tape initially to familiarize themselves with the subjects' tone of voice, speed of speaking, and content of the exchange. Next, utilizing the categories explained below, the raters played the tape a second time in order to score each statement of the ten minute sequence. The tape was stopped following each statement; the raters then discussed their respective judgments until mutual understanding and consensus were achieved.

For subsequent ratings of the experimental recordings, the raters coded the sequences without discussion. To facilitate later comparison and reliability checks, a sequential listing of each rater's codes was kept on ruled sheets of paper (a number thus corresponded to each separate statement). Reliability for the two raters within each coding category, for both maternal and filial statements, was calculated by dividing the number of statements scored the same by both raters, by the total number of statements within the category, multiplied by one hundred.

General Guidelines

The exit of the experimenter from the experimental room into the observation room marked the beginning of the ten-minute verbal interaction sequence eligible for scoring. All statements occurring within the next ten minutes were scored, even if the subjects had completed the task within the ten-minute limit. A statement which was initiated within the temporal deadline was scored, even if it ended outside of the allotted time.

A statement was defined usually as any sequential combination of subject and predicate which conveyed a complete thought, without respect to grammatical accuracy. In addition, sentence fragments which stood alone, were also scored as distinct statements: ie. "Yes"; "Stop"; or "Oh boy". Similarly, noises such as loud sighs, humming, and whistling

were also scored; noises which occurred at least one second apart were assigned independent scores. Separate thoughts contained within a single sentence and separated by at least one second, or a conjunction such as "and", were also scored as if they stood alone. The following are examples of statements, occurring within a mother-child interaction, which would each receive independent scores:

> ...Hold it (mother)...Okay (mother)...Yes; you can move now (mother)...Yes, that's it (mother) ...Yes (mother)...Wow (son)...Now it's my turn (son)...Go again (mother)...

Coding Categories

The scoring schema permitted every statement to be classified according to source (mother or son) as well as type. Seven categories were included in the initial scoring, although the Other category was not utilized for later analysis.

Direction. All statements which directed one participant to perform in a certain way with respect to task completion were included here. Simple commands such as "Turn right", "Stop", "You go to the top", "Draw a curved line", were typical of the statements scored as Direction.

Explanation. All statements which provided or requested information about the task in general or the other participant's performance were scored under this category. For example, "What's that?", "I will go to the top", "After

you move, I'll go to the left", and "Let's make a window", were all scored as Explanation since they served an information-sharing function rather than a directive aim. Similarly, responses to questions such as "Yes", "No", or even "I don't know", were included under this category since they provided the other participant with requested feedback of a non evaluative nature.

Praise. Any comment which was directed toward the performance of the other participant and which connoted positive evaluation was included under Praise. Thus, "Terrific", "That's good", and even "Yes", when offered spontaneously (not in response to a question), fell under the category Praise.

Criticism. As opposed to Praise, Criticism refers to all statements which implied negative evaluation of the other participant's performance. "That's wrong", "This is terrible", and even "No", were all coded as Criticism since they informed one of the participants that his partner did not appreciate his efforts. Further, loud, negatively-toned exclamations were also included under Criticism since they implied displeasure: ie. "Oh God!", "Aargh!", and "Yukkk!". However, discrimination was made between comments which carried negative valuation, from those which denoted improvement in a specified direction. Such statements as "Cut that out", or "Don't turn so hard", were more appropriately categorized under Impulse-Control, due to the

combination of two elements: negative feedback with implied direction.

Impulse-Control. Statements categorized here were a combination of Direction and Criticism. Impulse-Control suggestions attempt to control the direction of the other participant's behaviour through the delivery of a negatively-tinged evaluation. Often, the evaluation was carried in the harsh tone of voice if not in the content of the message: ie. "Act your age!", "Stop, stop, stop!", "Get your hand off my knob!", or "Jim said not to touch that equipment!".

Off-Task. All statements which referred to activities or events unrelated to the task situation were scored as being Off-Task. That is, references to events outside of the experimental room or non-task activities within the testing situation were appropriately coded here. "What's for dinner tonight mom?", "Isn't that a neat looking rocking horse?", and "That radar task sure was boring" were not relevant to the social interaction task and thus included under Off-Task.

Other. Since certain comments and asides were not classifiable under any of the preceding categories, one residual category was required. Such comments as "Oh", "This is hard", "I wonder what I should do now", "I'm sorry", and "I'm getting tired of this", were included here. Also, whistling, humming, singing, and nonsense noises were classified as Other.

# DRUG ADMINISTRATION SEQUENCES

Latin Square 1

| Ss | Week 1 | 2 | 3 |
|---|---|---|---|
| 1<br>2 | A | B | C |
| 3<br>4 | B | C | A |
| 5<br>6 | C | A | B |

Latin Square 2

| Ss | Week 1 | 2 | 3 |
|---|---|---|---|
| 7<br>8 | C | B | A |
| 9<br>10 | B | A | C |
| 11<br>12 | A | C | B |

A-Placebo
B-Ritalin .3 mg/kg
C-Ritalin 1.0 mg/kg

# APPENDIX K

## RAW DATA

| Subject | Drug Level | Variables | | |
|---|---|---|---|---|
| | | Correct | Omissions | Commissions |
| 1 | A | 160 | 10 | 5 |
| | B | 165 | 9 | 3 |
| | C | 175 | 6 | 2 |
| 2 | A | 172 | 5 | 1 |
| | B | 182 | 1 | 1 |
| | C | 180 | 2 | 0 |
| 3 | A | 175 | 14 | 1 |
| | B | 171 | 19 | 0 |
| | C | 186 | 6 | 0 |
| 4 | A | 155 | 21 | 0 |
| | B | 159 | 2 | 2 |
| | C | 145 | 17 | 1 |
| 5 | A | 174 | 5 | 27 |
| | B | 167 | 1 | 12 |
| | C | 185 | 0 | 3 |
| 6 | A | 188 | 1 | 2 |
| | B | 185 | 2 | 0 |
| | C | 186 | 3 | 0 |

A Placebo
B .3 mg/kg
C 1.0 mg/kg

RAW DATA

| Subject | Drug Level | Variables | | |
|---|---|---|---|---|
| | | Correct | Omissions | Commissions |
| 7 | A | 87 | 56 | 12 |
| | B | 137 | 16 | 2 |
| | C | 128 | 30 | 15 |
| 8 | A | 152 | 5 | 4 |
| | B | 173 | 6 | 1 |
| | C | 165 | 10 | 4 |
| 9 | A | 76 | 68 | 14 |
| | B | 134 | 26 | 8 |
| | C | 141 | 47 | 1 |
| 10 | A | 103 | 59 | 11 |
| | B | 98 | 71 | 4 |
| | C | 130 | 23 | 10 |
| 11 | A | 148 | 28 | 2 |
| | B | 157 | 8 | 3 |
| | C | 172 | 0 | 2 |
| 12 | A | 134 | 44 | 1 |
| | B | 169 | 0 | 10 |
| | C | 97 | 92 | 1 |

A = Placebo
B = .3 mg/kg
C = 1.0 mg/kg

RAW DATA

| Subject | Drug Level | Variables | | |
|---|---|---|---|---|
| | | Mother's Directions | Mother's Explanations | Mother's Praise |
| 1 | A | 7.7 | 34.6 | 0.0 |
| | B | 2.1 | 68.1 | 0.0 |
| | C | 1.6 | 77.4 | 0.0 |
| 2 | A | 54.2 | 34.2 | 0.8 |
| | B | 50.0 | 42.3 | 3.8 |
| | C | 33.3 | 51.3 | 2.6 |
| 3 | A | 37.7 | 55.7 | 1.4 |
| | B | 30.6 | 56.5 | 1.2 |
| | C | 18.9 | 77.4 | 0.0 |
| 4 | A | 58.5 | 24.4 | 1.1 |
| | B | 4.9 | 21.3 | 0.0 |
| | C | 50.5 | 28.6 | 9.5 |
| 5 | A | 43.5 | 36.5 | 1.2 |
| | B | 32.3 | 50.5 | 4.3 |
| | C | 73.4 | 10.8 | 5.8 |
| 6 | A | 41.3 | 50.0 | 0.0 |
| | B | 54.2 | 25.0 | 0.0 |
| | C | 3.2 | 90.3 | 0.0 |

Note—Data expressed as percentage of total responses.
A = Placebo
B = .3 mg/kg
C = 1.0 mg/kg

RAW DATA

| Subject | Drug Level | Variables: Mother's Directions | Mother's Explanations | Mother's Praise |
|---|---|---|---|---|
| 7 | A | 12.0 | 38.7 | 0.0 |
| | B | 13.7 | 52.1 | 1.4 |
| | C | 20.9 | 53.9 | 0.9 |
| 8 | A | 33.3 | 29.6 | 0.0 |
| | B | 54.8 | 29.0 | 0.0 |
| | C | 25.3 | 52.0 | 0.0 |
| 9 | A | 20.0 | 50.6 | 2.7 |
| | B | 11.5 | 51.9 | 3.8 |
| | C | 22.9 | 45.8 | 2.1 |
| 10 | A | 66.7 | 15.6 | 0.0 |
| | B | 51.1 | 28.8 | 0.0 |
| | C | 76.2 | 12.4 | 1.0 |
| 11 | A | 57.3 | 17.9 | 3.4 |
| | B | 62.2 | 12.2 | 9.1 |
| | C | 62.5 | 13.5 | 4.8 |
| 12 | A | 13.6 | 50.0 | 0.0 |
| | B | 5.0 | 60.0 | 0.0 |
| | C | 26.5 | 59.2 | 0.0 |

Note—Data expressed as percentage of total responses.
A = Placebo
B = .3 mg/kg
C = 1.0 mg/kg

RAW DATA

| Subject | Drug Level | Variables: Son's Directions | Son's Explanations | Son's Praise |
|---|---|---|---|---|
| 1 | A | 45.8 | 5.5 | 0.0 |
| | B | 73.4 | 15.6 | 0.0 |
| | C | 61.9 | 14.3 | 0.0 |
| 2 | A | 50.6 | 19.1 | 0.0 |
| | B | 58.2 | 30.9 | 0.0 |
| | C | 19.2 | 30.8 | 0.0 |
| 3 | A | 64.4 | 31.5 | 0.0 |
| | B | 72.4 | 22.4 | 0.0 |
| | C | 72.5 | 24.5 | 1.0 |
| 4 | A | 0.0 | 81.9 | 0.0 |
| | B | 1.4 | 16.7 | 0.0 |
| | C | 4.4 | 55.6 | 0.0 |
| 5 | A | 6.1 | 78.8 | 3.0 |
| | B | 57.8 | 42.2 | 0.0 |
| | C | 0.0 | 0.0 | 0.0 |
| 6 | A | 62.2 | 21.6 | 0.0 |
| | B | 54.5 | 27.3 | 0.0 |
| | C | 69.7 | 26.3 | 0.0 |

Note—Data expressed as percentage of total responses.
A = Placebo
B = .3 mg/kg
C = 1.0 mg/kg

RAW DATA

| Subject | Drug Level | Variables | | |
|---|---|---|---|---|
| | | Son's Directions | Son's Explanations | Son's Praise |
| 7 | A | 37.1 | 23.6 | 0.0 |
| | B | 25.5 | 52.0 | 1.0 |
| | C | 51.1 | 36.8 | 0.8 |
| 8 | A | 56.1 | 33.7 | 1.0 |
| | B | 58.8 | 30.6 | 0.0 |
| | C | 46.9 | 43.4 | 0.9 |
| 9 | A | 58.1 | 21.9 | 1.9 |
| | B | 50.0 | 25.0 | 0.0 |
| | C | 32.7 | 41.8 | 0.0 |
| 10 | A | 6.9 | 55.2 | 0.0 |
| | B | 13.3 | 60.0 | 0.0 |
| | C | 7.1 | 57.1 | 0.0 |
| 11 | A | 7.7 | 59.0 | 0.0 |
| | B | 0.0 | 95.5 | 0.0 |
| | C | 0.0 | 100.0 | 0.0 |
| 12 | A | 53.4 | 38.6 | 1.1 |
| | B | 66.2 | 27.7 | 2.3 |
| | C | 74.0 | 20.5 | 0.0 |

Note—Data expressed as percentage of total responses.
A = Placebo
B = .3 mg/kg
C = 1.0 mg/kg

RAW DATA

| Subject | Drug Level | Mother's Criticism | Mother's Off-task | Mother's Impulse-control |
|---|---|---|---|---|
| 1 | A | 11.5 | 7.7 | 34.6 |
| | B | 6.4 | 0.0 | 4.3 |
| | C | 0.0 | 0.0 | 6.5 |
| 2 | A | 3.3 | 1.7 | 1.7 |
| | B | 1.3 | 0.0 | -1.3 |
| | C | 2.6 | 0.0 | 7.7 |
| 3 | A | 1.4 | 0.0 | 0.0 |
| | B | 2.4 | 0.0 | 0.0 |
| | C | 0.0 | 0.0 | 0.0 |
| 4 | A | 1.7 | 0.6 | 11.4 |
| | B | 1.6 | 39.3 | 24.6 |
| | C | 2.9 | 0.0 | 5.2 |
| 5 | A | 3.5 | 2.4 | 3.5 |
| | B | 5.4 | 0.0 | 2.2 |
| | C | 3.6 | 0.0 | 6.5 |
| 6 | A | 0.0 | 0.0 | 2.2 |
| | B | 6.3 | 0.0 | 8.3 |
| | C | 0.0 | 0.0 | 0.0 |

Note —Data expressed as percentage of total responses.
A = Placebo
B = .3 mg/kg
C = 1.0 mg/kg

RAW DATA

| Subject | Drug Level | Variables: Mother's Criticism | Mother's Off-task | Mother's Impulse-control |
|---|---|---|---|---|
| 7 | A | 6.7 | 0.0 | 28.0 |
| | B | 2.7 | 0.0 | 1.4 |
| | C | 0.9 | 0.0 | 0.0 |
| 8 | A | 11.1 | 0.0 | 18.5 |
| | B | 4.8 | 0.0 | 1.6 |
| | C | 6.7 | 0.0 | 6.7 |
| 9 | A | 1.3 | 0.0 | 13.3 |
| | B | 3.8 | 5.8 | 1.9 |
| | C | 4.2 | 2.1 | 2.1 |
| 10 | A | 2.1 | 0.0 | 9.4 |
| | B | 0.0 | 0.0 | 4.4 |
| | C | 3.8 | 0.0 | 4.8 |
| 11 | A | 8.5 | 0.9 | 1.7 |
| | B | 4.9 | 0.0 | 5.5 |
| | C | 7.7 | 0.0 | 3.8 |
| 12 | A | 0.0 | 0.0 | 6.8 |
| | B | 0.0 | 0.0 | 0.0 |
| | C | 6.1 | 0.0 | 2.0 |

Note—Data expressed as percentage of total responses.
A = Placebo
B = .3 mg/kg
C = 1.0 mg/kg

RAW DATA

| Subject | Drug Level | Variables: Son's Criticism | Son's Off-task | Son's Impulse-control |
|---|---|---|---|---|
| 1 | A | 0.0 | 20.8 | 0.0 |
| | B | 11.0 | 0.0 | 0.0 |
| | C | 13.3 | 0.0 | 6.6 |
| 2 | A | 4.5 | 0.0 | 1.1 |
| | B | 0.0 | 0.0 | 0.0 |
| | C | 0.0 | 0.0 | 3.8 |
| 3 | A | 1.4 | 0.0 | 0.0 |
| | B | 0.0 | 0.0 | 0.0 |
| | C | 0.0 | 0.0 | 0.0 |
| 4 | A | 0.0 | 0.0 | 0.0 |
| | B | 8.3 | 66.7 | 0.0 |
| | C | 0.0 | 0.0 | 0.0 |
| 5 | A | 3.0 | 6.1 | 0.0 |
| | B | 0.0 | 0.0 | 0.0 |
| | C | 0.0 | 0.0 | 0.0 |
| 6 | A | 2.7 | 0.0 | 0.0 |
| | B | 9.1 | 0.0 | 2.3 |
| | C | 0.0 | 0.0 | 0.0 |

Note Data expressed as percentage of total responses.
A = Placebo
B = .3 mg/kg
C = 1.0 mg/kg

RAW DATA

| Subject | Drug Level | Variables: Son's Criticism | Son's Off-task | Son's Impulse-control |
|---|---|---|---|---|
| 7 | A | 0.0 | 5.6 | 0.0 |
| | B | 2.0 | 1.0 | 0.0 |
| | C | 2.3 | 0.0 | 0.0 |
| 8 | A | 0.0 | 0.0 | 0.0 |
| | B | 2.4 | 0.0 | 0.0 |
| | C | 0.0 | 0.0 | 0.0 |
| 9 | A | 1.0 | 0.0 | 1.0 |
| | B | 1.2 | 0.0 | 1.2 |
| | C | 1.8 | 3.6 | 0.0 |
| 10 | A | 3.4 | 0.0 | 0.0 |
| | B | 0.0 | 0.0 | 0.0 |
| | C | 0.0 | 0.0 | 0.0 |
| 11 | A | 0.0 | 5.1 | 0.0 |
| | B | 0.0 | 0.0 | 0.0 |
| | C | 0.0 | 0.0 | 0.0 |
| 12 | A | 0.0 | 0.0 | 0.0 |
| | B | 0.0 | 0.0 | 0.0 |
| | C | 0.0 | 0.0 | 0.0 |

Note—Data expressed as percentage of total response.
A = Placebo
B = .3 mg/kg
C = 1.0 mg/kg

RAW DATA

| Subjects | Drug Level | Variables: Sub Scale Ratings | Variables: Total Ratings |
|---|---|---|---|
| 1 | A | 16 | 34 |
| | B | 9 | 20 |
| | C | 6 | 12 |
| 2 | A | 12 | 44 |
| | B | 7 | 41 |
| | C | 1 | 8 |
| 3 | A | 0 | 1 |
| | B | 0 | 2 |
| | C | 0 | 6 |
| 4 | A | 7 | 15 |
| | B | 7 | 23 |
| | C | 1 | 10 |
| 5 | A | 15 | 81 |
| | B | 0 | 3 |
| | C | 2 | 8 |
| 6 | A | 15 | 43 |
| | B | 7 | 23 |
| | C | 2 | 9 |

A = Placebo
B = .3 mg/kg
C = 1.0 mg/kg

RAW DATA

| Subject | Drug Level | Variables: Sub Scale Ratings | Variables: Total Ratings |
|---|---|---|---|
| 7 | A | 10 | 33 |
| | B | 3 | 22 |
| | C | 2 | 11 |
| 8 | A | 16 | 64 |
| | B | 24 | 64 |
| | C | 11 | 61 |
| 9 | A | 3 | 9 |
| | B | 0 | 4 |
| | C | 1 | 4 |
| 10 | A | 9 | 34 |
| | B | 6 | 34 |
| | C | 12 | 49 |
| 11 | A | 0 | 0 |
| | B | 0 | 0 |
| | C | 0 | 3 |
| 12 | A | 5 | 24 |
| | B | 0 | 18 |
| | C | 2 | 21 |

A = Placebo
B = .3 mg/kg
C = 1.0 mg/kg

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## VITA AUCTORIS

On April 28, 1947 the author, youngest of four children, was born to Howard and Margaret Bambrick in Toronto, Ontario. He attended public schools in Peterborough and Toronto and was awarded the Secondary Graduation Certificate before leaving R. H. King Collegiate Institute, Toronto, in December, 1965. The author took his place as a member of the work force until he enrolled as an undergraduate student at the University of Guelph in 1968. The degree Bachelor of Arts in Honours Psychology was conferred in May 1971. In 1973 the degree Master of Arts in Psychology was also conferred by the University of Guelph. Following a summer studentship in the Neuropsychiatric Clinic at the Guelph Correctional Centre, the author entered full-time doctoral studies in the clinical psychology programme at the University of Windsor. During his residency years the author completed an internship at the Psychological Services Centre at the University of Windsor and was employed at the Ontario Hospital School at Cedar Springs, Ontario. In May, 1974, he left Windsor to work at the Community Psychiatric Clinic in Guelph for the summer prior to entering as a full-time psychology intern at the K-W Hospital in Kitchener, Ontario. During the year of internship, he

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