THE ASSESSMENT OF IMPULSIVITY AND MEDIATING BEHAVIORS
IN HYPERACTIVE AND NONHYPERACTIVE BOYS
PERFORMING ON DRL

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of the Ohio State University

By
Michael Gordon, B.A., M.A.

* * * * *

The Ohio State University
1977

Reading Committee:
Malcolm Helper, Ph.D.
David Hothersall, Ph.D.
Charles Wenar, Ph.D.

Approved By

Malcolm Helper, Ph.D., Adviser
Department of Psychology
To Jeanie
ACKNOWLEDGEMENTS

I thank the members of my committee and Dr. Donald R. Meyer for their critical insight and enduring support. I especially want to express my gratitude to Dr. David Hothersall for designing the programming equipment and for conducting the years of research upon which much of the present study is founded.

The entire staff at the North Area Branch of Children's Mental Health Center was enormously helpful in procuring subjects and in making my hours at the clinic more successful and pleasant. I am particularly indebted to Dr. Marilyn Moody for her extensive assistance and warm friendship, and to Ms. Jessie Mann who, among other things, typed this dissertation. I also appreciate the patience and commitment of those children, parents and teachers who participated in the study.

Finally, I thank my wife, Jeanie, whose many contributions to this work would, in themselves, take a dozen Leporellos to catalogue.
VITA


1974 . . . . . . . . . . . . B.A., Amherst College, Amherst, Massachusetts

1974-75. . . . . . . . . . Research Assistant, Laboratory of Comparative and Physiological Psychology, The Ohio State University, Columbus, Ohio

1975 . . . . . . . . . . . . M.A., The Ohio State University, Columbus, Ohio

1975-76. . . . . . . . . . Course Assistant, Department of Psychology, The Ohio State University, Columbus, Ohio

1976-77. . . . . . . . . . Public Health Service, Trainee in Developmental Psychology, NIMH Grant #1-T32-MH 1668-01

PUBLICATIONS


FIELDS OF STUDY

Major Field: Clinical-Child Psychology

Studies in Developmental Psychology. Professors George G. Thompson, Charles Wenar, and John Horrocks.


Studies in Developmental Psychobiology. Professors Donald R. Meyer and David Hothersall.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEDICATION</td>
<td>ii</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iii</td>
</tr>
<tr>
<td>VITA</td>
<td>iv</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>vii</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>viii</td>
</tr>
</tbody>
</table>

## Chapter

I. INTRODUCTION ........................................... 1

II. METHODS ............................................... 12

- Subjects ............................................... 12
- Design .................................................... 13
- Apparatus ............................................... 13
- Procedure ............................................... 14
- Measures ................................................ 15

III. RESULTS ............................................... 17

- DRL Analysis ............................................. 17
- Analysis of Schedule-Induced Behaviors .......... 20
- Discriminant Analysis ................................. 22

IV. DISCUSSION .............................................. 33

V. APPENDIX

- A .......................................................... 41
- B .......................................................... 43
- C .......................................................... 45
- D .......................................................... 47
- E .......................................................... 49
- F .......................................................... 51
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1</td>
<td>Cell and Marginal Means for Age (in months).</td>
<td>16</td>
</tr>
<tr>
<td>Table 2</td>
<td>Cell and Marginal Means for I.Q.</td>
<td>16</td>
</tr>
<tr>
<td>Table 3</td>
<td>Analysis of Variance Summary Table for Response (Groups classified according to Teacher Rating).</td>
<td>25</td>
</tr>
<tr>
<td>Table 4</td>
<td>Analysis of Variance Summary Table for Reinforcements (Groups classified according to the Teacher Rating).</td>
<td>26</td>
</tr>
<tr>
<td>Table 5</td>
<td>Analysis of Variance Summary Table for Efficiency Scores (Groups classified according to the Teacher Rating).</td>
<td>27</td>
</tr>
<tr>
<td>Table 6</td>
<td>Analysis of Variance Summary Table for Responses (Groups classified according to Parent Rating).</td>
<td>28</td>
</tr>
<tr>
<td>Table 7</td>
<td>Analysis of Variance Summary Table for Reinforcements (Groups classified according to the Parent Rating).</td>
<td>29</td>
</tr>
<tr>
<td>Table 8</td>
<td>Analysis of Variance Summary Table for Efficiency Score (Groups classified according to the Parent Rating).</td>
<td>30</td>
</tr>
<tr>
<td>Table 9</td>
<td>A List of Observed Mediating Behaviors.</td>
<td>31</td>
</tr>
<tr>
<td>Table 10</td>
<td>Concordance Between Teacher and DRL classifications of Hyperactivity.</td>
<td>32</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Figure 1: The performance of hyperactive and nonhyperactive groups over 3 time blocks of a DRL 6 second schedule. 24
CHAPTER 1

INTRODUCTION

The search for an underlying dimension along which hyperactivity in children can be conceptualized has led researchers down many a winding path. The traditional and most popular approach has been to take the implication of the label seriously and so regard hyperkinesis as a disorder of activity level. To the surprise of many, however, the sheer amount of activity has proven to be less than satisfactory as a defining characteristic of the disorder. Indeed, there is little evidence that the majority of children diagnosed as hyperactive are any more active, on the average, than a matched sample of nonhyperactive children, regardless of whether activity is measured by a stabilimeter cushion (Sprague and Toppe, 1966), ballistograph (McConnel et al., 1964), actometer (Schulman and Reisman, 1959), direct observations and ratings (Doubros and Daniels, 1966; Hutt et al., 1966; Ounsted, 1955), photoelectric and ultrasonic devices (Johnson, 1972), or by motion pictures (Davis et al., 1969; Lee and Hutt, 1964). Moreover, viewing hyperkinesis solely in terms of activity makes it difficult to understand many of the symptoms which are often associated with this disorder, e.g. antisocial behavior, learning disabilities, distractibility, and excitability. Why should a child who is very active necessarily
be antisocial or perform poorly in school? Why should an overly active child necessarily have difficulty keeping his impulses in check or his eyes fixed on a page? There appears to be more to hyperactivity than just hyperactivity, and the current trend is to identify those additional facets.

The disenchantment with homing on the quantity of a hyperactive child's activity has caused some investigators to turn their attentions toward the quality of that behavior. One such alternative which holds particular promise is to conceptualize hyperkinesis along a dimension of impulse control and sustained attention. According to Virginia Douglas (1972), a main proponent of this viewpoint, what typifies the hyperactive child is his inability to "Stop, Look and Listen." She writes:

As I looked back over our various studies, it struck me that one closely related group of characteristics can pretty well account for all of the deficiencies we have found. These youngsters are apparently unable to keep their own impulses under control in order to cope with situations in which care, concentrated attention, or organized planning are required. They tend to react with the first idea that occurs to them or to those aspects of a situation which are the most obvious or compelling. This appears to be the case whether the task requires that they work with visual or auditory stimuli and it also seems to be true in the visual-motor and kinaesthetic spheres. These same deficiencies -- deficiencies which I have come to think of as the inability to "stop, look and listen" -- seem also to influence the children's social behavior (1972, p. 275).

Douglas reviewed a body of research which appears to suggest that a combination of impulsivity and improper attentional controls lies
at the heart of the hyperkinetic syndrome. For example, Sykes (1969) showed that a sample of hyperactive children had significant difficulty on a continuous performance task. On this "vigilance" task, developed by Mirsky and Rosvold (1963), the child has to respond discriminately to a particular configuration of stimuli, e.g. only when one letter of the alphabet is preceded by another specific letter. The results indicated that the hyperactive children identified fewer of the correct stimuli, which suggests faulty attention to the task. In addition, they responded more often to incorrect stimuli, their performance deteriorated more quickly over time and they demonstrated increased motor restlessness as measured by a stabilimetric cushion. Sykes (1969) interprets this latter group of findings in terms of impulsivity, i.e. the children could not refrain from responding inappropriately, and they were unable to sit still and concentrate on the task for a sufficient period of time. There is more evidence, presented by Campbell (1969), which is strongly suggestive of an impulsivity dimension. Using the Kagan (1966) Matching Familiar Figures Test and the Witkin et al. (1962) Embedded Figures Test, she determined that the hyperactive children would be classified as more impulsive and field-dependent than the control group.

A series of studies not mentioned by Douglas, but supportive of her view, was conducted by Luria (1961, 1966a, 1966b). This eminent Soviet neuropsychologist instructed children, whom he described as cerebro-asthenic (minimally brain damaged/hyperactive),
to press a response key following an auditory or visual signal
designated as positive, and not to respond after the appearance
of a negative stimulus. In comparison with their "normal" peers,
the cerebro-asthenic children became erratic in their responding
when the presentation rate was increased. Either they did not
respond at all, or they pressed the keys impulsively when neither
the positive nor the negative stimulus was presented. Luria's
experiment thus provides additional evidence that hyperactive
children may be considered distractible and unable to inhibit
motor responses.

In their pioneering studies, Heinz Werner, Alfred Strauss,
and Laura Lehtinen also conceptualized the behavior of retarded,
brain damaged children in terms of impulsivity and distractibility.
Strauss and Lehtinen (1947) for example tested a small sample of
these children on a battery of perceptual tasks (e.g. The Tactual
Motor Test), and determined that the retarded children had dif-
ficulty attending to the relevant perceptual material. The authors
attributed this distractibility to a general hyperactivity caused
by frank brain damage. Strauss and Lehtinen (1947) and Strauss
and Kephart (1955) further hypothesized that the hyperactivity of
retarded children is due to a breakdown in the processing of
information, which results in a release of excess energy. There
is little contemporary support for this latter theory because the
concept of an energy reservoir runs contrary to more current
neurological thought (Cromwell, Baumeister and Hawkins, 1963).
In a sense, the framework of hyperactivity developed by Douglas (1972) extends this early work of the Wernerian group to nonretarded hyperactives. Since the distractibility and impulsivity noted in the mentally retarded, brain damaged children had long been casually ascribed to nonretarded hyperactives, it is clear that Douglas's attempts to verify this extrapolation with methodologically sound experiments constitute a significant contribution to the field. Yet, while she may have recapitulated much of Werner and Strauss's work, she does not adopt their notion that all hyperactivity is necessarily symptomatic of brain damage. She points out that her Montreal research group failed to find any suggestion of brain damage in the children's neurological examinations, birth histories or electroencephalograms (Werry, Weiss and Douglas, 1964; Werry, Weiss, Dogan, Minde and Douglas, 1969; Minde, Wells and Sykes, 1968), thus expanding the void of evidence for an ipso facto neurological etiology underlying all hyperactivity. Furthermore, while Douglas reaffirms the link between distractibility and impulsivity in hyperactive children, posited by Strauss and Lehtinen (1974), she is much less definite than her predecessors in her views of the exact relationship between the two characteristics. As Ross (1976) points out, Douglas does not make clear whether hyperactivity is a problem of sustaining attention, of controlling impulses, or of both processes. Ross contends that children are impulsive because of their inability to successfully attend to the task at hand; he therefore finds little need to invoke the notion
of impulse control as a causal factor. The argument that impulsivity is due to distractibility is plausible but not wholly convincing. It could just as well be that faulty inhibition of behavioral responding makes it difficult for a child to attend properly to a stimulus configuration. In Douglas's terminology, a child has to "stop" before he can "look" and "listen". In addition, hyperactive children have often been described as impulsive in situations that do not necessarily entail attending to a learning task, e.g. running into the deep end of a pool without knowing how to swim (Cantwell, 1975). Another possibility is that sustained attention and impulsivity arise from a common dimension of behavior, but that they represent two different levels of functioning. In other words, distractibility may be viewed as the failure to control adequately perceptual processes, while impulsivity may be that same lack of inhibition on a behavioral plane.

The advantages of conceptualizing hyperactivity in terms of impulsivity and poor attention are many, not the least of which is its usefulness in understanding the quality of the hyperactive child's behavior. In other words, what appears to characterize his behavior is not necessarily the sheer amount of activity, but his inability to keep that activity well organized and under good control.

While the supporting studies cited by Douglas (1972) are intriguing, there is still need for a much more direct assessment of the hyperactive's impulsivity than can be provided by a single
performance task or a measure of cognitive style. How does the hyperactive child actually perform in a situation where he must inhibit his behavioral responding in order to receive gratification? Fortunately, there is a tested technique which was derived from research in operant conditioning that provides an excellent opportunity to explore this question. In this procedure, termed DRL (Differential Reinforcement of Low Rate Responding), responses which occur before a set time interval has passed are not reinforced and, moreover, they serve to reset the timer governing reinforcement. Thus, a subject performing on a DRL 6 second schedule must wait at least six seconds between responses in order to receive a reinforcement. If a response is made before the six seconds have elapsed, the timer will reset and another six seconds must pass before a successful response can be made.

In general, laboratory animals and human subjects can do quite well on such a task. Normal rats working on a DRL 20 are able to develop efficient response patterns and are typically reinforced for seventy to eighty percent of the responses they make (Nothagersall, Alexander and Slonaker, 1972). It is interesting to note that rats with lesions of the septum show deficits when working on a DRL schedule (Ellen, Wilson and Powell, 1964; Burkett and Bunnell, 1966; Carey, 1967; MacDougall, Van Hoesen, and Mitchell, 1969; Ellen and Aitken, 1971), and it is assumed that this type of deficit stems from an inability to inhibit responding (McCleary, 1966).
There also exists a small but valuable literature on human DRL performance. For instance, Weisberg and Tragakis (1967) demonstrated that even relatively young children, ranging from fifteen to forty months, were able to maintain low levels of responding on both DRL 10 second and DRL 18 second schedules of snack reinforcement. Latency age boys (Stein and Landis, 1973) and college students (Randolph, 1965) have also been shown to perform efficiently on this schedule, although it should be said that the sample sizes for most studies were extremely small.

Thus, one major question posed by this dissertation is, How would a hyperactive child fare in a DRL situation in which behavioral responding must be suppressed? Might the DRL procedure provide an objective measure of impulsivity?

Researchers investigating DRL performances in animals have also observed that subjects in a time-based situation will typically engage in a sequence or chain of behaviors aside from making the reinforced response. The notion is that this collateral behavior sequence "fills up" the required temporal delay between responses, thus aiding the subject in gaining reinforcement. Examples of collateral behaviors in animals are wood chewing and tail licking (Laties, Weiss and Weiss, 1969; Slonaker and Hothersall, 1972), as well as grooming, climbing and exploration (Wilson and Keller, 1953). Collateral behaviors have also been observed when human subjects work on a DRL schedule. For example, Bruner and Revusky (1961) found that four high school boys developed collateral or
"mediating" responses which occurred regularly between the reinforced responses. During postexperimental interviews, all of the subjects were convinced that these extra behaviors served to "set up" the reinforced responses. Similar findings have been reported by Randolph (1965) in a study of collateral behavior in college students. The results of two studies by Stein and Landis (1973a) and Stein and Flanagan (1974) establish a clear relationship between the opportunity to develop collateral behaviors and the efficiency of DRL responding. Experimentally precluding such collateral behaviors led to a disruption of the subject's ability to make the proper temporal discriminations. The evidence from the bulk of these studies, then, indicates that for both animal and human subjects, collateral behaviors play an important mediating or controlling role during a temporally based task.

There is also a hint in the literature that collateral behaviors might play a part in helping the hyperactive child to function efficiently in tasks with a temporal delay. Douglas (1972) cites an observation recorded by Cohen (1970) that, during a delayed reaction time task, hyperactive children showed a "strong tendency to press and release the response button after the appropriate response had been made: they also exhibited more intense movements in the left hand simultaneous with the appropriate response to the reaction signal with the right hand" (Douglas, 1972, p. 267). It was found that these extra movements did not interfere with the performances of these subjects. In fact, there was a positive
relationship between the frequencies of these responses and the efficiency of the performances.¹ These observations may suggest: 1. that hyperactive children spontaneously develop mediating behaviors during tasks requiring delayed responding, and 2. that these collateral behaviors are important in helping the child to control his responding. It is another intent of this dissertation to examine further the possible relationship between collateral behavior and impulse control. Can it be shown more conclusively that a situation which facilitates the development of collateral behaviors helps to improve the DRL performance of hyperactive and, for that matter, normal children? And, regardless of the availability of experimentally introduced opportunities for collateral responding, will these children elicit mediating responses spontaneously as they perform on a DRL schedule?

The study that is being proposed here is of potential significance because it seeks to challenge the conventional wisdom that hyperactive children should be trained to sit still during and between those times when they must attend to various tasks requiring impulse control. It may be that a certain segment of the hyperactive child's hyperactivity is an attempt to control responding, i.e. by establishing collateral behaviors, and that proper management might entail

¹Again, it is provocative to observe that the DRL performances of rats with septal lesions improve dramatically when wood blocks on which they can chew are entered into the testing chamber. In fact, their efficiency in the task does not differ significantly from that of normal rats without wood blocks (Slonaker and Hothersall, 1972).
identifying and exploiting those behaviors to the fullest. Providing
or encouraging collateral behaviors in certain situations might
therefore be an alternative to the "time-out" sorts of techniques
in which any activity is discouraged.

In summary, the purpose of this dissertation is to pursue two
basic sorts of questions:

1. Do hyperactive boys show a deficit compared to controls when
working in a DRL situation? In other words, according to this
measure of behavioral inhibition, are they impulsive? Is the
DRL procedure a good way of measuring impulsivity in hyper-
active and normal children?

2. To what extent does providing opportunities for developing
collateral chains of behavior enhance the DRL performances of
hyperactive and nonhyperactive children? Furthermore, would
an analysis of their behaviors during testing reveal any
spontaneous behaviors which might serve a mediating function?

Using an established DRL procedure modelled after the methods of
Stein and Landis (1973b), it is hoped that the current exploration
of impulsivity in hyperactive boys will provide useful insights
into the nature of this disorder.
CHAPTER II

METHODS

Subjects

Twenty hyperactive boys between six and eight years of age (72 - 97 months), and a matched sample of nonhyperactive boys participated in the study. The subjects were selected from the client roster of a child guidance clinic in Columbus, Ohio; they were all non-retarded and enrolled in school at an age-appropriate grade level. A child was considered hyperactive if his teacher rated him as such on the hyperactivity factor of the Behavior Rating Scale (Conners, 1969), a sample of which appears in Appendix A. In accordance with the findings of a normative study conducted by Sprague et al., 1974, those children with a total score of at least fifteen on this scale were allotted to the hyperactive group, while subjects receiving a score of less than fifteen made up the control group. The two groups were statistically comparable for I.Q. (as measured by either the Wechsler Intelligence Scale for Children-Revised or the Stanford Binet), and for age (see Tables 1 & 2). Unfortunately, I.Q. information could be obtained for only nineteen subjects.
Design

The experiment involved four equal-sized groups: two groups of hyperactive and two groups of nonhyperactive boys. One hyperactive and one nonhyperactive group performed on a DRL 6 second schedule without the availability of collateral buttons (DRL ONLY), while the other two groups worked on DRL using the five-button console (DRL + COLLATERAL).

Apparatus

Each subject was seated before a console containing either one (DRL ONLY) or five (DRL + COLLATERAL) microswitch buttons mounted 4.0 cm apart. On a separate console, positioned immediately behind the button box, was a chassis containing a large six-digit add counter which indicated the cumulative number of reinforcements (points) earned, and a red light which burned for two seconds upon completion of a successful response. For the DRL ONLY condition, the one red button was programmed to produce reinforcement according to a DRL 6 second schedule. For the DRL + COLLATERAL condition, only one red button was programmed with the DRL schedule. The remaining four black collateral keys did not yield reinforcements, but they were individually monitored for the number of times they were pressed, and the response pattern was retained by an Esterline Angus Event Recorder. All sessions were recorded in their entirety on videotape. The programming equipment, counters, timers, recorders and monitoring equipment were housed in a separate room which was
joined to the experimental room by a one-way mirror and an intercom system.

Procedure

Prior to the testing session the mother of every subject received a private explanation of the study, had an opportunity to ask questions, and was requested to fill out a consent form (Appendix B), a release of information statement (Appendix C), and the Behavior Rating Scale. At the end of this brief meeting, each child was taken individually from the reception area to the experimental room which contained only a table, chairs and the testing apparatus. He then received the following instructions (adapted from Stein and Landis, 1973b):

You're going to play a game in which you will get a chance to win a lot of M&M's. Do you see this light (pointing to the reward indicator on the reinforcement box)? Every time you make this light go on you'll earn an M&M and this counter (pointing) will keep track of how many M&M's you've won. At the end of the game I'll give you all the M&M's that you earned. Now, to make the light go on all you have to do is push this red button (pointing), and wait a little while before pressing it again. You just press this red button, wait a while, then press it again. If you press it again too soon, though, then you will not get a point, the light won't go on, and you'll have to wait a while before you can press it to get another point. But if you push the button, wait a while, then push it again, you'll get a point every time.

For the DRL + COLLATERAL groups, these instructions were added:

These four black buttons will not give you points if you press them but, if you want, you can play with them while you're waiting to press the red button again.
The general instructions continued:

Do you have any questions? (All questions were answered.) O.K., I'll leave the room now and turn on the machine. When you hear my voice coming over the speaker saying, "You can start now", then you can begin playing the game. I'll come back when the game is over and bring you your M&M's. Have fun!

Each subject had a total of 15 minutes to earn points on the DRL schedule. At the session's end he was asked, "How did you do it?" and "Did you do anything to help you wait?". Following his response, he was paid his due of M&M's, thanked for his participation, and returned to his mother.

Measures

The DRL task yields three measures of a subject's performance: the total number of responses, the number of reinforcements earned and the efficiency score. Since this last score represents the percentage of reinforced responses, i.e. the number of reinforcements divided by the number of responses, it tends to be the most sensitive indicator of a child's performance. Every subject's response, reinforcement and efficiency scores were obtained for each of three five-minute time blocks, and then totalled for the entire fifteen-minute session. Also monitored were the number of responses emitted on the collateral keys (if available) and the pattern in which they were pressed. Data on I.Q., exact age, school grade and parent ratings were also collected.
Table 1. Cell and Marginal Means for Age (in months).

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Hyperactive</th>
<th>Nonhyperactive</th>
<th>Both Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRL ONLY</td>
<td>85.8</td>
<td>90.4</td>
<td>88.1</td>
</tr>
<tr>
<td>DRL + COLLATERAL</td>
<td>85.6</td>
<td>90.8</td>
<td>88.2</td>
</tr>
<tr>
<td>BOTH CONDITIONS</td>
<td>85.7</td>
<td>90.6</td>
<td>88.2</td>
</tr>
</tbody>
</table>

Table 2. Cell and Marginal Means for IQ.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Hyperactive</th>
<th>Nonhyperactive</th>
<th>Both Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRL ONLY</td>
<td>103.7</td>
<td>101.2</td>
<td>102.5</td>
</tr>
<tr>
<td>DRL + COLLATERAL</td>
<td>97.9</td>
<td>101.2</td>
<td>99.7</td>
</tr>
<tr>
<td>BOTH CONDITIONS</td>
<td>100.8</td>
<td>101.2</td>
<td>101.1</td>
</tr>
</tbody>
</table>
CHAPTER III
RESULTS

DRL Analysis

Analyses of variance (ANOVA's) for each of the three operant measures are presented in Tables 3 - 5. All the means are listed in Appendices D - F, and the mean scores for each trial are shown in Figure 1. Together they demonstrate a highly significant main Group (hyperactive vs. nonhyperactive) effect for all three DRL variables, especially the efficiency score (F(1, 36) = 18.33, p < .0013). Children rated as hyperactive by their teachers thus tended to emit more responses and receive fewer reinforcements during each of the time blocks than did children judged nonhyperactive. This main effect remains strong if the data are reanalyzed according to the parents' classifications of hyperactivity (Tables 6-8). The relative inefficiency of these hyperactive children suggests that they are significantly more impulsive as measured by the DRL 6 second schedule.

There were no Condition (DRL ONLY vs. DRL + COLLATERAL) effects on any of the dependent variables (Efficiency score, F(1, 36) = .133, p < .717), so that whether a child played with the one-button or the five-button console had an insignificant effect upon his DRL performance. A few Group x Condition interactions
did emerge: hyperactive children in the DRL + COLLATERAL condition tended to make more responses than did their counterparts in the DRL ONLY condition \((F(1, 36) = 6.4, p < .016)\), and nonhyperactive COLLATERAL subjects did significantly better according to the efficiency score than did the nonhyperactives in the DRL ONLY situation.

The ANOVA's yielded only one slightly significant main effect for Trials (time blocks): all groups tended to receive more rewards for their second-trial performance \((F(2, 72) = 3.08, p < .051)\). In general, the second trial was the most characteristic of a child's DRL work. For nearly all the various analyses, what held true for each trial taken separately or for the session as a whole, usually held true for the second-trial measures and, again, particularly for the second time-block efficiency score. This observation is supported by the inter-trial correlations for each measure. Since the correlations between Trial 2 and Trial 3 tend to be quite high (mean \(r = .69, p < .001\)), it would suggest that a boy's performance was apt to stabilize by the second trial. When these inter-trial correlations are computed for each group separately, there is evidence that the DRL conduct of nonhyperactive subjects generally consolidated from one trial to the next as he locked into a relatively efficient pattern (mean \(r = .75, p < .001\)). The hyperactive children were more erratic across trials (mean \(r = .54, p < .001\)), but their performance was not so unstable as to cause inter-trial correlations that were
statistically insignificant. On the contrary, their trial-to-trial performances are surprisingly constant, as a glance at Figure 1 should indicate.

In order to uncover relationships between the operant scores and a variety of descriptive data, all variables generated by this study were intercorrelated (Appendices G-I). The resultant matrices offered the following information: It was first found that the subject's age is thoroughly unrelated to any other aspect of his performance or to the hyperactivity ratings supplied by the teacher or parent. The boy's I.Q. was similarly unrelated except for an isolated correlation with the first-trial efficiency score ($r = .35, p < .05$). This finding should be viewed with some skepticism, however, since I.Q. information could be obtained for only nineteen of the forty subjects.

The teacher ratings of hyperactivity using the Behavior Rating Scale (Conners, 1969) were significantly correlated with all DRL variables; their correlation with the whole-session efficiency score, for example, was $r = .53 (p < .01)$. The parent rating was also tied to the major DRL scores ($mean r = .35, p < .05$), though slightly less than were the teacher ratings. The correlation between parents and teachers, themselves, was $r = .61$ -- highly significant ($p < .001$), but not so high as to instill total confidence in their reliability. Parents and teachers did closely agree (34/40 or 85% of the cases) on the gross classification of a child as hyperactive or nonhyperactive. Of the six contesting
cases, parents rated four teacher-classified nonhyperactives as hyperactive, and two teacher-classified hyperactives as nonhyperactive. It seems, therefore, that parents were apt to classify more children as hyperactive. Yet the teachers' mean ratings of the hyperactive boys (22.4) was slightly higher than those rendered by parents (20.0). So, teachers classified fewer children as hyperactive, but they judged the hyperactives as more severely hyperactive.

Analysis of Schedule-Induced Behaviors

As has been the case for almost all animal and human subjects working on a DRL schedule, the children who participated in this study tended to engage in a variety of inter-response ("schedule-induced", "mediating", "adjunctive" or "collateral") behaviors, which were either physically manifested or were reported to the examiner in response to a standard, end-of-session question, "How did you do it?" or "Did you do anything to help you wait?". A list of some of the mediating behaviors which were observed appears in Table 9. (It should be noted that only five of the twenty Collateral group subjects used the collateral buttons for their inter-response regimens.) In order to be considered a mediating behavior, the sequence had to be repeated between at least 10 responses within a particular trial. For the purposes of these analyses, a child received a code according to whether or not he demonstrated a physical collateral, a cognitive collateral (usually counting), either type of mediator, or both kinds. As it turned
out, every subject engaged in some obvious collateral behavior, and most did so in a very rigid fashion. Ninety percent of the hyperactive subjects engaged in an observable mediating behavior, while only 45% of the nonhyperactives employed such a strategy. On the other hand, just 30% of the hyperactive boys reported the use of a non-behavioral mediator, as opposed to 80% of the nonhyperactive subjects. A roughly comparable percentage of each group used both approaches (hyperactives = 20%, nonhyperactives = 25%).

The relationship between the tendency to engage in one or both categories of inter-response behaviors and the other experimental variables was a very significant one. To begin with, there was an inverse correlation between the use of a physical collateral and both the efficiency (r = -.32, p < .05) and reinforcement (r = -.55, p < .005) scores, especially after the first trial.

Hence, children who used an observable collateral scheme did worse on the DRL schedule; they were also apt to be rated as more hyperactive by their parents and teachers. The opposite pattern became manifest for cognitive mediators as there was a very high correlation between the children's reports of counting and all measures for each trial, particularly blocks 2 and 3 (mean r = .64, p < .001). Thus, subjects who engaged in cognitive collaterals fared better on DRL than those who did not. In addition, these boys were usually judged less hyperactive than their non-counting counterparts. Boys who used both strategies during the session also had better scores, though not as high as the scores of those
who only counted.

**Discriminant Analysis**

Because of the strength of the ANOVA Group effect, a discriminant analysis was computed in order to determine statistically how well a subject's efficiency score would predict the teacher's classification of hyperactivity. This analysis, therefore, provides information concerning the reliability of DRL 6 as a measure of hyperactivity. It was found that the efficiency score discriminated highly between the two groups of subjects ($\chi^2 = 13.71$, df(3), $p < .005$). The second-trial efficiency score offered the most weight to that discriminative power (standardized discriminant weight = 1.184), while the contributions of Trials 1 and 3 were .309 and .752, respectively. Furthermore, if each subject were to be classified as hyperactive or nonhyperactive based upon his efficiency score, the probability is that there would be agreement between DRL and the Teacher classifications on 75% of the cases (see Table 10).
Figure 1. The performance of hyperactive and nonhyperactive groups over 3 time blocks of a DRL 6 second schedule. Top: Responses; Middle: Reinforcements; Bottom: Efficiency score.
Figure 1.
Table 3. Analysis of Variance Summary Table for Responses (Groups classified according to Teacher Rating).

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>df</th>
<th>ss</th>
<th>ms</th>
<th>f</th>
<th>prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.36</td>
<td>7696.0</td>
<td>7696.0</td>
<td>5.86</td>
<td>.02</td>
</tr>
<tr>
<td>B</td>
<td>1.36</td>
<td>1576.9</td>
<td>1576.9</td>
<td>1.20</td>
<td>.28</td>
</tr>
<tr>
<td>C</td>
<td>2.72</td>
<td>349.3</td>
<td>174.7</td>
<td>.49</td>
<td>.62</td>
</tr>
<tr>
<td>A x B</td>
<td>1.36</td>
<td>8417.7</td>
<td>3417.7</td>
<td>6.41</td>
<td>.02</td>
</tr>
<tr>
<td>A x C</td>
<td>2.72</td>
<td>443.6</td>
<td>221.8</td>
<td>.62</td>
<td>.54</td>
</tr>
<tr>
<td>B x C</td>
<td>2.72</td>
<td>892.9</td>
<td>446.4</td>
<td>1.24</td>
<td>.29</td>
</tr>
<tr>
<td>A x B x C</td>
<td>2.72</td>
<td>41.6</td>
<td>20.8</td>
<td>.06</td>
<td>.94</td>
</tr>
<tr>
<td>D</td>
<td>36</td>
<td>47282.5</td>
<td>1313.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A = Group (Hyperactive vs. Nonhyperactive)  
B = Condition (DRL ONLY vs. DRL + COLLATERAL)  
C = Trials (Time blocks)  
D = Error
Table 4. Analysis of Variance Summary Table for Reinforcements (Groups classified according to the Teacher Rating).

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>df</th>
<th>ss</th>
<th>ms</th>
<th>f</th>
<th>prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1,36</td>
<td>1717.6</td>
<td>1717.6</td>
<td>13.29</td>
<td>.0008</td>
</tr>
<tr>
<td>B</td>
<td>1,36</td>
<td>0.8</td>
<td>0.8</td>
<td>0.01</td>
<td>.940</td>
</tr>
<tr>
<td>C</td>
<td>2,72</td>
<td>151.3</td>
<td>75.7</td>
<td>3.08</td>
<td>.052</td>
</tr>
<tr>
<td>A x B</td>
<td>1,36</td>
<td>12.0</td>
<td>12.0</td>
<td>0.09</td>
<td>.762</td>
</tr>
<tr>
<td>A x C</td>
<td>2,72</td>
<td>6.3</td>
<td>3.2</td>
<td>0.13</td>
<td>.879</td>
</tr>
<tr>
<td>B x C</td>
<td>2,72</td>
<td>15.5</td>
<td>7.6</td>
<td>0.52</td>
<td>.730</td>
</tr>
<tr>
<td>A x B x C</td>
<td>2,72</td>
<td>35.1</td>
<td>17.6</td>
<td>0.72</td>
<td>.490</td>
</tr>
<tr>
<td>D</td>
<td>36</td>
<td>4651.4</td>
<td>129.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A = Group (Hyperactive vs. Nonhyperactive)  
B = Condition (DRL ONLY vs. DRL + COLLATERAL)  
C = Trials (Time blocks)  
D = Error
Table 5. Analysis of Variance Summary Table for Efficiency Scores (Groups classified according to the Teacher Rating).

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>df</th>
<th>ss</th>
<th>ms</th>
<th>f</th>
<th>prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1,36</td>
<td>2.27</td>
<td>2.27</td>
<td>18.33</td>
<td>.0001</td>
</tr>
<tr>
<td>B</td>
<td>1,36</td>
<td>.02</td>
<td>.02</td>
<td>.13</td>
<td>.717</td>
</tr>
<tr>
<td>C</td>
<td>2,72</td>
<td>.004</td>
<td>.002</td>
<td>.10</td>
<td>.907</td>
</tr>
<tr>
<td>A x B</td>
<td>1,36</td>
<td>.67</td>
<td>.67</td>
<td>5.42</td>
<td>.026</td>
</tr>
<tr>
<td>A x C</td>
<td>2,72</td>
<td>.008</td>
<td>.004</td>
<td>.02</td>
<td>.980</td>
</tr>
<tr>
<td>B x C</td>
<td>2,72</td>
<td>.086</td>
<td>.043</td>
<td>2.05</td>
<td>.136</td>
</tr>
<tr>
<td>A x B x C</td>
<td>2,72</td>
<td>.024</td>
<td>.012</td>
<td>.06</td>
<td>.945</td>
</tr>
<tr>
<td>D</td>
<td>4.47</td>
<td>.124</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A = Group (Hyperactive vs. Nonhyperactive)  
B = Condition (DRL ONLY vs. DRL + COLLATERAL)  
C = Trials (Time blocks)  
D = Error
Table 6. Analysis of Variance Summary Table for Responses (Groups classified according to Parent Rating).

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>df</th>
<th>ss</th>
<th>ms</th>
<th>f</th>
<th>prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1,36</td>
<td>5802.5</td>
<td>5802.5</td>
<td>3.65</td>
<td>.054</td>
</tr>
<tr>
<td>B</td>
<td>1,36</td>
<td>2725.2</td>
<td>2725.2</td>
<td>1.71</td>
<td>.198</td>
</tr>
<tr>
<td>C</td>
<td>2,72</td>
<td>328.1</td>
<td>164.0</td>
<td>.51</td>
<td>.602</td>
</tr>
<tr>
<td>A x B</td>
<td>1,36</td>
<td>289.5</td>
<td>289.5</td>
<td>.18</td>
<td>.671</td>
</tr>
<tr>
<td>A x C</td>
<td>2,72</td>
<td>1544.4</td>
<td>772.2</td>
<td>2.41</td>
<td>.098</td>
</tr>
<tr>
<td>B x C</td>
<td>2,72</td>
<td>1089.0</td>
<td>544.5</td>
<td>1.70</td>
<td>.190</td>
</tr>
<tr>
<td>A x B x C</td>
<td>2,72</td>
<td>1538.0</td>
<td>769.0</td>
<td>2.39</td>
<td>.098</td>
</tr>
<tr>
<td>D</td>
<td>36</td>
<td>57183.2</td>
<td>1588.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A = Group (Hyperactive vs. Nonhyperactive)  
B = Condition (DRL ONLY vs. DRL + COLLATERAL)  
C = Trials (Time blocks)  
D = Error
Table 7. Analysis of Variance Summary Table for Reinforcements (Groups classified according to the Parent Rating).

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>df</th>
<th>ss</th>
<th>ms</th>
<th>f</th>
<th>prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1,36</td>
<td>1088.8</td>
<td>1088.8</td>
<td>7.41</td>
<td>.010</td>
</tr>
<tr>
<td>B</td>
<td>1,36</td>
<td>57.5</td>
<td>57.5</td>
<td>.39</td>
<td>.536</td>
</tr>
<tr>
<td>C</td>
<td>2,72</td>
<td>169.6</td>
<td>84.8</td>
<td>3.45</td>
<td>.037</td>
</tr>
<tr>
<td>A x B</td>
<td>1,36</td>
<td>.9</td>
<td>.9</td>
<td>.01</td>
<td>.937</td>
</tr>
<tr>
<td>A x C</td>
<td>2,72</td>
<td>26.8</td>
<td>13.9</td>
<td>.54</td>
<td>.582</td>
</tr>
<tr>
<td>B x C</td>
<td>2,72</td>
<td>7.1</td>
<td>3.5</td>
<td>.14</td>
<td>.866</td>
</tr>
<tr>
<td>A x B x C</td>
<td>2,72</td>
<td>12.0</td>
<td>6.0</td>
<td>.24</td>
<td>.784</td>
</tr>
<tr>
<td>D</td>
<td>36</td>
<td>5292.1</td>
<td>147.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A = Group (Hyperactive vs. Nonhyperactive)  
B = Condition (DRL ONLY vs. DRL + COLLATERAL)  
C = Trials (Time blocks)  
D = Error
Table 8. Analysis of Variance Summary Table for Efficiency Score (Groups classified according to the Parent Rating).

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>df</th>
<th>ss</th>
<th>ms</th>
<th>f</th>
<th>prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1,36</td>
<td>2.010</td>
<td>2.1</td>
<td>13.47</td>
<td>.0008</td>
</tr>
<tr>
<td>B</td>
<td>1,36</td>
<td>.156</td>
<td>.2</td>
<td>1.05</td>
<td>.312</td>
</tr>
<tr>
<td>C</td>
<td>2,72</td>
<td>.005</td>
<td>.002</td>
<td>.12</td>
<td>.890</td>
</tr>
<tr>
<td>A x B</td>
<td>1,36</td>
<td>.017</td>
<td>.017</td>
<td>.11</td>
<td>.739</td>
</tr>
<tr>
<td>A x C</td>
<td>2,72</td>
<td>.001</td>
<td>.001</td>
<td>.04</td>
<td>.966</td>
</tr>
<tr>
<td>B x C</td>
<td>2,72</td>
<td>.079</td>
<td>.040</td>
<td>1.90</td>
<td>.157</td>
</tr>
<tr>
<td>D</td>
<td>36</td>
<td>5.37</td>
<td>.149</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A = Group (Hyperactive vs. Nonhyperactive)  
B = Condition (DRL Only vs. DRL + Collateral)  
C = Trials (Time blocks)  
D = Error
Table 9. A List of Observed Mediating Behaviors.

a. circling DRL button with finger 9 times.
b. swinging legs 10, 12, or 20 times.
c. counting with lips.
d. counting out loud -- numbers or ABC's.
e. blowing on reward box.
f. singing out loud.
g. shaking reward box 10 times.
h. hitting knee with right hand 20 times.
i. foot-tapping 16 times.
j. tapping finger 10 times on button box.
k. "walking" fingers around DRL button 9 times.
l. stomping with foot 9 or 10 times.
m. running around table 1 time.
n. hitting side of box.
o. jumping jacks 4 times.
p. hitting collateral buttons.
Table 10. Concordance Between Teacher and DRL Classifications of Hyperactivity.

<table>
<thead>
<tr>
<th>Teacher Classified</th>
<th>Hyperactive</th>
<th>Nonhyperactive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyperactive</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>Nonhyperactive</td>
<td>6</td>
<td>16</td>
</tr>
</tbody>
</table>
CHAPTER IV

DISCUSSION

The prediction that children classified as hyperactive would encounter greater difficulties in managing the DRL task than would nonhyperactives was convincingly confirmed by the results of this study. According to every indicator of DRL performance, the hyperactive boys were relatively unable to refrain from making a high percentage of incorrect responses. In light of the enormous variability usually associated with the study of hyperactive children, the pervasiveness and statistical significance of this effect are all the more impressive. Consequently, they lend further credence to Douglas's (1972) proposal of an impulsivity dimension underlying the hyperkinetic syndrome, and to the validity of other measures of impulsivity presented by Sykes (1969) and Campbell (1969). Of all the assessment procedures, the DRL schedule would seem to provide the most direct and objective test of a child's ability to control his impulses in order to be rewarded, and it is for this reason, perhaps, that DRL was so sensitive to the impulsivity of hyperactive children.

These results may also give heart to those who advocate the animal with septal lesions as a model of hyperactivity, because both hyperactive children and septal animals perform much poorer on this task than do their more "normal" counterparts. Of course,
it cannot yet be suggested that this similar inability is symptomatic of septal lesions in hyperactive children. It is interesting, though, that the syndrome and its posited model do appear to share a common DRL deficit.

The finding that age was unrelated to any of the experimental variables was most likely a result of the rather narrow age range (3 years) of the subjects. It could also be that the ability tapped by the DRL task should have already been acquired by the age of six, so that failure to perform well is not a developmental phenomenon, per se, but the product of a disability or lag. The lack of I.Q. correlations might similarly be due to the narrow range imposed by the subject criteria (or to the limited amount of I.Q. information). Yet it may also be the case that the child's intelligence, as long as it is above the borderline level, has little effect upon overall performance, although it may be related to the speed with which he initially grasps the strategy of the task.

Since the experimental Condition (DRL ONLY vs. DRL + COLLATERAL) failed to emerge as a significant source of variance, it must be concluded that a box with five buttons is not the panacea for hyperactivity. However, given the observation that children engaged in many self-generated inter-response behaviors, this finding is not at all alarming. The fact is that a child will develop some type of inter-response strategy whether or not the experimenter provides a few extra buttons or telegraph keys. Even with the buttons present, only a small segment of the DRL +
COLLATERAL group used them. This finding is in sharp contrast to other studies of collateral responding by children (e.g. Stein and Landis, 1973a) in which all subjects apparently used the extra keys. One cannot help but wonder what was different about the present situation in which there was a lower usage of the collateral buttons, especially since all the children's ages, the instructions and equipment were essentially identical.

The finding of a Group X Condition interaction is a puzzling one. Apparently, the presence of collateral buttons interferes with a hyperactive child's performance, while it enhances or at least does not hinder the nonhyperactive's efficiency. Perhaps the extra buttons served to distract or disinhibit the hyperactive subject, causing him to lose some control. One is hard put, though, to explain their facilitative effect on the nonhyperactives, particularly in light of the fact that only two of these subjects made use of them.

In their attempts to quantify collateral responding, it appears that past investigators have missed the rich bounty of self-elicited behaviors which children exhibit during the course of a DRL session. Aside from their diversity, these schedule-induced behaviors are fascinating for the rigid manner in which they are executed; once a child chanced upon a successful strategy, he usually stuck with it ardently, even if it meant running around the table for seven minutes or slapping his thigh nine times between each response for nearly the entire session. The records
of children who did use the collateral buttons in a patterned fashion offer the most dramatic examples. Sometimes they went through their pattern too quickly, but were so locked into it that they faced some difficulty readjusting their strategy so it would provide reinforcements.

That the proclivity to engage in a physical or cognitive mediating behavior was so closely related to DRL performance as well as to ratings of hyperactivity is a highly intriguing result. Even with a relatively gross coding system, a strong pattern surfaced in which boys who displayed physical collaterals did worse on DRL and were rated more hyperactive than were boys who used cognitive means. In addition, many more hyperactive than nonhyperactive boys generated physical collaterals, an observation which may support the notion that a certain segment of the hyperactive child's hyperactivity is actually a series of mediating behaviors developed in an effort to control his impulses. The test performance of one very hyperactive child provides a startling example. This seven-year-old boy was in constant motion throughout the session and, unlike nearly all the other subjects, left his seat to unlock a closet, open drawers and, in general, to tear apart the room in which testing was conducted. But despite his many ramblings, he always returned to the DRL button and, in fact, succeeded in winning a respectable number (47) of M&M's. When asked how he managed the task, this subject's response was, "I went over there to play for a while, then I came and pressed it (the button),
then I went over and played there again." To the question, "Why did you go over there to play?", he responded, "To keep me busy."
The implication is, then, that his inter-response endeavors were, at least in part, a conscious attempt to help him wait out the necessary time interval.

While it appears certain that cognitive mediators are more efficient strategies than physical ones, it is impossible to determine from these data whether physical collaterals actually hindered DRL efficiency, or simply failed to facilitate it as much as the cognitive types did. The only hint available is the finding that the 18 subjects who employed physical collaterals during several trials had significantly higher efficiency scores than did the 9 children whose physical mediating was limited to one time block (p < .05). There is also that small amount of research which concerns the advisability of permitting adults (e.g. Stein and Flanagan, 1974) and rats (Slonaker and Hothersall, 1972) to engage in collateral behaviors. Nevertheless, the nature of the interaction between a physical collateral and the DRL performance of hyperactive children is a very important avenue of research which warrants further exploration. If engaging in physical mediators is more facilitative than not using any (or limited) collaterals, then the therapeutic implications would be to encourage hyperactive children to keep themselves physically if not mentally occupied. This is in contrast with strategies which promote "time-out" procedures as a management technique during those
occasions when it becomes necessary for the child to curb his impulsivity. However, if the results of research point out that extensive physical mediation is inferior to the absence or restricted use of these behaviors, then the "time-out" procedures and/or the training of cognitive collaterals would be more appropriate.

A somewhat unexpected but extremely intriguing aspect of these results was the extent to which the DRL variables could accurately discriminate between groups. According to the discriminant analysis and the inter-trial correlations, the efficiency score can serve as a reliable and stable predictor of teacher-classified hyperactivity. It thus appears that the DRL 6 task taps a major behavioral dimension which is independently assessed by the Behavior Rating Scale. Consequently, it is possible that the DRL task could actually be developed into a useful clinical tool which could aid the diagnostician in the assessment of impulsivity and the classification of hyperactivity. The DRL test holds promise as a useful diagnostic measure not only due to its statistical reliability, but also because it is an objective, quantitative technique that is simple and quick to administer. According to the experimental data, two trials (ten minutes) would be sufficient to garner the necessary information. Yet, needless to say, much more normative data must be amassed before a DRL assessment technique could be employed with confidence. It should also be shown that DRL is a more valid and reliable measure of hyperactivity than existing instruments, e.g. behavior rating scales and measures
of general activity.

Despite the high degree of consensus between the DRL measure and the Behavior Rating Scale, teacher and machine were not always in total accord. Indeed, there were several cases in which the two classifiers profoundly disagreed. In one instance all scores pointed towards normality, but the teacher rating form was returned with a firm judgement of hyperactivity. As always, it is hard to know with whom the truth may lie. Although it is a widely accepted instrument, the Conner's Scale is certainly not an infallible criterion since it has associated with it considerable error variance (as attested to by the modest correlation between parent and teacher ratings), while the DRL procedure is also not the paragon of reliability. Moreover, it may be that this child's behavior in school differs dramatically from his clinic behavior, or that his teacher, for some reason, is particularly sensitive to his general demeanor. Additional studies are clearly necessary in which there are multiple ratings of hyperactivity that can be combined into one score, thereby minimizing individual variations in raters' judgements. Another approach would be to design a rating scale which taps the teacher's judgements of a child's impulsivity, in particular, and then to correlate that score with the DRL variables. Also needed are more extensive reliability studies in which the DRL test is administered to much larger and diverse groups of a wider age range. In addition, test-retest reliability should be ascertained.
One very curious facet of the DRL situation was the degree to which each child was absorbed and entertained by this operant task. There was something definitely compelling about pushing those buttons: even the most impatient of the boys stayed with the "game" for the full session and, in many cases, wanted to continue playing after the session's official end. The almost uniform response to the question, "How did you like it?" was a resounding "It was fun!", and several mothers later commented that their sons would not stop talking about their experiences with the game. The intense interest generated by the DRL task is a very pleasant attribute of the procedure, one which may have contributed to the overall reliability and efficacy of assessment. Aside from these more practical considerations, though, one wonders exactly what it was about this situation which so captivated these subjects. Perhaps it was the universal desire to "beat the machine" which, for years, has lured both child and adult into pinball parlors and penny arcades. Or maybe children will do anything for a heavy dose of M&M's. Whatever may be the attraction, it is reassuring to know that the study of impulsivity using the DRL procedure can be as entertaining to the child as it is informative to the researcher.
Appendix A. The Behavior Rating Scale (Conners, 1969).

Numbers in parentheses are the scores assigned to each column, and items comprising the hyperactivity factor are starred.
**BEHAVIOR RATING SCALE**

<table>
<thead>
<tr>
<th>Name of Child</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>(0) Not at all</th>
<th>(1) Just a little</th>
<th>(2) Pretty much</th>
<th>(3) Very much</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Constantly fidgeting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Humes and makes other odd noises</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Demands must be met immediately - easily frustrated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Coordination poor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Restless or overactive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Excitable, impulsive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Inattentive, easily distracted</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Fails to finish things he starts - short attention span</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Overly sensitive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Overly serious or sad</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Daydreams</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Sullen or sulky</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Cries often and easily</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Disturbs other children</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Quarrelsome</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Mood changes quickly and drastically</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>Acts &quot;smart&quot;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>Destructive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>Steals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>Lies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>Temper outbursts, explosive and unpredictable behavior</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.</td>
<td>Separates himself from other children</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td>Appears to be unaccepted by group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24.</td>
<td>Appears to be easily led</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25.</td>
<td>No sense of fair play</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26.</td>
<td>Appears to lack leadership</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27.</td>
<td>Does not get along with opposite sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28.</td>
<td>Does not get along with same sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29.</td>
<td>Teases other children or interferes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30.</td>
<td>Submissive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31.</td>
<td>Defiant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32.</td>
<td>Impudent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33.</td>
<td>Shy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34.</td>
<td>Fearful</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35.</td>
<td>Excessive demands for teacher's (parent's) attention</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>36.</td>
<td>Stubborn</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37.</td>
<td>Overly anxious to please</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38.</td>
<td>Uncooperative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39.</td>
<td>Attendance problem</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other observations (use reverse side if more space is required):
Appendix B. The Consent Form.
CONSENT FORM

I consent to let my son, ____________________, born on _________________, participate as a subject in the research investigation entitled "The Assessment and Modification of Impulsivity in Hyperactive Children."

The nature and general purpose of the research procedure have been explained to me. This research is to be performed by Michael Gordon, M.A. and is under the supervision of Malcolm Helper, Ph.D. and John L. Sullivan, Ph.D.

I understand that any further inquiries I make concerning this procedure will be answered. I also understand that my identity and the identity of my son will be kept strictly confidential. Finally, I understand that I am free to withdraw my consent and discontinue participation at any time. My signature represents a free and voluntary act.

Signed ____________________

Witness:
Appendix C. The Release of Information Statement
To help us in conducting research at North Area Guidance Center, we would appreciate it if you would complete the attached Behavior Rating Scale for ___________________________ and send it back immediately using the enclosed envelope. The release of information statement below has been signed by the child's parent. It should also be pointed out that this child is not necessarily receiving treatment at the Center.

Thank you very much for your cooperation.

Sincerely,

Michael Gordon
M.A. Psychologist

This is my authorization for information about my child ___________________________
born on ___________________________ to be released to: North Area Guidance Center, 733 East Granville Road, Columbus, Ohio 43229.
(Telephone: 614/885-2532)

Signed ___________________________
Relationship _______________________
Appendix D. Cell and marginal means of Responses.
<table>
<thead>
<tr>
<th></th>
<th>Hyperactive</th>
<th>Nonhyperactive</th>
<th>Both Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DRL ONLY</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial 1</td>
<td>41.5</td>
<td>37.3</td>
<td>39.4</td>
</tr>
<tr>
<td>Trial 2</td>
<td>44.7</td>
<td>47.9</td>
<td>46.3</td>
</tr>
<tr>
<td>Trial 3</td>
<td>41.9</td>
<td>35.1</td>
<td>43.5</td>
</tr>
<tr>
<td>Whole Session</td>
<td>42.7</td>
<td>43.4</td>
<td>43.1</td>
</tr>
<tr>
<td><strong>DRL + COLLATERAL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial 1</td>
<td>73.3</td>
<td>35.1</td>
<td>54.2</td>
</tr>
<tr>
<td>Trial 2</td>
<td>67.6</td>
<td>34.7</td>
<td>51.2</td>
</tr>
<tr>
<td>Trial 3</td>
<td>59.2</td>
<td>32.0</td>
<td>45.6</td>
</tr>
<tr>
<td>Whole Session</td>
<td>66.7</td>
<td>33.9</td>
<td>50.3</td>
</tr>
<tr>
<td><strong>BOTH CONDITIONS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial 1</td>
<td>57.4</td>
<td>36.2</td>
<td>46.8</td>
</tr>
<tr>
<td>Trial 2</td>
<td>56.2</td>
<td>41.3</td>
<td>48.7</td>
</tr>
<tr>
<td>Trial 3</td>
<td>50.5</td>
<td>38.6</td>
<td>44.6</td>
</tr>
<tr>
<td>Whole Session</td>
<td>54.7</td>
<td>38.7</td>
<td>46.7</td>
</tr>
</tbody>
</table>
Appendix E. Cell and marginal means of Reinforcements.
<table>
<thead>
<tr>
<th>CONDITIONS</th>
<th>Groups</th>
<th>Hyperactive</th>
<th>Nonhyperactive</th>
<th>Both Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DRL ONLY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial 1</td>
<td></td>
<td>19.5</td>
<td>24.3</td>
<td>21.9</td>
</tr>
<tr>
<td>Trial 2</td>
<td></td>
<td>19.8</td>
<td>27.8</td>
<td>23.8</td>
</tr>
<tr>
<td>Trial 3</td>
<td></td>
<td>18.6</td>
<td>26.6</td>
<td>22.6</td>
</tr>
<tr>
<td>Whole Session</td>
<td></td>
<td>19.3</td>
<td>26.2</td>
<td>22.7</td>
</tr>
<tr>
<td><strong>DRL + COLIATERAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial 1</td>
<td></td>
<td>16.2</td>
<td>25.3</td>
<td>20.8</td>
</tr>
<tr>
<td>Trial 2</td>
<td></td>
<td>20.3</td>
<td>28.4</td>
<td>24.4</td>
</tr>
<tr>
<td>Trial 3</td>
<td></td>
<td>19.0</td>
<td>26.4</td>
<td>22.7</td>
</tr>
<tr>
<td>Whole Session</td>
<td></td>
<td>18.5</td>
<td>26.7</td>
<td>22.6</td>
</tr>
<tr>
<td><strong>BOTH CONDITIONS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial 1</td>
<td></td>
<td>17.9</td>
<td>24.8</td>
<td>21.9</td>
</tr>
<tr>
<td>Trial 2</td>
<td></td>
<td>20.1</td>
<td>28.1</td>
<td>23.8</td>
</tr>
<tr>
<td>Trial 3</td>
<td></td>
<td>18.8</td>
<td>26.5</td>
<td>22.6</td>
</tr>
<tr>
<td>Whole Session</td>
<td></td>
<td>18.9</td>
<td>26.5</td>
<td>22.7</td>
</tr>
</tbody>
</table>
Appendix F. Cell and marginal means of the Efficiency Score.
<table>
<thead>
<tr>
<th></th>
<th>Hyperactive</th>
<th>Nonhyperactive</th>
<th>Both Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DRL ONLY</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial 1</td>
<td>.59</td>
<td>.73</td>
<td>.66</td>
</tr>
<tr>
<td>Trial 2</td>
<td>.53</td>
<td>.66</td>
<td>.60</td>
</tr>
<tr>
<td>Trial 3</td>
<td>.56</td>
<td>.67</td>
<td>.62</td>
</tr>
<tr>
<td>Whole Session</td>
<td>.56</td>
<td>.69</td>
<td>.62</td>
</tr>
<tr>
<td><strong>DRL + COLLATERAL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial 1</td>
<td>.36</td>
<td>.77</td>
<td>.56</td>
</tr>
<tr>
<td>Trial 2</td>
<td>.40</td>
<td>.83</td>
<td>.62</td>
</tr>
<tr>
<td>Trial 3</td>
<td>.41</td>
<td>.84</td>
<td>.62</td>
</tr>
<tr>
<td>Whole Session</td>
<td>.39</td>
<td>.81</td>
<td>.60</td>
</tr>
<tr>
<td><strong>BOTH CONDITIONS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial 1</td>
<td>.47</td>
<td>.75</td>
<td>.61</td>
</tr>
<tr>
<td>Trial 2</td>
<td>.46</td>
<td>.75</td>
<td>.61</td>
</tr>
<tr>
<td>Trial 3</td>
<td>.48</td>
<td>.76</td>
<td>.62</td>
</tr>
<tr>
<td>Whole Session</td>
<td>.47</td>
<td>.75</td>
<td>.61</td>
</tr>
</tbody>
</table>
Appendix G. Intercorrelational matrix for combined groups.
<table>
<thead>
<tr>
<th></th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Whole Session</th>
<th>TBRS</th>
<th>PBRS</th>
<th>Age</th>
<th>I.Q</th>
<th>Phys Coll</th>
<th>Cogn Coll</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reinforcements</td>
<td>- .41</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficiency Ratio</td>
<td>- .75</td>
<td>- .69</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reinforcements</td>
<td>- .00</td>
<td>- .66</td>
<td>- .39</td>
<td>- .65</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficiency Ratio</td>
<td>- .45</td>
<td>- .58</td>
<td>- .79</td>
<td>- .74</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reinforcements</td>
<td>- .51</td>
<td>- .36</td>
<td>- .67</td>
<td>- .86</td>
<td>- .21</td>
<td>- .68</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficiency Ratio</td>
<td>- .34</td>
<td>- .45</td>
<td>- .68</td>
<td>- .59</td>
<td>- .53</td>
<td>- .74</td>
<td>- .66</td>
<td>- .56</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reinforcements</td>
<td>- .24</td>
<td>- .42</td>
<td>- .47</td>
<td>- .52</td>
<td>- .29</td>
<td>- .44</td>
<td>- .29</td>
<td>- .36</td>
<td>- .52</td>
<td>- .53</td>
<td></td>
</tr>
<tr>
<td>Efficiency Ratio</td>
<td>- .25</td>
<td>- .21</td>
<td>- .36</td>
<td>- .32</td>
<td>- .41</td>
<td>- .22</td>
<td>- .48</td>
<td>- .50</td>
<td>- .21</td>
<td>- .39</td>
<td>- .47</td>
</tr>
<tr>
<td>Teacher Rating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parent Rating</td>
<td>- .14</td>
<td>- .25</td>
<td>- .35</td>
<td>- .13</td>
<td>- .01</td>
<td>- .15</td>
<td>- .02</td>
<td>- .04</td>
<td>- .21</td>
<td>- .19</td>
<td>- .10</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.Q</td>
<td>- .30</td>
<td>- .22</td>
<td>- .42</td>
<td>- .19</td>
<td>- .49</td>
<td>- .38</td>
<td>- .13</td>
<td>- .56</td>
<td>- .32</td>
<td>- .55</td>
<td>- .32</td>
</tr>
<tr>
<td>Cognitive Coll.</td>
<td>- .33</td>
<td>- .56</td>
<td>- .48</td>
<td>- .29</td>
<td>- .61</td>
<td>- .53</td>
<td>- .32</td>
<td>- .59</td>
<td>- .37</td>
<td>- .67</td>
<td>- .61</td>
</tr>
<tr>
<td>Both Phys &amp; Cogn</td>
<td>- .24</td>
<td>- .20</td>
<td>- .36</td>
<td>- .15</td>
<td>- .18</td>
<td>- .21</td>
<td>- .23</td>
<td>- .08</td>
<td>.03</td>
<td>.25</td>
<td>.37</td>
</tr>
</tbody>
</table>

$r = .31$ for $p < .05$

$r = .44$ for $p < .01$
Appendix H. Intercorrelational matrix for the hyperactive group.
<table>
<thead>
<tr>
<th></th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Whole Session</th>
<th>TBS</th>
<th>PBRS</th>
<th>AGE</th>
<th>I.Q</th>
<th>Phys. Coll.</th>
<th>Cogn. Coll.</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responses</td>
<td></td>
<td>.54</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reinforcements</td>
<td>-.73</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficiency Ratio</td>
<td></td>
<td>-.37</td>
<td>.63</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responses</td>
<td>.38</td>
<td>-.56</td>
<td>-.63</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reinforcements</td>
<td>.13</td>
<td>.53</td>
<td>.36</td>
<td>-.26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficiency Ratio</td>
<td></td>
<td>-.37</td>
<td>.63</td>
<td>.62</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responses</td>
<td>.42</td>
<td>-.48</td>
<td>-.61</td>
<td>.84</td>
<td>.17</td>
<td>.60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reinforcements</td>
<td>.42</td>
<td>.17</td>
<td>.10</td>
<td>.01</td>
<td>.71</td>
<td>.36</td>
<td>.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficiency Ratio</td>
<td></td>
<td>-.21</td>
<td>.33</td>
<td>.61</td>
<td>.43</td>
<td>.39</td>
<td>.53</td>
<td>.57</td>
<td>.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reinforcements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficiency Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher Rating</td>
<td>.17</td>
<td>-.26</td>
<td>-.20</td>
<td>.10</td>
<td>-.05</td>
<td>.13</td>
<td>.14</td>
<td>.02</td>
<td>.12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parent Rating</td>
<td>.00</td>
<td>.21</td>
<td>.07</td>
<td>-.50</td>
<td>.21</td>
<td>.22</td>
<td>.27</td>
<td>.26</td>
<td>.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>.20</td>
<td>.09</td>
<td>-.05</td>
<td>.19</td>
<td>.35</td>
<td>.04</td>
<td>.15</td>
<td>.32</td>
<td>.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.Q</td>
<td>.32</td>
<td>.24</td>
<td>.36</td>
<td>-.14</td>
<td>-.01</td>
<td>.18</td>
<td>.09</td>
<td>.18</td>
<td>-.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Collateral</td>
<td>.03</td>
<td>-.15</td>
<td>.03</td>
<td>.02</td>
<td>.13</td>
<td>.03</td>
<td>.09</td>
<td>.18</td>
<td>.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive Collateral</td>
<td>.26</td>
<td>.38</td>
<td>.29</td>
<td>-.09</td>
<td>.43</td>
<td>.21</td>
<td>.15</td>
<td>.26</td>
<td>.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both Phys. &amp; Cogn.</td>
<td>.24</td>
<td>.32</td>
<td>.35</td>
<td>-.09</td>
<td>.40</td>
<td>.22</td>
<td>-.10</td>
<td>.16</td>
<td>.47</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$r = .44$ for $p < .05$
$r = .50$ for $p < .01$
Appendix I. Intercorrelational matrix for the nonhyperactive group.
<table>
<thead>
<tr>
<th></th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Whole Session</th>
<th>TDRS</th>
<th>PDRS</th>
<th>AGE</th>
<th>IQ</th>
<th>Phys</th>
<th>Cogn</th>
<th>BOTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reinforcements</td>
<td>.43</td>
<td>.50</td>
<td>.41</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficiency Ratio</td>
<td>-.84</td>
<td>.56</td>
<td>-.76</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ r = .44 \text{ for } p < .05 \]
\[ r = .56 \text{ for } p < .01 \]
REFERENCES


