

A CASE STUDY OF THE EFFECTS OF RITALIN
ON THE PERFORMANCE OF TWO CHILDREN

by

Susan Terrant

Approved by

H. Schneider

Chairman, Thesis Committee

William H. Knight

Professor of Psychology

William W. May

Assistant Professor of Psychology

Jay G. Branch

Chairman, Department of Psychology

B. F. Strickland

Dean of the Graduate School

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A Thesis

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Abstract

Many studies in recent years have looked at the effects of Ritalin on the performance of hyperactive children. In general, these studies have shown Ritalin to be significant in reducing the symptoms of hyperactivity usually referred to as impulsivity, short attention span, low frustration tolerance, and overly active. This study was designed to examine the effects of Ritalin on the performance of two children taking Ritalin on four tasks: concept learning, reaction time, visual discrimination, and memory. Unlike past studies, the present one used children who had been taking Ritalin for at least six months immediately preceding the study. Results showed Ritalin to have a variable effect on the performance of the two children.

A CASE STUDY OF THE EFFECTS OF RITALIN

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The use of drugs in the treatment of children diagnosed as hyperactive has been the subject of many studies in recent years. Grinspoon & Singer (1973) reviewed several possible explanations for hyperactivity and the effect of medication. One frequently cited theory is that amphetamines stimulate the inhibitory function of the diencephalon so as to protect the cortex from over-stimulation. Another theory is that amphetamines stimulate the reticular activating system and increase general alertness in the hyperkinetic child. In either case, the stimulating effects of the drug both increase alertness and inhibit interfering stimuli from reaching the cortex.

Another explanation offered by Wender (1971) is that it is possible that there are differential rates of maturation of various neurohumeral systems within the brain. Hyperactivity might be the result of functional underactivity of a Dopamine (DA) system within the caudate nucleus. In the adult, amphetamine apparently stimulates neurons acting within the reticular activating system (RAS). If the hyperactive child had only small amounts of DA within his caudate nucleus and none of the neurohumors which mediated the activity of the RAS, administration of amphetamine would stimulate the caudate nucleus but not the RAS and thus decrease rather than increase his hyperactivity.

Douglas (1972) has described the hyperactive child as having the inability to "stop, look, and listen". Reports from parents and teachers contain such descriptions as impulsive, short attention span, overly active,

low frustration level, emotional extremes, or difficulty getting along with other children. Douglas' conclusions are in agreement with other studies - namely that the inability to sustain attention and control impulsivity account for the major deficits of hyperactive children. Many studies have been done by Douglas and her associates, as well as others, assessing the effects of Ritalin (methylphenidate) on hyperactivity and found Ritalin effective in helping the hyperactive child to sustain attention and control impulsivity (Campbell, et al., 1971; Cohen, et al., 1971; Connors, 1971; Douglas, 1972; Knights & Hinton, 1969; Sprague, et al., 1970; Sykes, et al., 1971).

Past studies have been concerned with the effects of Ritalin on children who have had no previous experience with the drug. Sykes, et al., 1971, question whether their results would be the same if the drugs had been taken over an extended period of time. While Ritalin is not thought to have any long-term physiological effects, the improvement in sustaining attention and controlling impulsivity while taking Ritalin may transfer to a non-medicated state and alter the child's approach to learning and problem solving.

Previous studies have shown that on tasks requiring speed of responding, hyperactive children have slower reaction time (RT) and make more errors than normals (Campbell, et al., 1971; Connors, 1971; Douglas, 1972; Knights & Hinton, 1969; Sprague et al., 1970; Sykes, et al., 1971). The administration of Ritalin results in decreased RT and fewer errors. Conversely, on tasks requiring restraint, hyperactive children have decreased RTs and more errors than normal children. Ritalin increases RT and decreases errors. This increase in

RT may be due to the inability to sustain attention. Hyperactive children may miss the warning signal or the stimuli presented, thus increasing RT. Impulsivity is said to be responsible for poor performance (increased RT, increased errors) on tasks requiring restraint. In most studies of RT and impulsivity, the task requires a response after attending to a warning stimuli. The child must attend to the warning signal and maintain attention until the presentation of the stimulus. He must then restrain his response long enough to decide on his answer.

The conclusions of the above studies are that hyperactive children displayed an "inability to concentrate" and thus the warning signal may not serve its purpose. Ritalin improved performance and decreased errors. In serial RT study by Sykes (1971) hyperactives did not differ from normals with respect to the number of correct responses but made significantly more incorrect responses. Again Ritalin decreased errors.

In a RT task requiring repeated naming of pictures of already familiar animals, Campbell et al., (1971) found no significant differences between hyperactive children and normal children and no significant change in performance when hyperactives were given Ritalin. However, in a similar task requiring naming of colors, hyperactive children took significantly longer and Ritalin did not produce any improvement in performance. This suggests that on a task using already learned stimuli and requiring quick responding, the hyperactive children would do at least as well as normal children.

Conceptual difficulties among hyperactive children have been reported by several authors (Burke, 1960; Clements & Peters, 1962; Rosenfeld & Bradley, 1948). However, Freibergs & Douglas (1969) found

hyperactives as efficient as normals in a standard concept learning task as long as there was continuous reinforcement. Under partial reinforcement the performance of all children decreased with the hyperactive children showing significantly larger decrements. In addition, Freibergs found no systematic effects on performance attributable to the medication (either chlorpromazine or a placebo). The implication is that differences in performance were due to the reinforcement procedure. Performance of conceptual tasks would also be expected to improve with age. For example, Youniss & Furth (1964) have shown that the ability to transfer bedimensional logical principles such as disjunction from one set of stimuli to another to increase with age (9 to 14 years).

Discrimination learning in hyperactive children has been investigated primarily using visual or auditory stimuli. According to two-stage discrimination theory (Zeaman & House, 1963) attention to the stimuli and then a choice response is required. Sprague *et al.* (1970) found the learning of a discrimination was enhanced by Ritalin during the acquisition phase. Ritalin produced significantly higher accuracy scores and significantly faster RTS.

Statement of the Problem

In the previously cited studies, the children had no previous experience with Ritalin. To consider the possibility of sustained effects of Ritalin, the present study used subjects who had been taking Ritalin over an extended period of time. This study assessed the effects of Ritalin on reaction time, concept learning, visual discrimination, and memory in children who have been taking medication for more than six months.

Inability to sustain attention is one of the most often mentioned characteristics of the hyperactive child. Most reaction time studies require the child to attend to a warning signal. Nonattention at the

time of the signal presentation results in slower reaction time. In the present serial RT study, children responded to the warning signal to insure attending to it. Each additional stimulus served as a warning signal for the next stimulus and required a response. It was expected that focusing attention through requiring a response to the warning signal should decrease RT.

Given the evidence from other studies of the improvement in performance while taking Ritalin, it was expected that Ritalin would have a facilitating effect on performance in all tasks.

Method

Subjects

There were two subjects who were taking Ritalin, one first grade female, 7 years old, and one fifth grade male, 11 years old. Both children had normal intelligence and had been taking Ritalin for at least 6 months immediately preceding the study. The children had hyperactivity as the major symptom as reported by parents, physician, and/or school. One child was from Watauga County and the other was from Caldwell County. Both were located through a preliminary survey of schools, physicians, and clinics. For more information about these two subjects see Appendices I and II.

There were six non-hyperactive subjects, one male and one female at each of three grade levels. The two first grade subjects were 7 years old; the two third grade subjects were 9 years old; and the two fifth grade subjects were 11 years old. All non-hyperactive children were from the Watauga County school system.

Design

Each subject was tested on four different days. There were four tasks: Reaction Time, Concept Learning, Visual Discrimination, and

Digit Span. The four tasks were administered each day. Order of task presentation over the four sessions was counter-balanced. Order of task presentation in each session was also counter-balanced. Each child was randomly assigned to a task order each session and over the four sessions (see Appendix III).

Each hyperactive subject was tested two days on Ritalin and two days off Ritalin. The non-hyperactive children were included to control for the effects of practice and to provide some basis for comparing Ritalin-produced performance with that of other children of similar ages. They received no medication.

Apparatus

Serial Reaction Time task. Equipment consisted of a panel containing 4 - $2\frac{1}{2}$ x $2\frac{1}{2}$ inch windows covered with opaque plexiglass. Behind each window was a light bulb. The bulbs were programmed to light in six different series. Each plexiglass window was hinged so that touching the window triggered a microswitch connected to 2 Standard Electric clocks which provided two separate measures of RT.

Task Materials

Concept Learning task. Four different sets of concept problems were used. The stimuli were geometric shapes drawn on 3 x 5 inch cards laminated for protection. The concepts to be learned were disjunctive. For example, the correct concept for Set A was blue and/or square. A description of all concept stimuli are included in the appendix (see Appendix IV). There were 54 stimulus cards in each set, 30 correct examples and 24 incorrect examples. For the final search task, an array of 24 stimuli were presented on an 11 x 14 inch card.

Visual Discrimination task. Stimuli consisted of four sets of 3 x 5 inch cards showing pairs of line drawings of everyday objects. Each set included one stimulus deck and six test decks. The decks were identical except that in the stimulus deck one drawing in each pair was colored in. There were eight cards in each deck. The cards in each deck were presented in a different order.

Memory task. Digit span series' were typed on a sheet of paper.

Procedure

Each child was tested on all four tasks over four separate sessions. Each hyperactive child served as his own control in a double-blind/placebo design. Order of drug administration was randomized with one child beginning on the drug and one child beginning on placebo. Each child received two capsules daily. One capsule contained Ritalin, the other contained a placebo. The child beginning on the drug received a placebo after the testing. The child beginning on the placebo received the drug after the testing. This insured that neither child was deprived of his medication for longer than the one hour testing session. Ritalin was expected to be entirely eliminated from the body in six hours (Swisher, Note 1). Drug/placebo were administered according to an ABAB design. Drug and placebo were identical in form and looked the same. A physician served as consultant in the administration of the drug according to the child's usual dosage which was 20 mg. per day in both cases. The children were tested in the morning. The child's parents administered the drug/placebo to the child one hour before the session; the experimenter administered the capsule following the session. Neither the child, his parents, or the experimenter knew if Ritalin or a placebo had been administered until

the conclusion of the four sessions. Non-hyperactive children received no medication.

All children received instructions before each task. Each child was told he would receive a checkmark for each correct response which would be exchanged at the end of each session for pennies.

I. Concept learning task. In each session the children were given one set of stimulus cards. Two correct examples were presented to the child and identified as "winning" cards. The child was then instructed to sort the cards into two groups - winners and non-winners. Each correct choice was reinforced both verbally and with a checkmark. Completion of the set constituted one trial. The cards were then hand shuffled five times and the next trial began. The child sorted each deck six times unless the cards were correctly sorted on one trial in which case testing stopped. The child was then asked to verbalize the rule he used for determining which cards were winners or non-winners. The child was then switched to a search task in which he was presented an array of the same stimuli used in the concept learning task. Each array contained 6 correct examples of the concept. The children were required to identify the examples of the concept just learned. Time from presentation to identification of all instances were recorded. Time per trial and number of errors in the concept learning task were recorded.

II. Serial Reaction Time task. Each child was given instruction in how to respond and was then given five practice trials. The experimenter turned on the first light. The child was instructed to respond by touching the lighted window as quickly as possible after seeing the light. This turned off the lighted window and lit another to which the

child was to respond in the same manner. The child responded to three lights, the initial warning light and two others. This constituted one trial. Time from response to first light and response to second light was measured as well as time from second response to third. In addition, errors were recorded. The child received checkmarks for each correctly performed trial. There were 36 trials.

III. Visual Discrimination task. In each session the child was presented the stimulus deck, one card at a time. Each card was presented for approximately two seconds. The child was instructed that the colored-in drawing on each card was the "winning" drawing. Each test deck was then presented to the child. As each card was presented, the child indicated the winning drawing. Each correct response was reinforced both verbally and with a checkmark. One trial consisted of presentation of all the cards in one set (8 cards). There were 6 trials. Time to complete the response and number of errors was recorded.

IV. Memory task. In each session the child was administered the digit span test according to the procedure used for the Digit Span subtest of the WISC-R. The child was asked to repeat back a series of numbers presented to him at one second intervals. If he succeeded, the next series of numbers was presented. If he incorrectly repeated the series, he was given a second trial with another series containing the same number of digits. Testing continued until the child was unable to correctly respond to either trial.

Results

Results of the reaction time (RT) task showed a variable effect of Ritalin on the performance of the two hyperactive children. The

children were required to respond to three lights which lit one at a time. The time it took to respond to the first light was not measured. The time to respond to the second light was measured as Interval I (I_1). The time to respond to the third light was measured as Interval II (I_2). Table 1 shows the mean RT of the hyperactive children compared to the control children of the same age. When off Ritalin, Child A (age 7) had a mean RT slightly faster than control children the same age for I_1 and I_2 . Ritalin increased RT for I_1 but decreased RT for I_2 .

Figure 1 shows mean time and errors for Child A on drug and off drug as well as for control children on the concept learning task. Child A (age 7) had an increased time when on Ritalin ($\bar{X} = 176.15$ sec.). Mean time off Ritalin was 153.75 sec. Mean time for control children, age 7, was 146.29 sec. Mean errors for Child A (age 7) were 17.65 on drug and 19.33 off Ritalin. Control children (age 7) mean was 12.0.

In the search task based on the concept learning task, while on Ritalin, Child A (age 7) took a mean time of 155.0 sec. to locate the correct instances of the concepts with mean errors of 4.0. When not on Ritalin, Child A took 110.5 sec. (mean time) with mean errors of 18.67.

On the visual discrimination task, Ritalin produced an increase in mean time of response for Child A (age 7). Child A had a mean time on drug of 42.58 sec. and a mean time off drug of 24.42 sec. Control children the same age (age 7) had a mean time of 16.48 sec. with mean errors of 0.73. Child A made no errors either on drug or off drug.

Child A had a mean digit span of 4.0 on drug and 4.5 off drug. Control children (age 7) had a mean digit span of 5.0.

<u>Reaction Time</u>	<u>Child A</u>	<u>Control</u>	<u>Child B</u>	<u>Control</u>
Drug \bar{X} : I_1 (msec.)	87.99		56.94	
I_2 (msec.)	65.12		53.75	
No Drug \bar{X} : I_1 (msec.)	71.82	77.03	53.75	47.35
I_2 (msec.)	73.73	75.98	49.05	44.02
<u>Concept Learning</u>				
Drug \bar{X} : time(sec.)	176.15		94.75	
errors	17.65		15.50	
No Drug \bar{X} : time(sec.)	153.75	146.29	147.00	98.73
errors	19.3	12.00	17.99	7.96
<u>Concept Search Task</u>				
Drug \bar{X} : time(sec.)	155.00		49.5	
errors	4.00		6.00	
No Drug \bar{X} : time(sec.)	110.5	56.00	135.00	26.63
errors	18.67	7.43	12.00	0.13
<u>Visual Discrimination Learning</u>				
Drug \bar{X} : time(sec.)	42.58		12.90	
errors	0.0		0.17	
No Drug \bar{X} : time(sec.)	24.42	16.48	14.17	8.72
errors	0.0	0.73	0.59	0.14
<u>Digit Span</u>				
Drug \bar{X} :	4.0		4.5	
No Drug \bar{X} :	4.5	5.00	5.0	5.25

Table 1. Summary of the Performance of Hyperactive Children and Control Children of the Same Age.

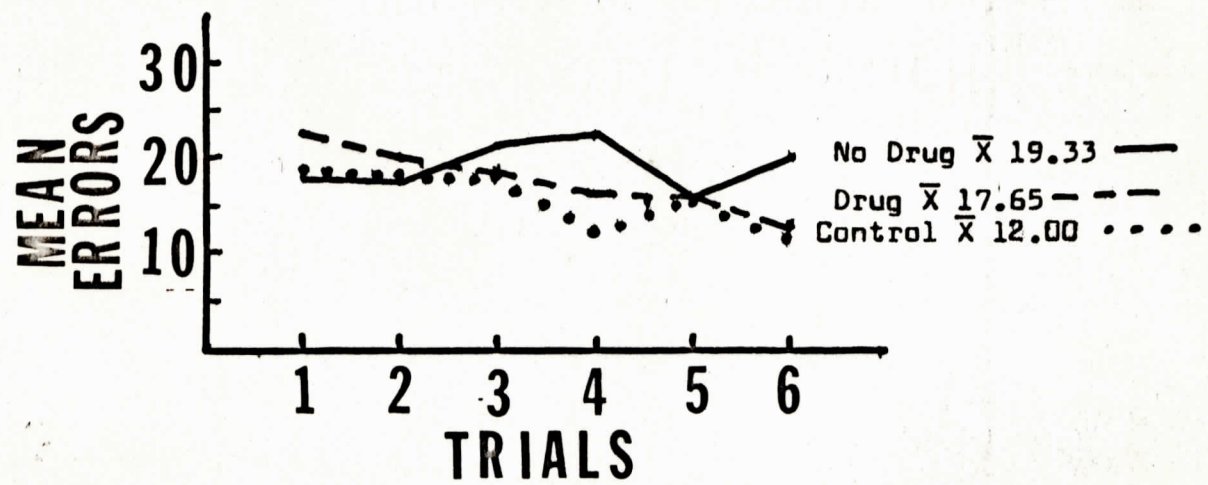
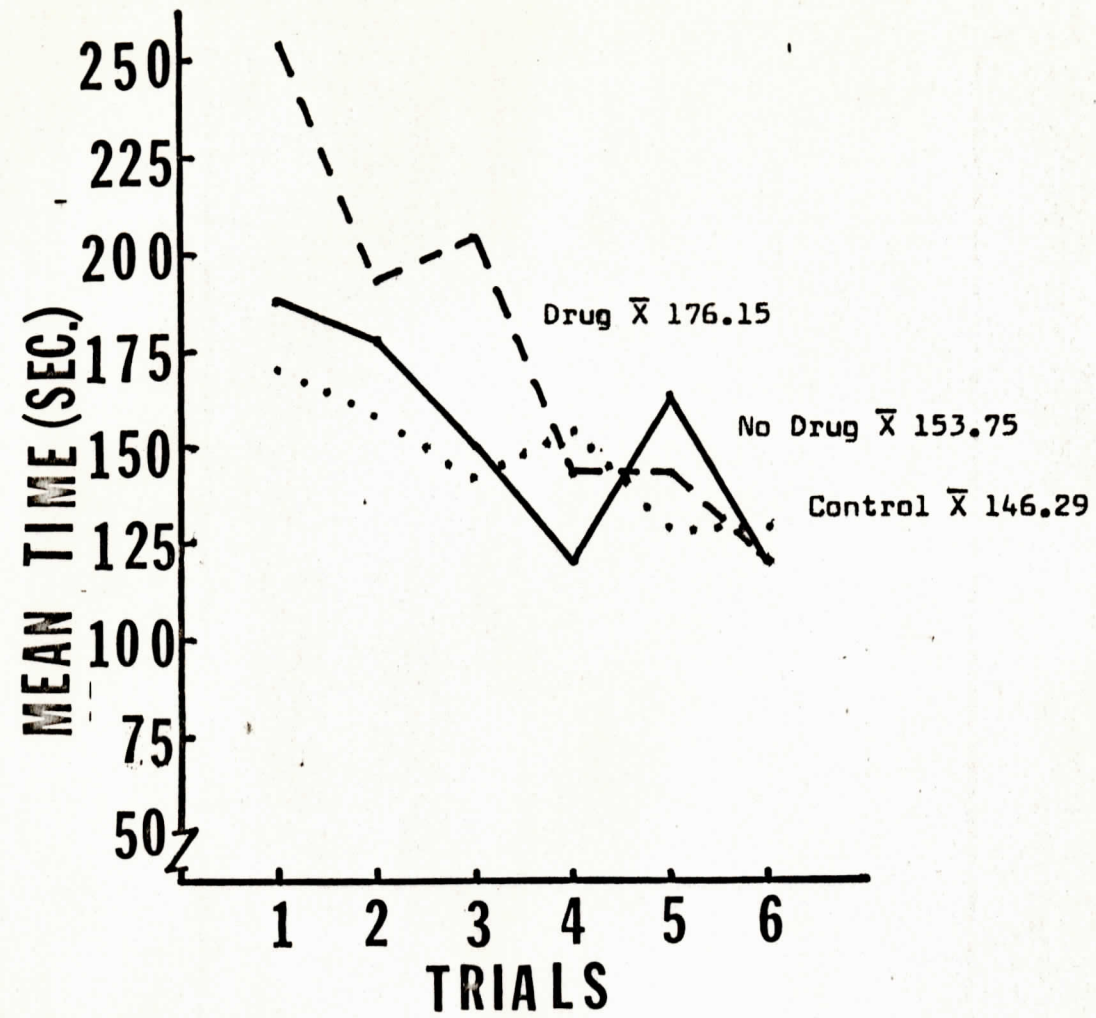


Figure 1. Mean time and errors for Child A on the Concept Learning Task

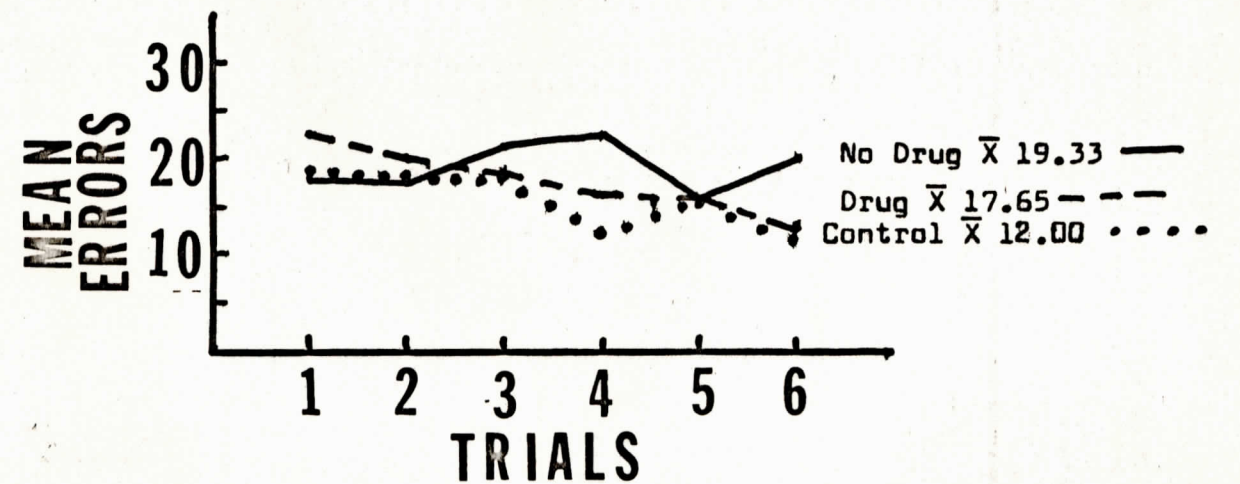
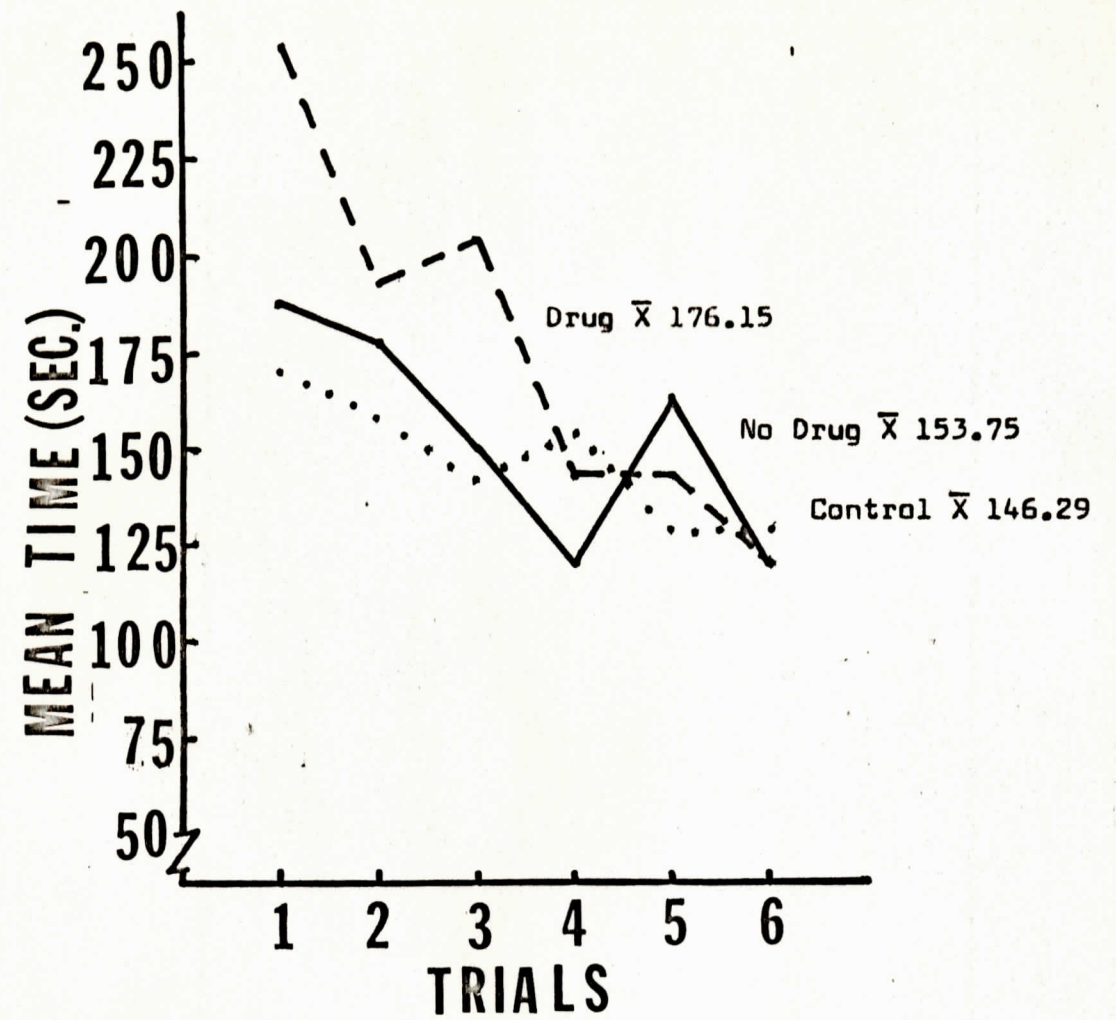


Figure 1. Mean time and errors for Child A on the Concept Learning Task

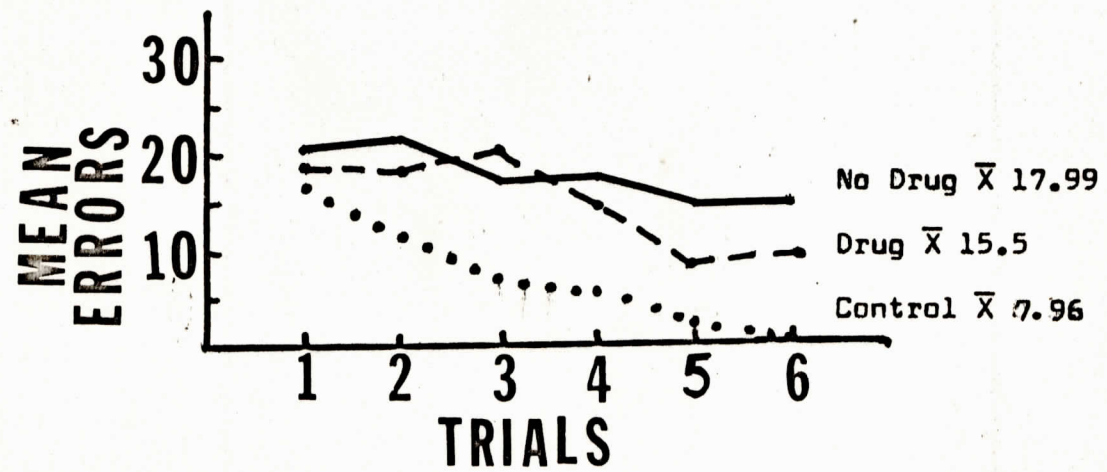
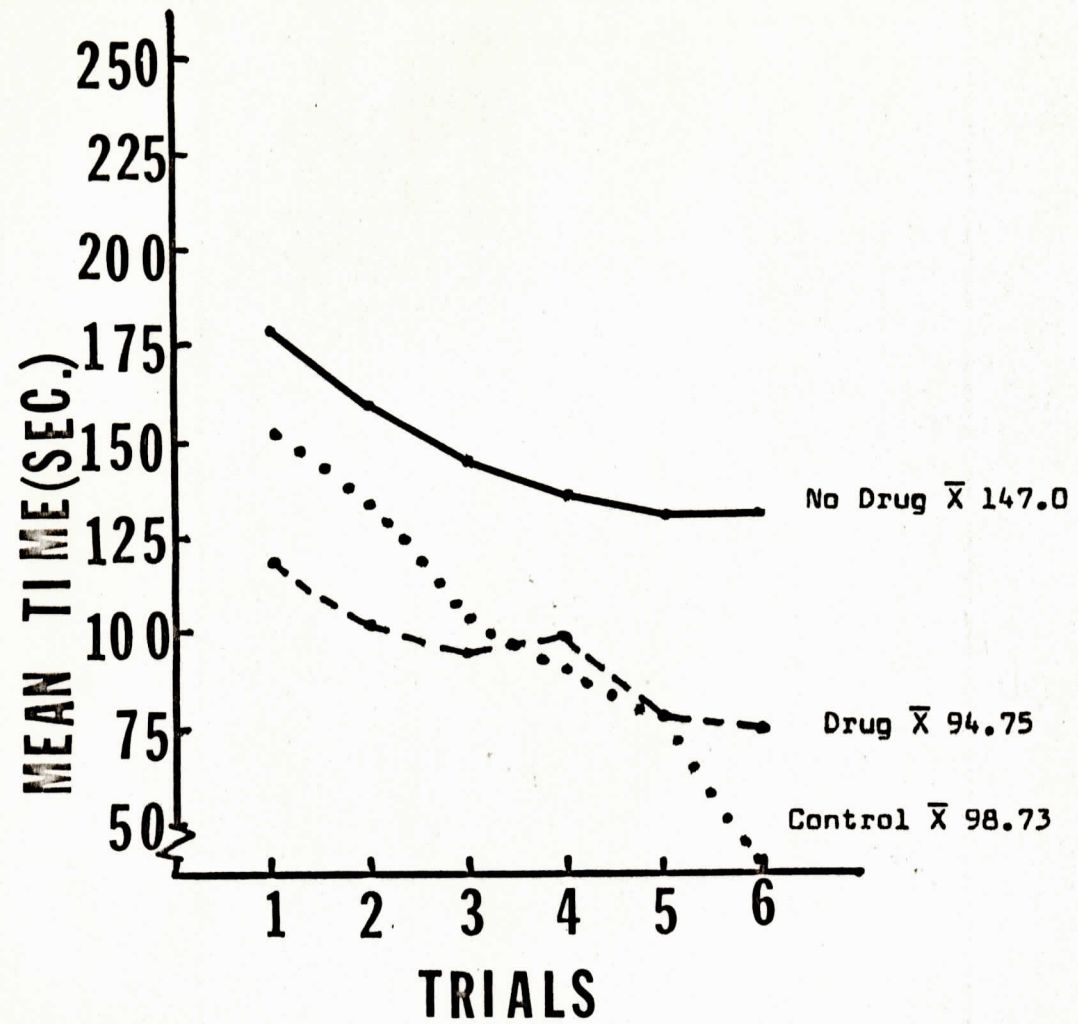


Figure 2. Mean time and errors for Child B on the Concept Learning Task.

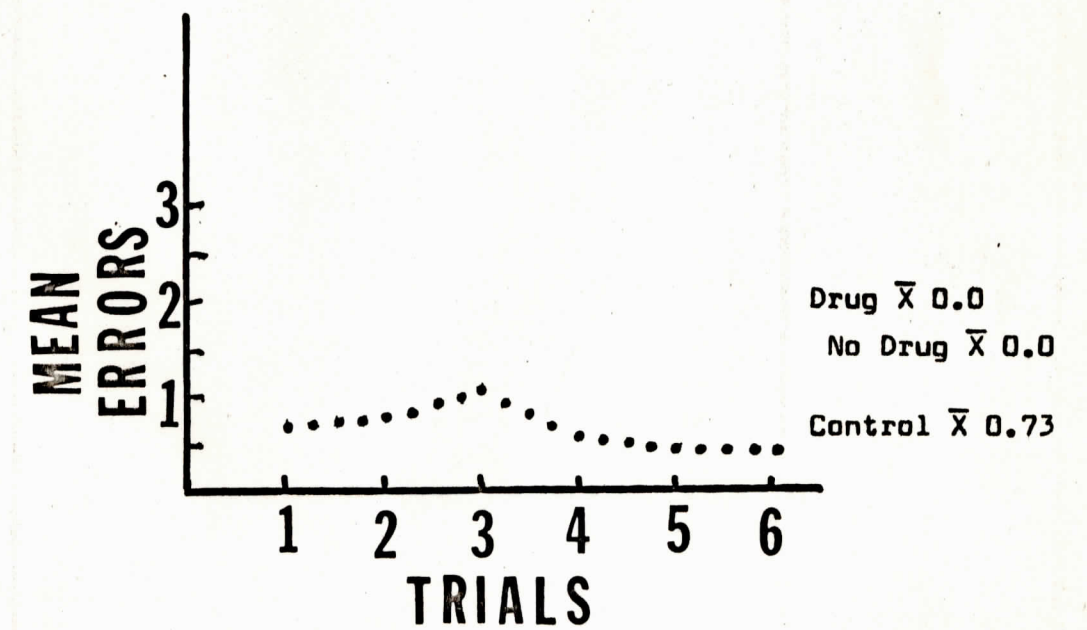
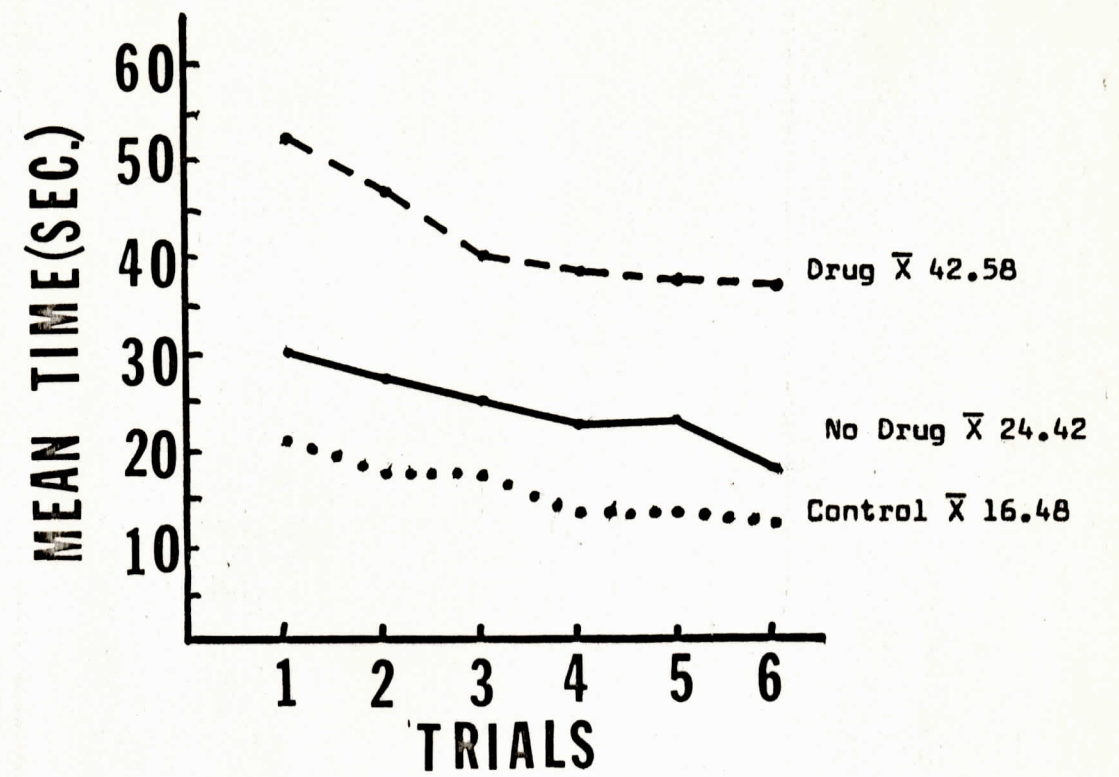


Figure 3. Mean time and errors for Child A on the Visual Discrimination Task.

When off Ritalin, Child B (age 11) had slower mean RTs than control children the same age for both I_1 and I_2 on the reaction time task. Ritalin produced even slower responding on both intervals.

On the concept learning task, Ritalin decreased latency ($\bar{X} = 94.75$ sec.) for Child B. Mean time off Ritalin for Child B was 147.0 sec. Control children, age 11, had a mean time of 98.73 sec. (See Figure 2). Child B (age 11) had mean errors of 15.50 on drug and 17.99 off drug. Control children (age 11) had mean errors of 7.96.

In the search task following the concept learning task, Child B had a mean time of 49.5 sec. and mean errors of 6.0 on Ritalin and a mean time of 135.0 sec. and mean errors of 12.0 when not on Ritalin. Control children had a mean time of 48.71 sec. and mean errors of 5.39.

Ritalin produced little or no effect for Child B (age 11) on the visual discrimination task. Child B had a mean time on drug of 12.90 sec. and a mean time off drug of 14.17 sec. Mean errors for Child B were 0.17 on drug and 0.59 off drug. Control children (age 11) had a mean time of 8.72 sec. and mean errors of 0.14. (See Figure 4) Child B had a mean digit span of 4.5 on drug and 5.0 off drug. Control mean was 5.25.

Control children showed a decrease in time as age increased on the concept learning task. Children, age 7, had a mean time of 146.29 sec., children, age 9, had a mean time of 122.44 sec., and children, age 11, had a mean time of 98.73 sec. Errors for this group did not show this decline (12, 13.44, 7.96).

The control children showed a decrease in time as age increased. Children, age 7, had a mean time of 16.48 sec., children, age 9, 11.73 sec.,

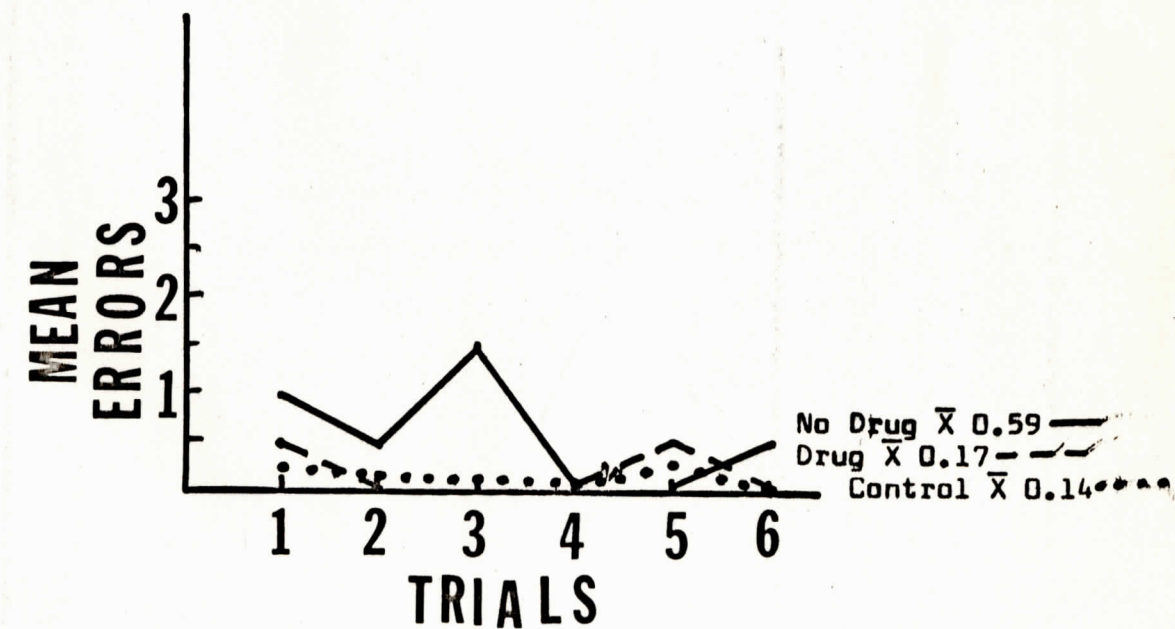
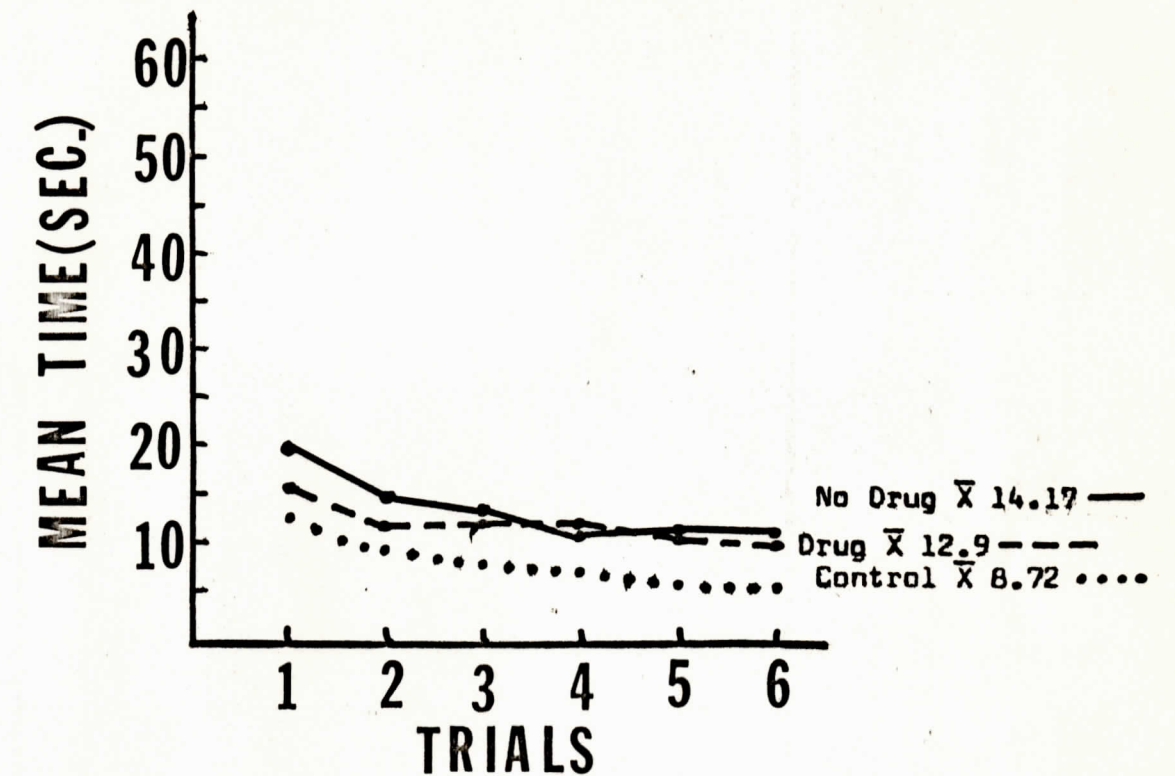


Figure 4. Mean time and errors for Child B on the Visual Discrimination Task.

and children, age 11, 8.72 sec. Errors did not show as fast a decline ($\bar{X} = 0.73, 0.14, 0.14$, respectively). Control children had a mean digit span of 5.0 for children age 7, 5.9 for children age 9, and 5.25 for children age 11.

In summary (see Table 1), for Child A (age 7) Ritalin had a variable effect on performance on the reaction time task, it increased latency on the concept learning task, and increased latency on the visual discrimination task. For Child B (age 11), Ritalin increased RT on the reaction time task, decreased latency on the concept learning task, and had little or no effect on the visual discrimination task.

Discussion

Ritalin had a variable effect on the performance of the two children. Child A (age 7) had a no-drug mean RT that was less than that of the control children (age 7). The administration of Ritalin produced a drug mean RT greater than the no-drug mean RT or the control mean RT for I_1 . However, for I_2 it had the opposite effect. Mean RT for I_2 was less than no-drug RT or control RT. This does not support the findings of previous studies (Douglas, 1972; Sykes *et al.*, 1971) who found hyperactive children to have slower RTs than normals and Ritalin to decrease RT. Child A did not have slower RTs than controls but Ritalin did decrease RT in I_2 . It also increased RT in I_1 . The increase in RT when taking Ritalin facilitates reflectivity.

Figure 1 shows mean time and errors for Child A on and off drug and for control children the same age (age 7) on the concept learning task. Ritalin increased mean response time for Child A. However, performance over trials seems to show less variation than the no-drug performance.

This suggests again that Ritalin facilitates reflectivity. When compared to controls, errors for Child A did not show much variation.

In the search task immediately following the concept learning task, Ritalin does not seem to have facilitated locating the correct examples of the concept for Child A. However, Child A did have more incorrect choices when not taking Ritalin. Control children were able to locate the correct examples in about half the time of the hyperactive children.

On the visual discrimination task, Ritalin increased RT for Child A (age 7). Figure 3 shows mean RT for Child A and for control children the same age (age 7). Child A had an increased RT on Ritalin and also made no errors on either the drug or the no-drug conditions. Control children (age 7) had faster RTs than Child A but made more errors.

The performance of Child B on the reaction time task was different than that of Child A. Child B (age 11) had both drug and no-drug mean RTs greater than those of control children (age 11). Ritalin increased RT for both I_1 and I_2 . As with Child A, this does not support the findings of Douglas (1972) or Sykes *et al.*, (1971) who found hyperactive children to have slower RTs than normals and Ritalin to decrease RT. Child B did have slower RTs than controls the same age but Ritalin did not decrease RT. Again, the increase in RT when taking Ritalin is more supportive of the notion that Ritalin facilitates reflectivity.

Figure 2 shows mean time and errors for Child B (age 11) and control children (age 11) on the concept learning task. Child B had a decrease in response time when on Ritalin suggesting Ritalin facilitates speed of responding. Control children (age 11) had fewer errors than Child B. In the search task immediately following, Ritalin seems to have

facilitated locating the correct examples of the concept for Child B.

Child B also had more incorrect choices when not taking Ritalin.

Figure 4 shows mean RT for Child B (age 11) and control children the same age on the visual discrimination task. Child B had slower drug and no-drug conditions.

Performance on digit span did not appear to be affected by Ritalin nor did the performance of the hyperactive children vary much from that of controls although control children appeared to have a span of one digit greater than the hyperactive children.

In conclusion, the effects of Ritalin on the performance of these two children was found to vary from task to task. In some tasks it increased time and in some tasks it decreased time. It also varied from child to child. No systematic effects were found common to both except that it did have some effects on performance. While the tasks included in this study were not consistent for the two subjects or in agreement with other studies of hyperactive children, they could be useful in determining the effects of Ritalin for a specific child. In a short period of time (four days) a child could be observed and some idea could be gained as to whether the medication is having the desired effect.

The inconsistencies in performance of the two children may have been due to many causes. One likely explanation is the lack of an objective and systematic method for diagnosing hyperactivity and prescribing Ritalin. Another limitation to the study was the inability to locate sufficient numbers of children taking Ritalin. One major reason for the difficulty in locating subjects was the reticence of parents or other knowledgeable people to identify or discuss their children who have problems. A larger group of children would perhaps have allowed more consistent results.

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Appendix I

Child A

BIRTH HISTORY:

Child A was adopted at the age of 3½ months by her present parents. There is no detailed information about her natural parents other than that as far as can be ascertained, there is no history of disease or illness that might be inherited. The natural mother was 15 years old when Child A was born and the birth was an uncomplicated forceps delivery. Otherwise, there was no indication of anything unusual either prenatally or during the birth. Child A weighed seven pounds, nine ounces at birth.

SOCIAL HISTORY:

Child A is the second of three children in her family. The first child, a boy, age eight years and six months, was also adopted as an infant. The third child, a girl, age five years, was a natural child. Child A's father is on the faculty of a state university. Her mother is a graduate student and housewife. Child A had been taking Ritalin 24 months.

DEVELOPMENTAL HISTORY:

Child A was an alert, active baby. She seemed to need less sleep than most babies, being satisfied with short naps (about 20 minutes duration) or none at all. While she did not walk unaided until thirteen months of age, she could stand and walk aided at seven months of age. Other developmental milestones seemed to develop at the expected times as best remembered. She had the usual childhood illnesses without complications.

Child A seemed always to need or demand attention or supervision. She seldom occupied herself with any activity for any length of time.

gradually became more manageable. She was able to begin kindergarten at the expected time in a private school. She adapted gradually but not without problems and continued on into public school for the first grade. Social adjustment was still a problem.

SCHOOL HISTORY(1 year beyond the date of testing)

A psychological evaluation done when Child A was seven years old revealed the following:

WISC: Verbal IQ 115; Performance IQ 110; Full Scale IQ: 114

Conclusions from the psychological evaluation were that Child A was functioning somewhat above average with potential for higher functioning. No patterns often associated with specific intellectual impairments were elicited. Distractability was somewhat above average. There was much psychomotor activity. Screening tests showed no evidence of specific learning disorders. Child A was taking Ritalin at the time of the evaluation.

Despite sufficient intelligence and potential, Child A is currently performing below grade level in most areas, especially reading. Apparently when most basic skills were being taught she was struggling with social adjustment. Today at the age of eight she is aware of her school and social difficulties, but seems to be making progress. Her self-concept is not very good but seems to be improving. She is presently with teachers who direct a very structured class and who provide her with a great deal of reinforcement. Her reading skills are still deficient but her teachers feel she is improving. Her math skills are at grade level. Her handwriting, once illegible, has become fairly legible when she is confident about the subject matter. She is no longer taking Ritalin, having ceased taking it shortly after the research testing sessions.

She never had a favorite toy or activity, but preferred to be with another person or playing whatever everyone else was playing. By eighteen months, she was "difficult to handle", needing constant supervision, generally not responding to reward or punishment. Temper tantrums were frequent. The best descriptions of Child S's behavior was "inconsistent and unpredictable". She had difficulty getting along with other children and had few friends. She enjoyed physical contact and liked to be held, rocked or stroked. The birth of her younger sister did not seem to affect her adversely. During this time her father was absent for a year (military duty) and she was frequently cared for by many different relatives all of whom provided different guidelines for her.

SCHOOL HISTORY:

From age three years to age four, Child A went to preschool for half a day. She enjoyed this, however, she was frequently disruptive at the school. She was reported to have thrown chairs, climbed on or under tables, and made loud disruptive noises. She frequently destroyed toys, furniture, etc. Tantrums became more frequent, sometimes violent. She was very difficult to control. Time-out was used but it only seemed to curtail her activity temporarily. Her behavior could best be described by extremes - she was either extremely angry or extremely happy, laughing loudly.

After moving at the age of four, she was placed in another preschool, but her disruptive, aggressive behavior caused her removal. At this point, she was placed on Ritalin, after consultation with a psychologist and the family doctor. She was also placed in a school for exceptional children. With very consistent behavioral management at the school and at home, she

Appendix II

Child B

BIRTH HISTORY:

Child B was born after a full-term but difficult pregnancy. His mother had had two previous miscarriages. During the time she was pregnant with Child B, she took several kinds of medication to prevent miscarriage, counter the spotting which began at three months, and "calm her nerves". She describes herself as "very nervous" throughout the pregnancy. There was nothing unusual about the delivery. Child B weighed seven pounds, eleven and one half ounces at birth.

SOCIAL HISTORY:

Child B was the first of two children. The second child, also a boy, is four years younger. Child B's father is an auto mechanic for a small auto repair shop. His mother is a factory worker. Child B had been taking Ritalin eight months.

DEVELOPMENTAL HISTORY:

Child B has been described by his mother as a friendly, easy to manage child. Other than having colic as an infant, he had an unremarkable childhood. Developmental milestones appeared at the expected times. When Child B was four years old his younger brother was born. Child B's mother reports he was very jealous of the new baby and had many nightmares. He took "nerve medicine" to help him sleep soundly.

Child B had recurring ear infections until his tonsils and adenoids were removed about age seven. He has had surgery two other

times for removal of cysts on his leg. Otherwise, there were no serious illnesses during childhood.

Child B has not had difficulty making friends. He is equally comfortable with peers or with adults. He has not had temper tantrums.

SCHOOL HISTORY:

Child B has a history of school problems due mainly to lack of interest and motivation. According to his mother, his grades are good at the start of the school year but decline steadily. At the time of testing he was unhappy with his teacher. Both teacher and principal described Child B as not paying attention or completing homework. Child B's mother reported that Child B was very nervous and cried all the time as the result of school problems. She saw a television program describing medication as a treatment for children who had behaviors she thought similar to her son's and the family doctor agreed to try Ritalin. Child B and his family both felt he had benefited greatly from the medication. He apparently cried less frequently and was able to stay in his classroom without getting "nervous".

SCHOOL HISTORY: (one year beyond date of testing)

Child B is still having problems in school. His motivation is low and he prefers to draw. His parents provided him with art lessons and since he began the lessons his grades have improved. Child B's mother says some achievement tests were done but results are not available. She does not feel the school has been very communicative with parents. Her concern about Child B currently is that he sides with the younger children at school and tries to

protect them from bigger children. This frequently gets him into a fight.

Child B is now taking Cylert rather than Ritalin. It apparently has the desired effect. (Cylert is a newer drug having the same effect as Ritalin but fewer disadvantages and side effects). He has been taking Cylert about nine months.

Appendix III
Assignment of Tasks to Subjects

<u>Subject</u>	<u>DAY</u>			
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
1	ABCD-drug	BDAC-no drug	DCBA-drug	CADB-no drug
2	ABCD-no drug	BDAC-drug	DCBA-no drug	CADB-drug
5	BDAC	CADB	ABCD	DCBA
4	BDAC	CADB	ABCD	DCBA
3	CADB	DCBA	BDAC	ABCD
7	CADB	DCBA	BDAC	ABCD
6	DCBA	ABCD	CADB	BDAC
8	DCBA	ABCD	CADB	BDAC

A = Reaction Time Task
 B = Concept Learning Task
 C = Visual Discrimination Task
 D = Digit Span Task

Appendix IV

Concept Learning Stimuli

Set I - relevant attributes: square and/or 1 border

Dimensions

shape (square, triangle, crescent)
color (green, blue, red)
no. borders (one, two, three)
type border (solid, broken)

Set II - relevant attributes: one border and/or yellow

Dimensions

shape (circle, pentagon, parallelogram)
color (yellow, green, brown)
no. borders (one, two, three)
type border (solid, broken)

Set III - relevant attributes: solid and/or star

Dimensions

shape (trapezoid, diamond, star)
color (purple, orange, grey)
filling (none, stripes, solid)
position (vertical, horizontal)

Set IV - relevant attributes: blue and/or horizontal

Dimensions

shape (rectangle, oval, arrow)
color (lt. blue, black, pink)
size (small, large)
position (horizontal, vertical, angle)