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THE RELATIONSHIP BETWEEN HYPERACTIVITY AND IMPULSIVE RESPONSIVENESS IN ELEMENTARY SCHOOL CHILDREN

by

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A great deal of research as well as theoretical speculation has centered on the clinical syndrome of the "hyperactive child." The literature in this area lists the major symptoms which usually accompany the disorder as follows: distractibility, impulsivity, seemingly aimless motor activity (hyperkinesis), limited attention span, poor concentration, irritability, low frustration tolerance and visuo-perspective difficulties. Although some children with the syndrome are retarded, a significant number are of normal intelligence or better.

A review of the research relating to this syndrome reveals confusion about etiology, vagueness in descriptive terminology and a great many conflicting findings. For example, in a recent monograph, Clements (1966) lists no less than 38 terms used to describe the syndrome, 18 of which refer to etiology, and 20 of which describe behavior. Shrager, et al (1966) also note the multiplicity of referrant terms. This proliferation in terminology has been due, in part, to a shift in emphasis; while early interest in the syndrome stressed the role of the central nervous system (causing widespread use of terms such as "minimal brain injury"), the more recent focus has been on the behavioral aspects of the disorder (resulting in the use of terms such as "hyperactive child" syndrome).

The de-emphasis of the role of the central nervous system is socially beneficial to the hyperactive child of normal intelligence for whom a label such as "minimal brain damage" can be stigmatizing.

Unfortunately, however, the concentration on symptomotology has created a new problem; there is a disturbing vagueness about the relationship between specific behavioral phenomena and the terms used to describe that behavior. For example, the child who is overtly over-responsive to irrelevant stimuli might be described by the terms "hyperactive" or "impulsive" or "distractible" or by any combination of those terms.

Of course, there have been some attempts to distinguish between high activity level and over-responsiveness to stimuli. Such a distinction has been made by Eisenberg (1966) and by Rosvold and Mishkin (1960). Although the latter authors based their discussion on evidence drawn from animal studies,[1] their suggestions do have relevance to the problem under discussion. They theorize that there may be two forms of hyperactive behavior. One is a motoric hyperactivity (due to defective inhibitory mechanisms in the cortical motor system) which would be relatively unaffected by alterations in external stimulation. The other is a generalized hyperreactivity (due to defective inhibitory mechanisms in the sensory sphere) which, as the name implies, would be influenced significantly by external stimulation. This reasoning is supported by evidence from certain studies of frontal

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[1]Hyperactivity and distractibility were found to be behavioral consequences of frontal ablations in monkeys. (Kleuver, 1942; Konorski, 1961; Richter and Hines, 1938; Stanley and Jaynes, 1949) but may be found after ablations in other cerebral areas.

ablations in monkeys (Adey et al, 1957; Isaac and DeVito, 1959; Kennard, et al, 1941; Malmo, 1942).[1] The notion of sensory hyperreactivity is not unlike Goldstein's observations (1939) of the "stimulus-bound" brain-injured patient who cannot refrain from attending to every novel stimulus.

This distinction between high activity level and over-responsiveness to stimuli, regrettably, was not part of many experimental studies of the relationship between distractibility and activity level.[2] (Brown, 1963; Browning, 1967; Cruse, 1962; Gardner et al, 1959). In some of these studies, electronic measures of activity level of hyperactive and nonhyperactive children were made under conditions of "distraction" (usually the addition of interesting objects to the room) and "no distraction." None of the studies were able to report any clear-cut relationship between subjects of high and low activity level and conditions of distraction.

It is apparent from the foregoing, that insofar as research with children is concerned, an experimental distinction has yet to be made between observed high activity level and excessive overt responsiveness to stimuli. It would also be interesting to explore the parameters

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[1]Isaac and DeVito found hyperactivity in frontal monkeys diminished as stimuli were reduced, until it ceased altogether in darkness.

[2]Primarily conducted on retarded children.

of visual stimulation which elicit inappropriate overt responses. The present study is concerned with these two relatively unexplored areas.

Summary of Related Research

Two factors were responsible for the assumption that CNS dysfunction caused the behavior symptoms noted earlier. One was the existence of the symptoms as sequalae to encephalitic disorders (Ebaugh, 1923; Kahn and Cohen, 1934; Levy, 1959). The other was the series of observations by Strauss and others of two different types of retarded children, the familial (endogenous) and the brain-injured (exogenous). Research generated by these observations explored perceptual (Jenkin and West, 1959; Strauss and Kephart, 1955; Werner and Strauss, 1941; Werner and Thuma, 1942) as well as cognitive functioning. (Bijou and Werner, 1945; Strauss and Werner, 1942; 1943; Werner and Carrison, 1944). The theoretical discussions of the results of these studies generally indicated that brain-injured children who had no primary sensory defects were less able to integrate discrete elements of perception because of defects in central integrative mechanisms.

There have been other attempts to explain the syndrome with theories of central nervous system dysfunction.[1] Among these are

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[1]None of the etiological theories are mutually exclusive. They merely represent different emphases.

(1) diencephalon or midbrain disorder, and (2) a theory utilizing the excitation-inhibition cycle as originally elucidated by Pavlov.[1] The theory of diencephalon involvement was tentatively advanced by Laufer and Denhoff (1957) following research on the effects of administration of amphetimine to hyperkinetic and nonhyperkinetic retarded children. They suggested that over-reactivity in children might be attributed to a breakdown of synaptic resistance to impulses in subcortical structures.[2] This theory has the advantage of being directly related to experimental findings, whereas the excitation-inhibition theory does not offer specific evidence of a correspondence between physiological events and overt behavior. Nevertheless, the excitation-inhibition theory has provided a convenient and workable model within which A.R. Luria of the Soviet Union conducted his research with

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[1]The Pavlovian model of a neuronal excitation-inhibition cycle states that with stimulation there is cerebral excitation which (a) is followed by inhibition in the same area and (b) induces inhibition coincidentally in surrounding areas. Thus, there is an excitation-inhibition cycle termporally for a given region and spatially for a broader region. Pavlov states:

> It is highly probable that excitation and inhibition, the two functions of the nerve cell which are intimately interwoven and which so constantly supersede each other may fundamentally represent only different phases of one and the same physico-chemical process. (Pavlov, 1927, p. 378)

[2]Their discussion also is based on the work of Watson and Denny-Brown (1955).

hyperactive children. (1960)[1] It also has been utilized by Birch, Belmont and Karp (1964) to refer to concepts of abnormal distractibility and short attention span, even though their discussion seems to create arbitrary and confusing distinctions in behavioral phenomena as well as in the underlying neurological processes. They state:

> Short attention span may be viewed as the result of relatively weak excitation and/or weak surrounding inhibition; perseveration as the result of excessively strong or persistant excitation and/or strong surrounding inhibition; distractibility as the product of short-lived excitation and/or weak surrounding inhibition resulting in ineffective insulation. (Birch et al, 1964, p. 547)

Unfortunately none of the etiological theories have produced conclusive evidence of the specific nature of the disorder. It is probable that CNS dysfunction does exist in many children who have the symptoms, even though the diagnosis of brain-injury is inferential in those cases where neurological indices are equivocal. Nevertheless, a number of writers have suggested that labels connoting CNS dysfunction be discarded. From a purely clinical point of view this makes sense for the following reasons: (1) terminology which suggests pathology serves to enlighten neither parents nor professionals, (2) educational and therapeutic treatment is related to the severity and nature of the symptoms rather than to considerations of specific etiology, (3) in many cases the symptoms diminish with increased age, and (4) clinical use of terminology which refers to behavior need not prevent ongoing research directed toward

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[1]Luria viewed the hyperactive child as one in whom "weakness of the nervous processes develop against the background of high excitability and the particularly deteriorated inhibitory process..." (Ibid, 1960)

discovery of an underlying neurological disorder. The fundamental problem relating to diagnostic labels is pointed out by Birch and Demb:

> The term brain damage or brain injury when applied to children refer to a combination of psychological functions which are presumed to originate in prenatal, perinatal and inferred insults to the cerebrum. The category is entirely behavioral and implies that any number of kinds of cerebral damage will result in a common pattern of behavioral disturbance. Locus of injury, the nature of the lesions, and the temporal course of the illness are usually not considered in the designation and non-behavioral, neurological confirmation of the fact of anatomical insult has been conspicuous by its absence. These considerations make it clear that the term 'brain damage' refers to the behavioral syndrome and not to the fact of brain damage as such. (Birch and Demb, 1965, p. 162).

Further efforts to discard references to CNS dysfunction are reflected in suggestions that the syndrome represents delayed development within the motoric reactive system. (Abrams, 1968; Paine, 1963; Shrager et al, 1966). (Abrams strongly urges the term "delayed and irregular maturation" as a substitute for nomenclature referrant to CNS dysfunction). Such an approach is supported by clinical evidence which indicates that many children outgrow the symptoms. (Childers, 1945; Laufer, 1962).

Difficulties in determining etiology also have led researchers and practitioners to stress other forms of investigation. One of these has been the search for significant correlates of the syndrome, such as birth difficulties and choreiform movements.[1] With respect to the

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[1]There have also been many attempts to correlate electroencephalographic abnormalities with one or more of the symptoms, but these have produced inconclusive evidence. Some of these studies included subjects who had many of the symptoms but were not specifically categorized as hyperactive or brain damaged. (Anderson, 1963;

first of these, several investigators have found a relationship between the symptoms and prenatal and perinatal complications. (Anderson, 1963; Graham et al, 1962; Lillienfeld et al, 1955; Paine, 1963; Prechtl and Stemmer, 1962; Timme, 1948). On the other hand, Stewart et al, (1963) failed to confirm this relationship. Choreiform activity (small involuntary finger movements, referred to as "adventitious motor overflow" in an unrelated investigation (Hertzig and Birch, 1966) have been measured electromyographically (Prechtl and Stemmer, 1962) and observed empirically (Rutter et al, 1966; Stemmer, 1964; Wolff and Hurowitz, 1966). Here again, results have been conflicting although there is some convincing evidence to suggest that choreiform movements are more prevalent among hyperactive children.

One other area of research particularly relevant to the syndrome under discussion concerns the longitudinal studies on differences in activity level and sensory thresholds in infants. (Escalona and Heider, 1959; Fries and Woolf, 1953; Thomas and Chess, 1957). These studies demonstrate the wide range of activity patterns among human neonates as well as the long term endurance of those patterns. Any theoretical assumptions about the hyperactive child, based on

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Burks, 1965; Frosch and Wortis, 1964; Hanvik, 1954; Knobel et al, 1959; Michael and Secunda, 1944; Schwade and Geiger, 1956; Strauss and Ralem, 1940; Werry et al, 1965).

these studies, may include the concept of organic dysfunction. However, the notion of a wide range of individual differences in reactive patterns make it possible to consider the syndrome without reference to the idea of cerebral damage, as such, and without resorting to a "normal-abnormal" dichotomy. An early reference to the possible relationship between constitutional variation and hyperactivity was offered by Kahn and Cohen (1934) in a statement which has relevance despite the quaintness of the language:

> We believe there are individuals who are possessed of organic driveness from birth either as a consequence of prenatal encephalopathy, or injury, or birth injury, or as a constitutional variant. (Kahn and Cohen, 1934, p. 752)

More recently, Stella Chess has stated:

> Although hyperactivity may be present in all diagnostic categories, its recognition as a physiological variant in an otherwise psychodynamically normal child is important. (Chess, 1960, p. 2385).

A number of observations arising from all of the research and writing summarized above are relevant to the work of A. R. Luria (1960). He was primarily interested in the effect of speech as a regulatory mechanism on motoric impulsiveness. This interest led him to research and discussion pertaining to the hyperactive child. Luria suggested that in the normally developing child, the mediating effect of language serves to inhibit the motoric response system. However, if there is early brain damage (prior to the development of speech) the verbal intellective functioning may be intact, while the volitional motor

system may be disrupted. One possible result of this disruption would be a pathological weakness of inhibitory processes which Luria called the "cerebral-aesthenic syndrome" and which is similar to the syndrome presently under discussion.

In his experiments, Luria utilized a simple motoric act as his response unit. For example, the subject was instructed to press a rubber bulb under certain conditions ("when the light goes on") and not to press it when the condition did not occur. (This is a simple "go" "no go" procedure). If impulsive incorrect pressures (go errors) occurred when the stimulus was not present, it was interpreted as a predominance of excitation over inhibition.[1] Two of Luria's major findings which have particular importance to the present study are: (1) children who have the "cerebral-aesthenic" syndrome are more given to impulsive responding, and (2) prior to the experimental introduction of verbal inhibitory mechanisms, hyperactive children in the 9-12 year age range were unable to suppress responses appropriate to positive ("go") stimuli in the presence of negative ("no go") stimuli, a behavior pattern similar to that of normal 5-6 year olds.

Luria's work is relevant to many of the observations and findings of the research reviewed earlier in this paper, as well as to the present investigation. These will be summarized below:

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[1]Luria's use of the excitation-inhibition theory was noted earlier.

1. The hyperactive syndrome can be present in children of normal intelligence. Luria noted the possibility of independent development of verbal intellective functioning and motoric activity level.

2. The hyperactive syndrome represents delayed development. Luria's findings that older hyperactive children perform similarly to younger nonhyperactive children is particularly cogent to this.

3. There appears to be a relationship between high activity level and impulsive responding to specific stimuli (hyperreactivity) but the relationship has not been explored systematically in many studies, nor has there been sufficient clarification of the terms. Luria specifically measured impulsive responding with a simple "go" "no go" procedure and found that hyperactive children are more likely to respond impulsively.

The Present Study

The present study which is primarily based on these considerations will investigate the relationship between observed behavioral hyperactivity and inappropriate motoric responses to stimuli in children of normal intelligence at three age levels. It will do this by means of the simple "go" "no go" procedure somewhat similar to that which Luria utilized. The following hypotheses have been formulated:

Hypothesis 1: The ability to inhibit impulsive responsiveness will be

an increasing function of age in children of normal intelligence.

Hypothesis 2: Impulsive responsiveness will occur to a greater extent among operationally defined hyperactive children (HYP) than among nonhyperactive children (NONHYP).

Hypothesis 3: Impulsive responsiveness of older HYP children will be similar to that of younger NONHYP children.

In addition, this study will be concerned with the relationship of distractibility to hyperactivity, and with the relatively unexplored area of specific parameters of visual stimulation which are associated with impulsive responding. The following questions relate to such exploration:

Question 1: How do age and hyperactivity relate to the ability to restrict attention as directed to specific relevant stimuli in the presence of distracting stimuli?

Question 2: What will be the effect of increased level of difficulty of of stimuli on hyperactive and nonhyperactive children?

Question 3: What will be the effect of shorter exposure interval of stimuli on hyperactive and nonhyperactive children?

METHODS

Subjects

One of the operational assumptions of this study is that hyperactive children can be identified by the judgment of teachers in two successive grades. Several clinical and behavioral studies have utilized behavior rating scales to determine hyperactivity and distractibility for research and classification. (Knobel et al, 1950; Schulman et al, 1963; Stewart et al, 1966; Strauss and Kephart, 1940). The populations from which these designations have been made usually were intellectually subnormal, or exhibited educational and/or behavioral disturbance. The present study utilizes a similar method of selecting subjects from a normal school population.

S's used in this study were elementary school pupils in the East Broadway school in Levittown, Long Island. All were considered to be of at least average intelligence and were functioning in a regular classroom.[1] In the Spring of 1967, a circular was given to kindergarten,

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[1]At that time the Levittown school system was participating in a program called Extended Readiness. This special program provided prescriptive teaching methods for first, and second graders who scored below a certain percentile in reading readiness tests, but who were not emotionally disturbed, brain damaged or intellectually retarded. As a result, all kindergarten children at the East Broadway school had been through a screening process during the course of which, any emotionally disturbed, brain damaged or intellectually retarded youngsters were diverted to other teaching facilities.

second, third and fifth grade teachers. This circular presented a list of behavior characteristics generally associated with the syndrome,[1] and asked the teachers to list the names of children in their class who exhibited some or all of those characteristics. In December of 1967, a second such request was circulated to first, third, fourth and sixth grade teachers similarly requesting names for the study.

The final number of children for the experimental groups who had been listed by two successive teachers as hyperactive is given in Table 1. It should be reiterated that only those whose names appeared on teachers' lists in the spring and the fall were included in the experimental group.[2]

Table 1

Number of Children Listed as Hyperactive by Two Successive Teachers

Grade	Boys	Girls	Grade Total
1st gr.	13	4	17
3rd gr.	5	3	8
4th gr.	13	4	17
6th gr.	10*	1	11
Total (All grades)	41**	12**	53

* This does not include the two boys who were added later.
** The ratio of boys to girls is a reflection of population trends with respect to the syndrome.

[1]The text of the circular appears in the appendix.

[2]It should be noted that one fifth grade teacher had failed to reply in the Spring of 1967. All boys who had been listed as hyperactive by

At this point it was decided that only male subjects in first, fourth and sixth grades would be used. The small number of hyperactive girls in all grades and the small number of hyperactive children in third grade[1] made such a decision feasible.

Selection of nonhyperactive (control) S's was similar to that of experimental S's except that the estimate of only one teacher was solicited. The request for names included the following behavioral characteristics:

Not easily distracted

Has a reasonably long attention span

Does not frustrate easily

Is able to sit still for reasonable periods of time

Is not fidgety

Has good concentration

Is not impulsive

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their sixth grade teacher in December were checked as to their fifth grade class. Three boys were found who had been in that nonreplying fifth grade teacher's class. A check of their cumulative records indicated a history of distractibility and hyperactivity for two of the boys and they were included in the experimental group.

[1]There was an attrition in the number of pupils in the primary grades due to the transfer to Catholic parochial schools.

The number of children rated as nonhyperactive is given in Table 2 below.[1] Although not subsequently used, third graders are included for comparison purposes.

Table 2

Number of Children Rated as Nonhyperactive by One of Their Teachers

Grade	Boys	Girls	Grade Total
1st gr.	16	26	42
3rd gr.	10	21	31
4th gr.	13	23	46
6th gr.	13	20	33
Total (All grades)	52	90	152

It was decided to utilize 12 subjects in each of six groups (1st, 4th and 6th gr. HYP, and 1st, 4th and 6th gr. NONHYP). The remaining number over the 12 would be held as reserve in the event of unavailability of any of the boys, or if any other difficulties in procedure developed. Selection of the twelve was random. The final number of subjects available is presented in Table 3.

[1]The greater number of nonhyperactive girls relative to nonhyperactive boys can be compared to the reverse finding in the hyperactive group.

Table 3

Total Number of Subjects Available for Study

Grade	HYP	NONHYP
1st gr.	13	16
4th gr.	13	13
6th gr.	12*	13

* Includes the two boys who were added to the group.

Characteristics of the Sample

The experiment was conducted in March, April and May of 1968. Table 4 presents the ages of the groups.

Table 4

Median and Range for Ages of Six Groups as of April, 1968

Group	Median Age	Range
1st gr. HYP	6 yrs. 10 mos.	6-6 to 7-4
1st gr. NONHYP	6 yrs. 10 mos.	6-7 to 7-4
4th gr. HYP	9 yrs. 8 mos.	9-5 to 10-4
4th gr. NONHYP	9 yrs. 10 mos.	9-4 to 10-4
6th gr. HYP	11 yrs. 8 mos.	11-5 to 12-5
6th gr. NONHYP	12 yrs.	11-4 to 12-4

Some form of standardized test scores were available for most, if not all subjects. Table 5 presents the mean percentile scores obtained by first grade subjects on the Metropolitan Reading Readiness Tests, (Harcourt, Brace and World, 1948) together with the standard deviations of test scores for those groups.

Table 5

Mean Percentile Scores on the Metropolitan Reading Readiness Test for First Graders

Group	N	Mean	S.D.
HYP	12	.51	.17
NONHYP	11	.91*	.09

* Significant at the < .01 level of confidence. (Mann-Whitney U test, one-tailed. U=3, 11 and 12 df.)

Table 6 presents the mean I.Q. scores obtained by 4th and 6th grade groups on the Otis Quick Scoring Mental Abilities Tests (Harcourt, Brace and World, 1952).

Table 6

Mean I. Q. Scores on the Otis Quick Scoring Mental Abilities Tests for 4th and 6th Grade Groups

Group	N	Mean	S. D.
4th gr. HYP	11	107	11.23
4th gr. NONHYP	7	114	7.90
6th gr. HYP	9	110	10.58
6th gr. NONHYP	10	122*	7.14

* Significant at the < .01 level of confidence. (Mann-Whitney U Test, one-tailed, U=3, 9 and 10 df).

Procedures

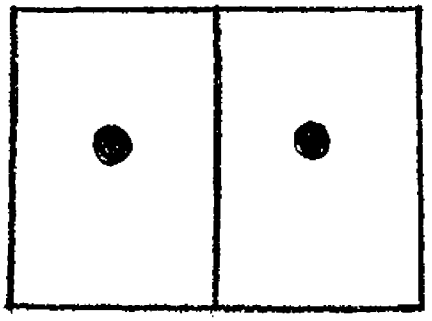
Each subject was brought into the room individually, and after being permitted a preliminary inspection of equipment, was seated at a table facing a rear-projection screen. Stimuli were presented in the form of slides, each of which had a line down the center and figures on either side of the line. S's were instructed to squeeze a rubber bulb when the figures were the same and to refrain from squeezing it when they were not the same. Pressures on the bulb were recorded on a chart mover. Details of stimuli, equipment, instructions to subject and data assessment are elucidated below.

Stimuli

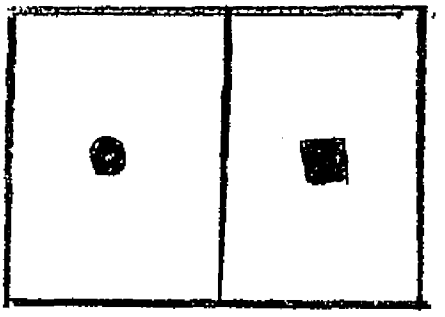
Slides were fabricated by photographing 9 x 6 sheets of white drawing paper on which a black line had been drawn down the center with a magic marker and on which relevant stimuli were drawn in black. For those stimuli on which irrelevant, distracting material was presented, Dennison's gummed stickers were used representing flowers and fruit. A total of 72 such 35 mm slides were used. These represented three levels of the Distraction (D) variable, and four levels of the Configuration (C) variable. Half of the total number of 72 slides were the same (requiring a squeeze of the bulb) and half were different (requiring no squeeze of the bulb). Thus, there were 12 "go" and 12 "no go" stimuli, and each of these 24 stimuli were presented three times.

1. Distraction variable (D) slides

D1: Only black relevant figures appeared. There were no distracting figures in the stimulus field.

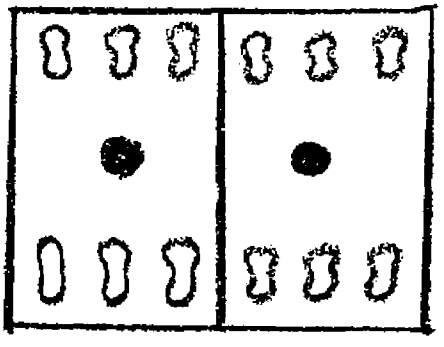


D1-same ("go")

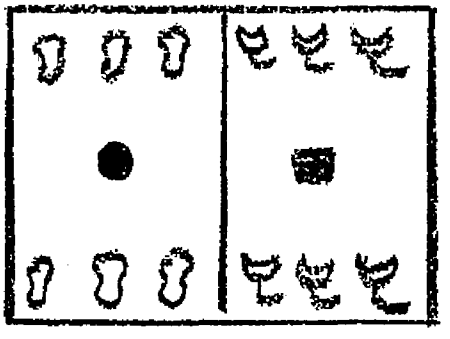


D1-different ("no go")

D2: Distracting figures appeared in the stimulus field. When relevant black figures were the same, distracting figures were the same, and when relevant figures were different, distracting figures were different.

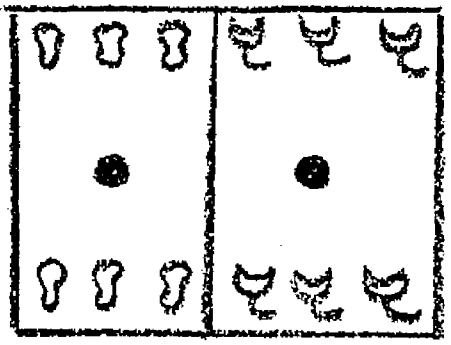


D2-same, same ("go")

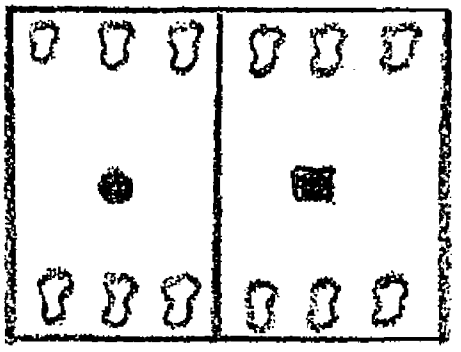


D2-different, different ("no go")

D3: Distracting figures were present in the stimulus field. However, when relevant black figures were the same, distractors were different, and when relevant black figures were different, distractors were the same.



D3-same, different ("go")



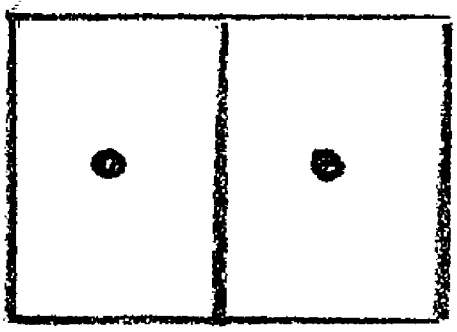
D3-different, same ("no go")

Thus, (s), (ss) and (sd) slides required a positive response (pressure on bulb) while (d), (dd) and (ds) slides required a negative response (no pressure of the bulb).

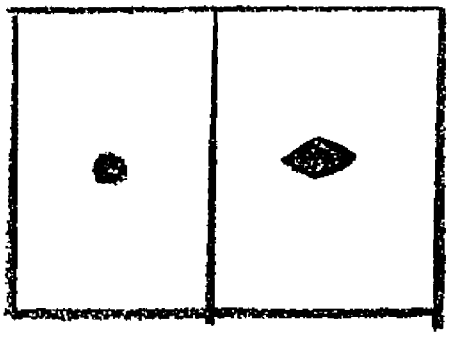
2. Configuration variable (C) slides

There were four levels of the Configuration variable, each of which also could be either the same or different. These are illustrated below.

C1: Any one of three geometric figures (circle, square or diamond.)

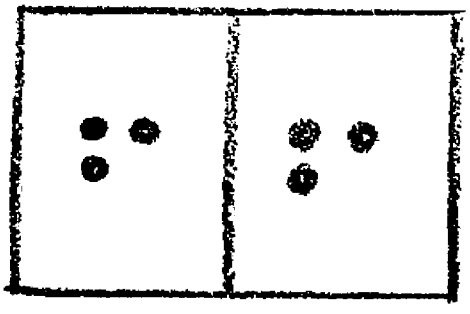


C1-same ("go")

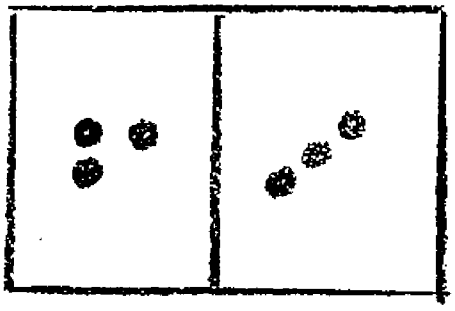


C1-different ("no go")

C2: A cluster of three circles. The pattern of the circles could be the same for positive slides and different for negative slides.

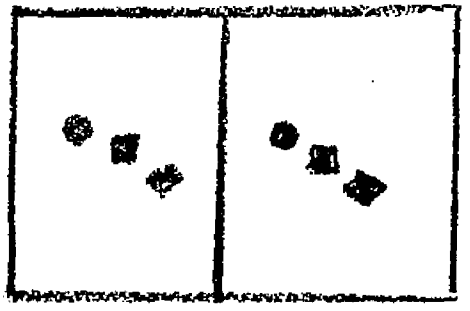


C2-same ("go")

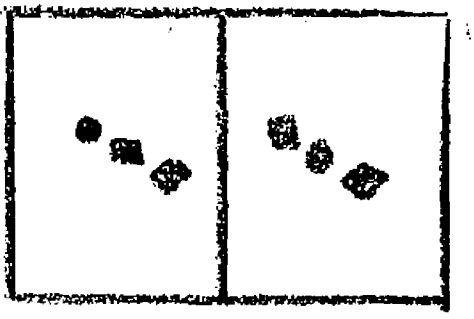


C2-different ("no go")

C3: Three geometric figures presented together in a diagonal series.[1]

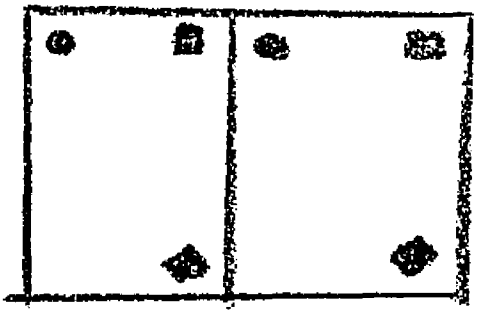


C3-same ("go")

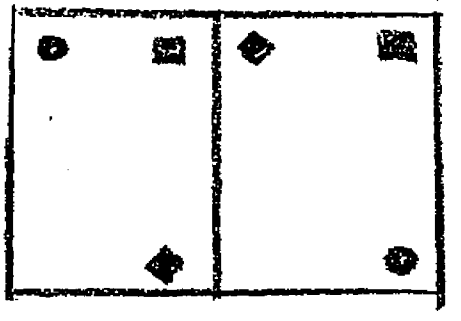


C3-different ("no go")

C4: Three geometric figures as in C3 but placed around the outside of the stimulus space.[2]



C4-same ("go")



C4-different ("no go")

These 24 stimuli (12 positive representing a combination of 3 levels of D and 4 levels of C, and 12 negative representing the same combinations) were shown in 3 blocks of 24 presentations each. Each of the 24 stimuli appeared once in each block. These 3 blocks represented the third condition of the experiment and will be described below.

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[1]Actually when the first of the series of three figures were the same, the other two in the series also were the same although no mention was made to the subject. This was done simply to minimize the range of error which could result from alterations in the order of figures. No one subject seemed to note this.

[2]When C4 stimuli were presented under D2 and D3 conditions requiring irrelevant figures in the field, these figures were placed in the lower left corner of the area.

Presentation Blocks (E Variable)

E1: In the first block, slides were shown for two and a half second exposure with two second inter-trial interval. Slides representing the D variable were randomized, but those representing the C variable were not. The order of presentation of the 24 slides in E1 are given in the appendix.

E2: The second block was shown at the same rate of speed as the first and with the same exposure interval but the following changes were introduced:

1. Slides were randomized for the C variable as well as D variable.
2. Randomization was modified to include sequencing for perseverative errors.

E3: As in E2 both D and C variable stimuli were randomized, although a different random order was employed. This also applied to sequencing for perseverative errors. This block differed from E2 however, in that the exposure time for stimuli was reduced to one second. Inter-trial interval remained at two seconds. The order of presentation of these slides also appears in the appendix.

Equipment

The room utilized for the study was windowless, approximately 8 x 20 feet and lined with shelves. The slides were projected by a Honeywell Rondelle automatic slide projector on to an opaque rear-view screen 8 x 12 inches. (A schematic drawing of the setup can be

found on the following page). Responses were recorded on a chart mover (Harvard Apparatus Company catalog number 850 standard 10-inch model). To this, a rubber tube with a squeeze bulb was attached. A pressure release adjustment was inserted between the tube and the tambour to enable expulsion of excess air which prevented overloading of the diaphragm within the tambour.

The Rondelle standard timer attachment was adapted such that time-on interval was decreased to a minimum of approximately one-second exposure. The timer was installed in a metal box with an RC circuit such that the "on" signal fed simultaneously to the projector via a transformer linkage which activated the time-mark needle on the chart mover.

Each time a slide was shown, a time-mark was recorded on the upper portion of the grid paper on the chart mover. The subject's response was recorded in the lower portion. It was possible to record even the very small pressures on the bulb although the strength of the squeeze could not be correlated with the amount of deflection of the needle.[1] Each S's record consisted of several yards of chart paper, with markings of "on" and "off" periods for the slides. E then recorded the sequence of slides on the chart paper in order to determine the relationship of response to a particular stimulus.

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[1]Amount of deflection of needle was partly dependent upon the recovery period of the needle, and that, in turn, was dependent on the amount of deflection of the preceding response. However this study was concerned with frequency, rather than amplitude of pressure.

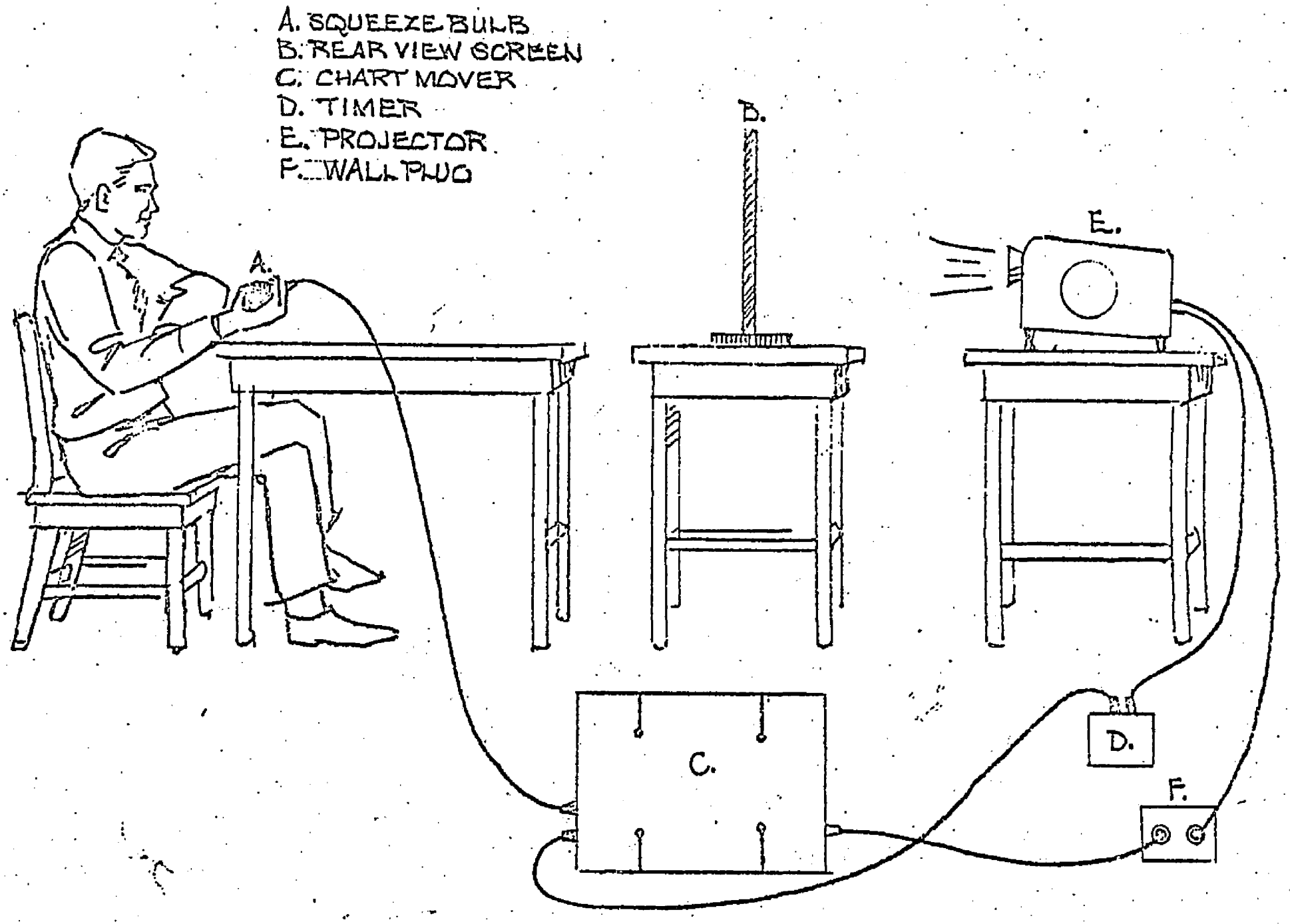

Fig. 1. Schematic drawing of apparatus

Instructions

The S was brought into the room and told he would be shown some slides. He was permitted to examine the equipment, shown how the chart mover worked and how his squeeze of the bulb deflected the needle. During this time he was permitted to ask questions and to become familiar with the surroundings. He then was seated at a small table facing the screen. Pre-trial training commenced and proceeded as follows:

The E projected the first trial slide (C1 D1-same) on the screen. E said:

> All the slides you will see will have a black line down the center like this. On this slide there are two figures, one on each side of the line. These are the same, aren't they?

If the S gave the wrong response he was corrected. Than the second trial slide was shown (C1 D1-different). E said:

> These two figures are not the same, are they?

Again, the S was corrected if wrong. E next showed four more trial slides (C1 D1-same and C1 D1-different), asking each time if they were the same or different and making needed corrections. These six slides were shown over and over until a criterion of all correct was achieved. (Actually, this procedure took very little time). Next E said:

> Now I'll show you some slides like the others only this time they will have colored pictures on them as well. These colored pictures may be the same on both sides of the line,

> or they may be different. However, you are to pay no attention to the colored pictures. Try to pretend they aren't there. Look only at the black figures and tell me whether they are the same or different.

Next a series of six trial C1 slides were presented involving D2 and D3 levels of the Distraction variable. These were shown until a criterion of all correct was achieved. Then E turned the projector off and sat next to the child at the table and said:

> That was one kind of slide. There are three other kinds, but we'll study them by looking at them on pieces of paper.

For this, the original 9 x 6 pictures from which slides were made were used. The E put the rubber bulb into the S's hand and said:

> From now on, instead of saying 'same' or 'different' when you look at the pictures or slides, I want you to squeeze the bulb if the black figures are the same. When they are different, don't squeeze it. Don't do anything.

A picture representing C2 D1-same was shown:

> See this group of three circles on this side of the line and the three circles on the other side? They are arranged exactly the same, aren't they?

A stimulus representing C2 D1-different was shown.

> There are not the same, are they? Let's look at some of the others. I won't say anything except to tell you if you are right or wrong. You squeeze the bulb when they are the same, and don't squeeze it or do anything else when they are different. Some of the pictures will have colored pictures on them too, but remember, pay no attention to the colored pictures. Look only at the black figures.

A group of eight stimuli representing Condition C2 and the six possibilities of D were shown over and over until a criterion of eight

correct was achieved. Throughout this the S was corrected when necessary not only for incorrect responses, but when he failed to respond by pressing or not pressing the bulb and called out "same" or "different" instead. When this training block was completed to criterion, E said:

> Now we'll look at the third kind of slide. (C3 D1-same). See these three figures here, and these here. They are in the same order on both sides of the line. But look at these. (C3 D1-different). These are not the same. They are different. (S is allowed to compare both cards simultaneously). Now we'll do the same thing as before. I'll show you one of these and you squeeze the bulb when the figures are in the same order on both sides of the line, but don't squeeze or do anything when they are different. Remember to pay no attention to the colored pictures when they appear.

Procedure was repeated as above to a criterion of eight correct, successive identifications. E then went on with C4 picture and said:

> These are a little different. Instead of putting the black figures in the center of each page or slide, they are around the outside. When colored pictures are on the slide, they will be here (indicating lower left hand corner). But you do the same thing as before. Squeeze the bulb when the black figures are the same and don't squeeze it when they are different.

The procedure was repeated as above to a criterion of eight correct successive identifications. E then said:

> Now we'll review. I'm going to turn the slide projector on soon, and my machine over there (chart mover) also. You will see the slides like the four kinds of pictures we have looked at. When the black figures are the same on both sides of the line you squeeze this bulb as fast as you can. Remember that when you squeeze, it moves the needle. When the black figures are different don't squeeze

> or do anything. Remember, some of the slides will have colored pictures as well as black figures. Pay no attention to the colored pictures. Look only at the black figures.

The E then ran the first block of 24 slides. After completion, the slide projector was turned off and reset for the second block during which time the subject was told:

> Now you will see slides just like the ones before only this time they will be in a mixed-up order. Remember to squeeze when the black figures are the same and don't squeeze when they are different. Are you ready?

The slide projector was turned on and the second block of 24 slides shown. Upon completion, the timer on the slide projector was reset and E said:

> Now you will see some more slides like the others only this time they will be shown very fast. Remember when the black figures are the same, squeeze, and do not squeeze when they are different. Are you ready?

The third block of 24 slides was shown

Data Treatment

The following scores were available:

1. Correct "go" responses: (Squeeze of the bulb when stimuli were the same).
2. "Go" errors: (Squeeze of the bulb when the stimuli to be matched were different and the required response was "no squeeze").
3. Correct "no go" responses: (No squeeze of the bulb when stimuli were different).

4. "No go" errors: (Failure to squeeze the bulb when stimuli were the same and the appropriate response was "squeeze").

Scores from these four response categories were used to form a four cell matrix in which "go" and "no go" stimuli formed one two-fold dimension and "go" and "no go" responses formed the other.[1] These entries were then transformed as follows:

Discrimination scores: The ratio of the sum of all correct responses (both "go" and "no go"), to the total number of responses.[2] Thus a perfect discrimination score would be 1.00 and a performance no better than chance would yield a score of .50.

Inhibition scores: These were derived as a ratio of the number of correct "no go" responses to the total number of correct responses. As a result, a high Inhibition score (maximum = .50)

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[1]The four-fold possibilities yielded by the stimulus-response relationships provided analogous response categories to a signal detection analysis. (Swets, 1964). However, the problem which presented itself was that in analyzing responses of the six groups under each of the three experimental conditions, the number of repeated presentations would be too few to justify a method clearly derived from hundreds of repeated presentations. Therefore, it was decided to adopt the model of signal detection analysis but to utilize the ratio of errors and correct responses, rather than the ultimate conversion to z scores involved in signal detection analysis.

[2]In the analyses of scores of groups irrespective of stimulus variation, the denominator (total number of responses) was 72. In the analyses of stimulus variables the denominator was seventy-two divided by the number of levels of the variable.

indicates a high ability to inhibit inappropriate "go" responses. Of course this analysis could have been accomplished by obtaining an "excitation" score which would be the ratio of "go" errors to the total number of errors, but it was felt that presentation of results would be simplified if the subject's ability to inhibit inappropriate responses was compared to the ability to discriminate stimuli since Discrimination and Inhibition scores would be expected to vary in the same direction.

It is obvious that Discrimination and Inhibition scores are not independent of each other. A subject who responded perfectly (36 correct "go" responses and 36 correct "no go" responses) received a Discrimination score of 1.00. Under these circumstances, there only was one possible Inhibition score-. 50. As Discrimination scores decrease, the range of variation possible in Inhibition scores increase, until at a Discrimination score of . 50 (no better than chance) there is the greatest possible range of Inhibition scores. The relationship of Discrimination and Inhibition scores is presented graphically in Figure 2.[1]

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[1]Consideration of the interdependence of these two scores proved to be an important factor in analyzing data on the first grade groups. This will be elaborated in a later section.

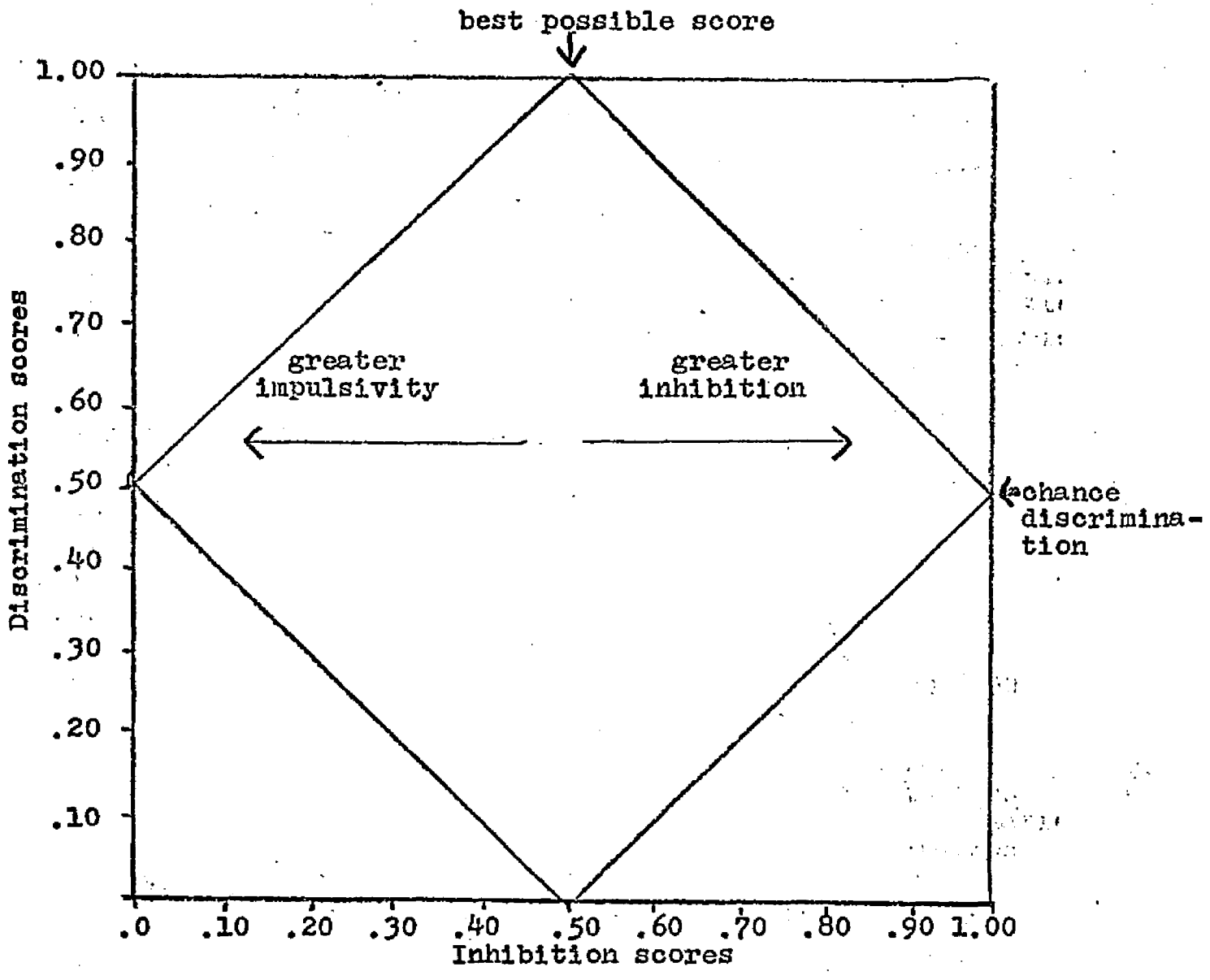

Fig. 2. Relationship of Discrimination and Inhibition Scores. Diamond figure represents the boundaries of Inhibition scores for given Discrimination Scores.

In addition to Discrimination and Inhibition scores other measures were available from the data as follows:

Perseverative errors:

a. Perseverative "go" errors: A "go" error occurring on a "no go" stimulus presented after a series of five "go" stimuli.

b. Perseverative "no go" errors:[1] A "no go" error occurring on a "go" stimulus presented after a series of five "no go" stimuli.

Since two of the 72 stimuli provided opportunity for "no go" perseverative errors and two for perseverative "go" errors, two of each type of error could occur for each subject.

Adventitious movements: These were any recorded pressures on the bulb during the response interval[2] which were over and above the one full pressure counted as either correct "go" response or "go" error. When they occurred, these responses (1) might appear as one or two extra pressures on the bulb, (2) might result from continued, clutching pressure on the bulb after the squeeze, but before the release, and (3) might occur as a series of several pressures on the bulb occurring in quick succession, and are

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[1]Perseverative "no go" errors were included for control purposes only.

[2]A response interval is defined as the period of time between the onset of one stimulus and the onset of the next. All pressures occurring during the inter-trial interval were attributed to the immediately preceding stimulus.

hereafter referred to as "multiple bursts."

Scores on adventitious movements were utilized as follows:

a. The number of response intervals (total=72) during which adventitious movements occurred. (This included the three types described above).

b. The number of subjects in each group (total=72) who evidenced multiple bursts of adventitious movements.

RESULTS

Results of Discrimination and Inhibition Scores for Groups

The mean Discrimination and mean Inhibition scores for the six groups are presented in Table 7. Analyses of variance of those scores are summarized in Tables 8 and 9.

1. Grade

   Discrimination: The ability to discriminate stimuli proved to be an increasing function of age. (The F ratio for grades (columns) is 42.2 (Table 8) significant at the< .01 level of confidence). A Duncan new Multiple range test (Edwards, 1963) indicates that the 4th and 6th grade groups were significantly better than the 1st grade group.

   Inhibition: The ability to inhibit impulsive responding was not an increasing function of age. (F ratio for grades in Table 9 is 2.1 which is not statistically significant).

2. Hyperactive-Nonhyperactive

   Discrimination: Differences between hyperactive and nonhyperactive groups (irrespective of grade) were not significant. (F ratio in Table 8=2.64).

   Inhibition: Differences between HYP and NONHYP were significant

at < .01 level. (F ratio = 10, Table 9).

3. Interaction

Discrimination: Duncan analysis of the significant F ratio for interaction (8.41, significant at < .01 level) indicates that differences between HYP and NONHYP first grade groups was significant, but the difference between the 4th grade groups and the difference between the 6th grade groups, were not significant.

Inhibition: The F ratio was not significant. However, the 1st grade NONHYP group had a higher Inhibition score than the 4th grade HYP group.[1] This has added importance by virtue of the fact that the Discrimination scores of the 4th grade HYP group were higher than those of the first grade NONHYP group.

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[1]Although the insignificant F ratio did not justify it, a Duncan analysis was performed and indicated this difference was significant at < 05 level.

Table 7*

Mean Discrimination and Mean Inhibition Scores for Six Groups

Group	N	Mean D Score	Mean I Score
1st gr. HYP	12	.765	.442
1st gr. NONHYP	12	.901	.483
1st gr. Mean	24	.832	.463
4th gr. HYP	12	.917	.458
4th gr. NONHYP	12	.958	.479
4th gr. Mean	24	.937	.469
6th gr. HYP	12	.938	.476
6th gr. NONHYP	12	.962	.485
6th gr. Mean	24	.950	.481
HYP Mean	36	.873	.459
NONHYP Mean	36	.940	.482

* Graphic representation in Figs. 3, 4, and 5.

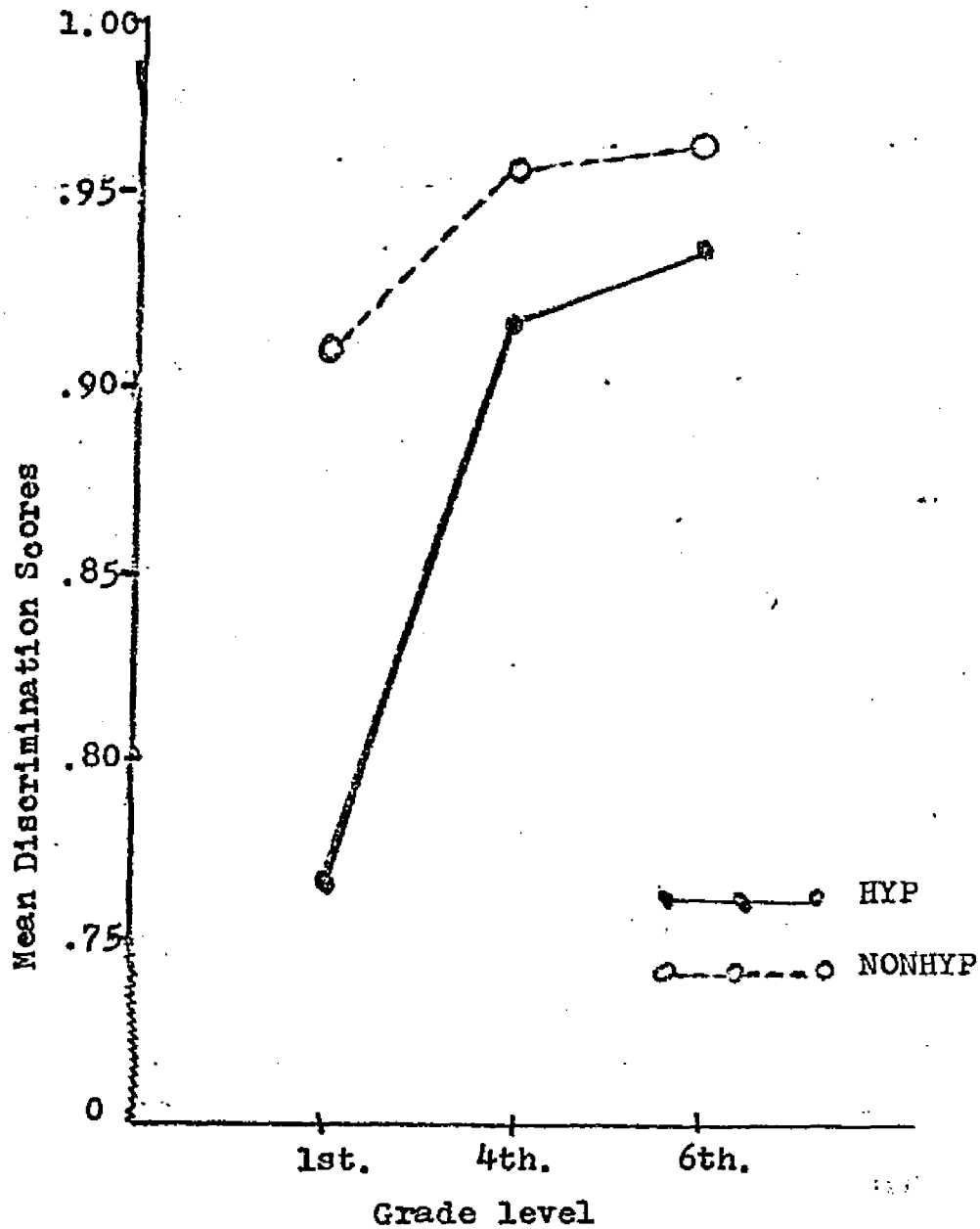

Fig. 3. Mean Discrimination scores for six groups.

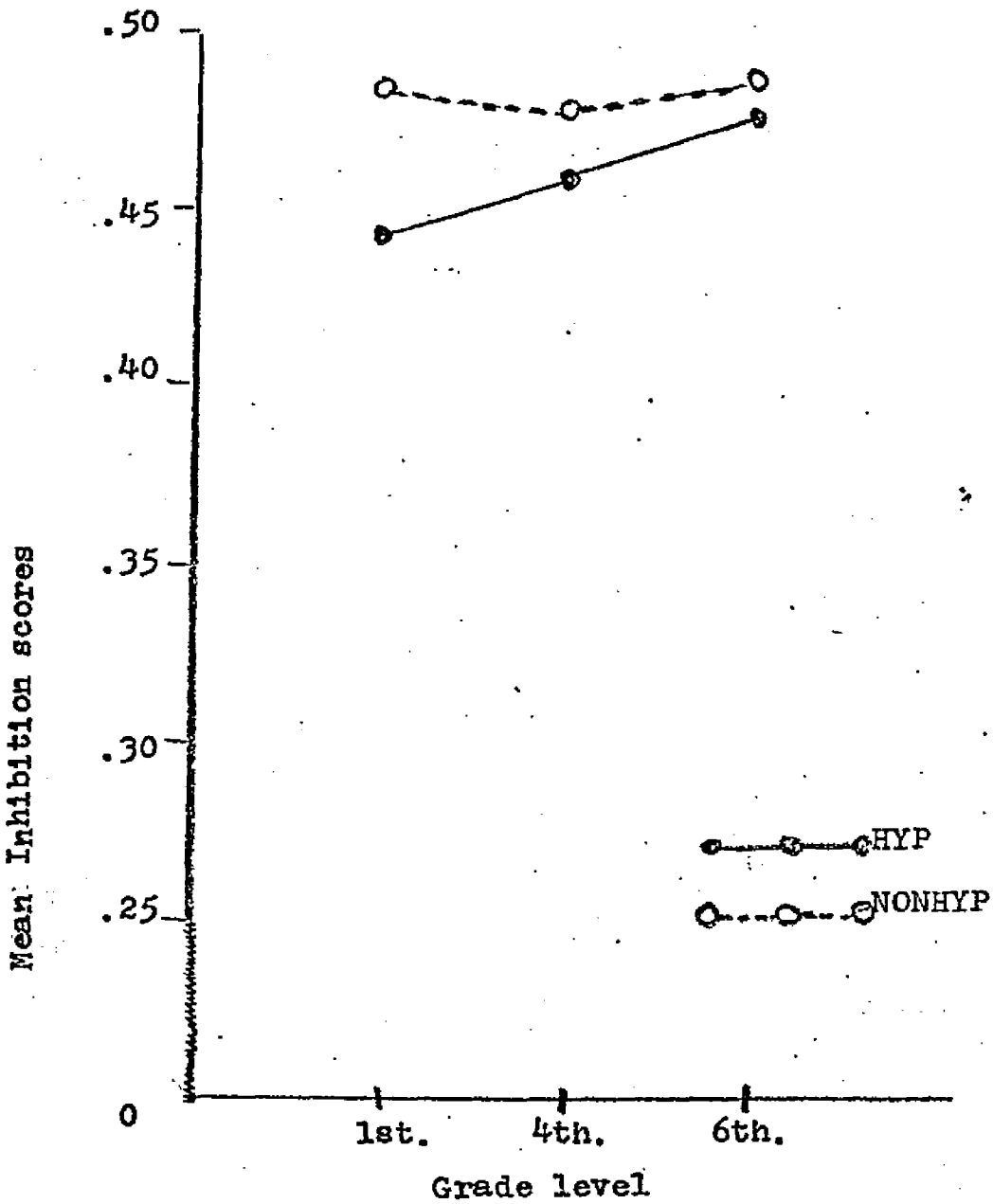

Fig. 4. Mean Inhibition scores for six groups.

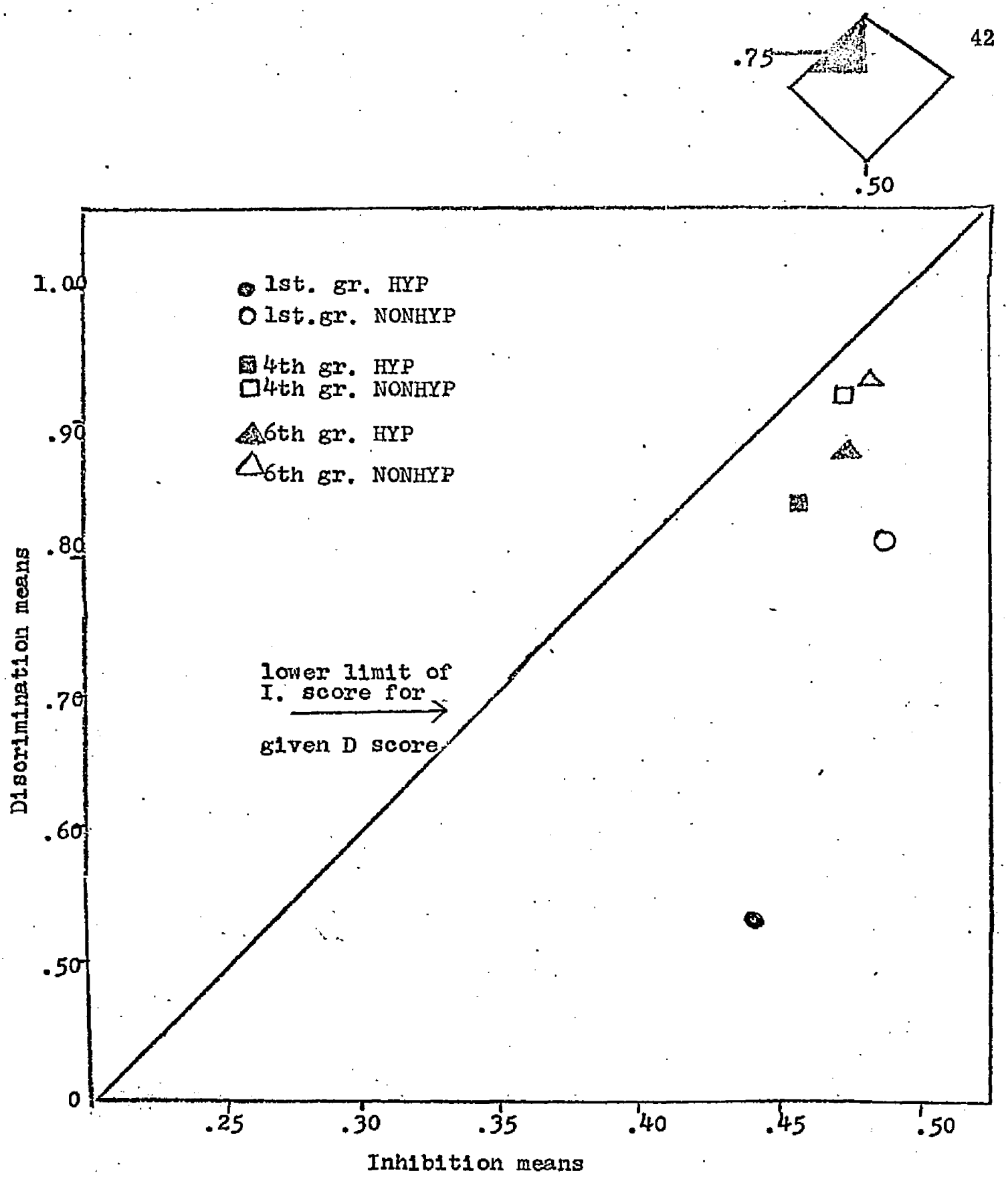

Fig. 5. Relationship of Discrimination and Inhibition means for six groups. Figure represents shaded portion of small diagram in upper right.

Table 8

Summary of Analysis of Variance[1] of Discrimination Scores

Source of variance	df	Mean Square	F
Total	72		
Rows (HA-NONHYP)	1	.0066	2.64
Columns (grade)	2	.1055	42.2*
Within	66	.0025	
R X C interaction	2	.0210	8.41*

* <.01 level of confidence

Table 9

Summary of Analysis of Variance[2] of Inhibition Scores

Source of variance	df	Mean Square	F
Total	72		
Rows (HYP-NONHYP)	1	.0100	10*
Columns (grade)	2	.0021	2.1
Within	66	.0010	
R X C interaction	2	.0016	1.6

* <.01 level of confidence

[1]Actually these analyses represent the "between" portion of three-way analyses of variance with repeated measures on one variable. (Winer, 1962). The "within" portions appear in the presentation of the results on stimulus variables.

[2]Ibid.

Perseverative Errors

The experimental design included perseverative "go" and "no go" errors. Since only one perseverative "no go" error occurred throughout the six groups, comparison of "go" errors for the six groups will be made without further reference to perseverative "no go" errors. Table 10 presents the total number of perseverative errors ("go" errors) for the six groups for Blocks E2 and E3.

Grade: Differences among grade levels for Block E2 are significant ($X^2 = 7.5$, df = 2, $<.02$ level).[1] Differences among grade levels for Block E3 are not significant.

Hyperactive-Nonhyperactive: Differences between HYP and NONHYP are significant for Block E2 ($X^2 = 9.9$, df = 1, $< .01$ level), but not for Block E3.

Interaction: The 4th grade HYP groups produced a greater number of perseverative errors than 1st grade NONHYP groups. The difference was not significant, but it must be remembered that a similarity of the two groups was hypothesized, and these findings suggest that the older group was even less able to inhibit responsiveness than the younger group.

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[1] X^2 one-sample test, Seigel, S. (1956).

Table 10*

Number of Positive Perseverative Errors for Six Groups

Group	N	E2	E3	Total
1st gr. HYP	12	9	9	18
1st gr. NONHYP	12	2	7	9
1st gr. Total	24	11	16	27
4th gr. HYP	12	4	12	16
4th gr. NONHYP	12	0	7	7
4th gr. Total	24	4	19	23
6th gr. HYP	12	2	5	7
6th gr. NONHYP	12	0	6	6
6th gr. Total	24	2	11	13
HYP Total	36	15	26	41
NONHYP Total	36	2	20	22

* Graphic representation appears in Fig. 6.

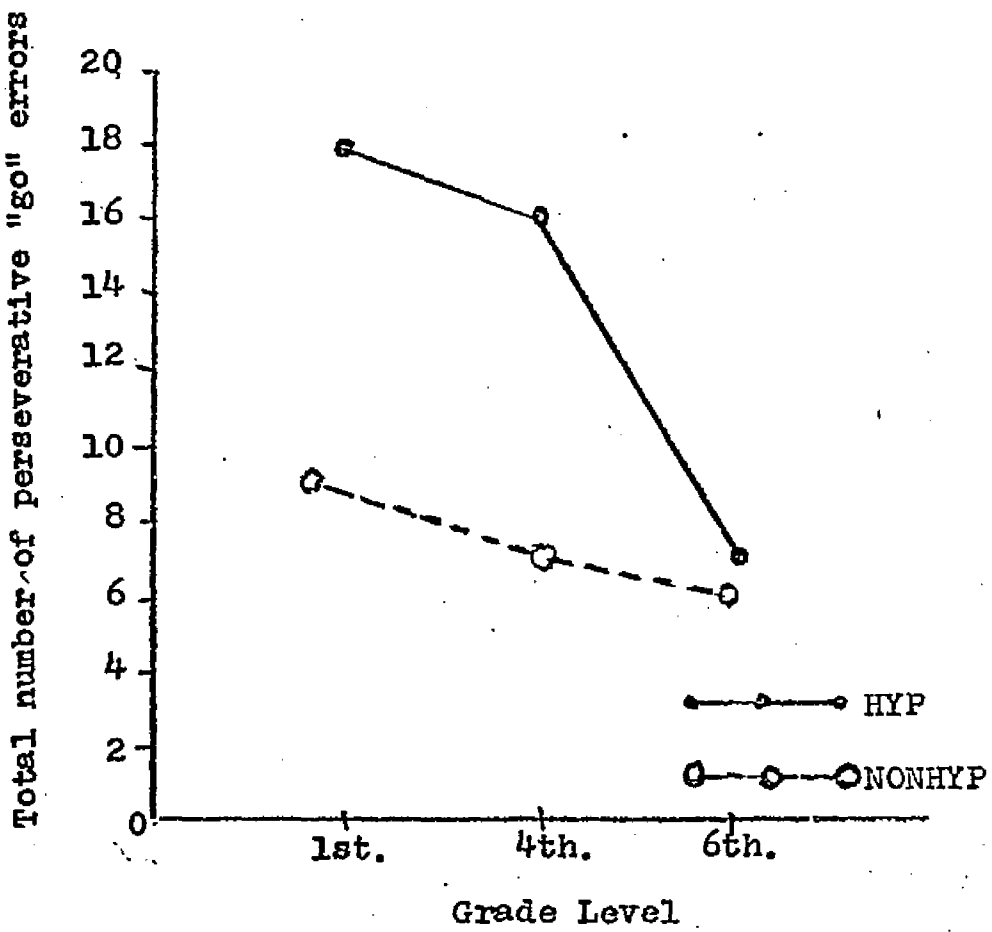

Fig. 6. Total number of perserverative "go" errors for six groups

Adventitious Movements

Table 11 presents the mean number of response intervals with adventitious movements for the six groups. Summary of analysis of variance of those figures appear in Table 12.

Grade: The occurrance of adventitious movements was an increasing function of age. (F ratio for grades = 3.9, significant at < .05 level). Duncan comparison indicates that significant difference occurred between 6th and 1st grade groups.

Hyperactivity-nonhyperactivity: Difference was not significant (F ratio = 2.9). However, the difference is in the predicted direction.

Interaction: The F ratio for interaction was not significant. However, inspection of the means in Table 11 indicates that the 4th grade HYP and 1st grade NONHYP groups are more similar than the two first grade groups or the two fourth grade groups are to each other. This is also true for comparison between fourth and sixth grades.

Table 11*

Mean Number of Response Intervals with Adventitious Movements for Six Groups

Group	N	Mean
1st gr. HYP	12	10.5
1st gr. NONHYP	12	7.8
1st gr. Mean	24	9.1
4th gr. HYP	12	7.4
4th gr. NONHYP	12	5.7
4th gr. Mean	24	6.5
6th gr. HYP	12	6.4
6th gr. NONHYP	12	3.3
6th gr. Mean	24	4.8
HYP Mean	36	8.1
NONHYP Mean	36	5.6

* Graphic representation in Fig. 7.

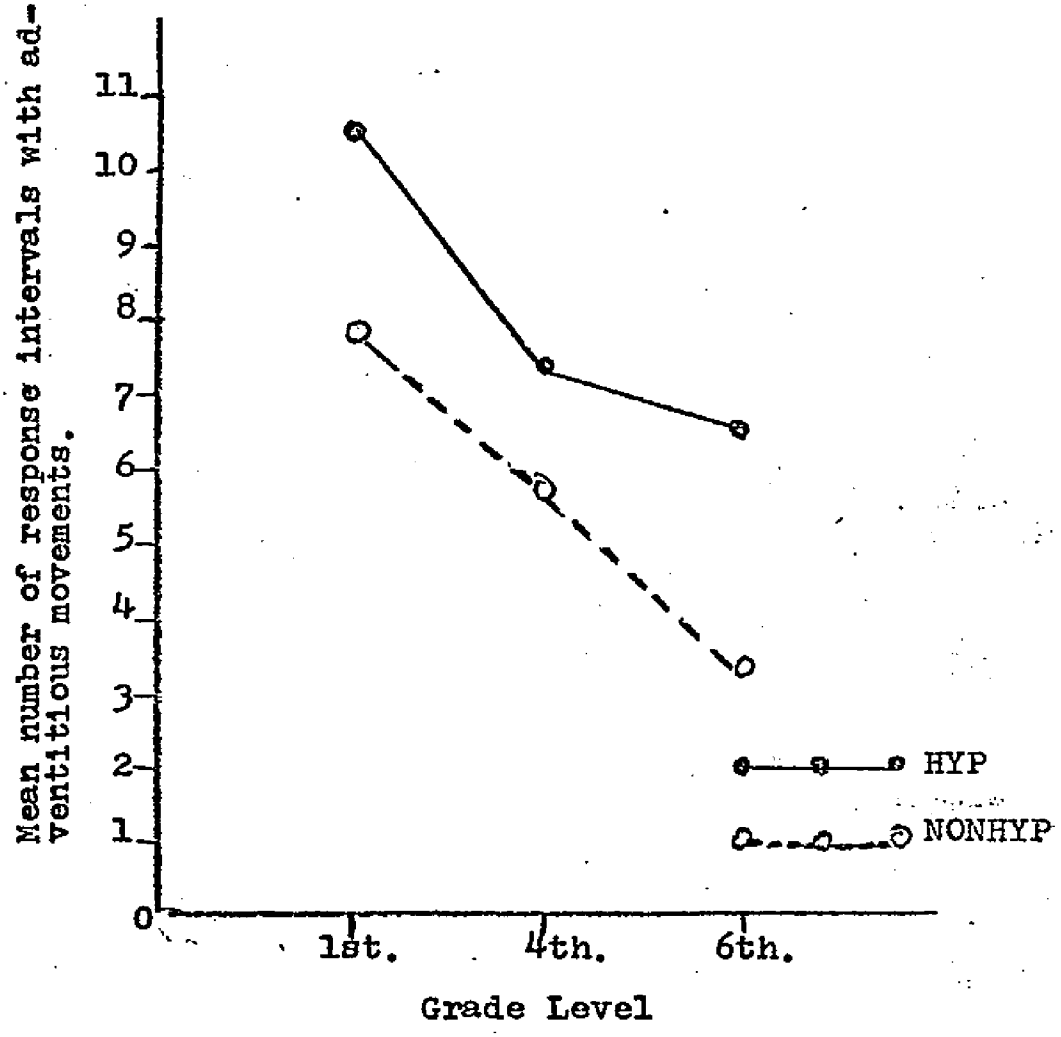

Fig. 7. Mean number of response intervals with adventitious movements for six groups.

Table 12

Summary of Analysis of Variance of Number of Response Intervals with Adventitious Movements

Source of Variance	df	Mean Square	F
Total	72		
Rows (HA-NONHYP)	1	87.23	2.9
Columns	2	114.35	3.9*
Within	66	29.61	
R X C interaction	2	16.57	.5

* Significant at <.05 level

Multiple Bursts of Adventitious Movements:

Table 13 presents the number of subjects in each group who evidenced multiple bursts of adventitious movements.

Table 13

Number of Subjects in Each Group Who Produced Multiple Bursts of Adventitious Movements

Grade	HYP	NONHYP	Grade TOTAL
1st	9	4	13
4th	6	1	7
6th	2	1	3
Total (All grades)	17	6	23

Graphic representation in Fig. 8

Grade: Differences among grades were significant ($X^2 = 6$, df = 2, $< .02$ level).

Hyperactive-Nonhyperactive: Difference between HYP and NON-HYP significant ($X^2 = 5.2$, df = 1, $< .05$ level).

Interaction: Here, as in the data on adventitious movements, older HYP groups responded more impulsively than younger NONHYP groups.

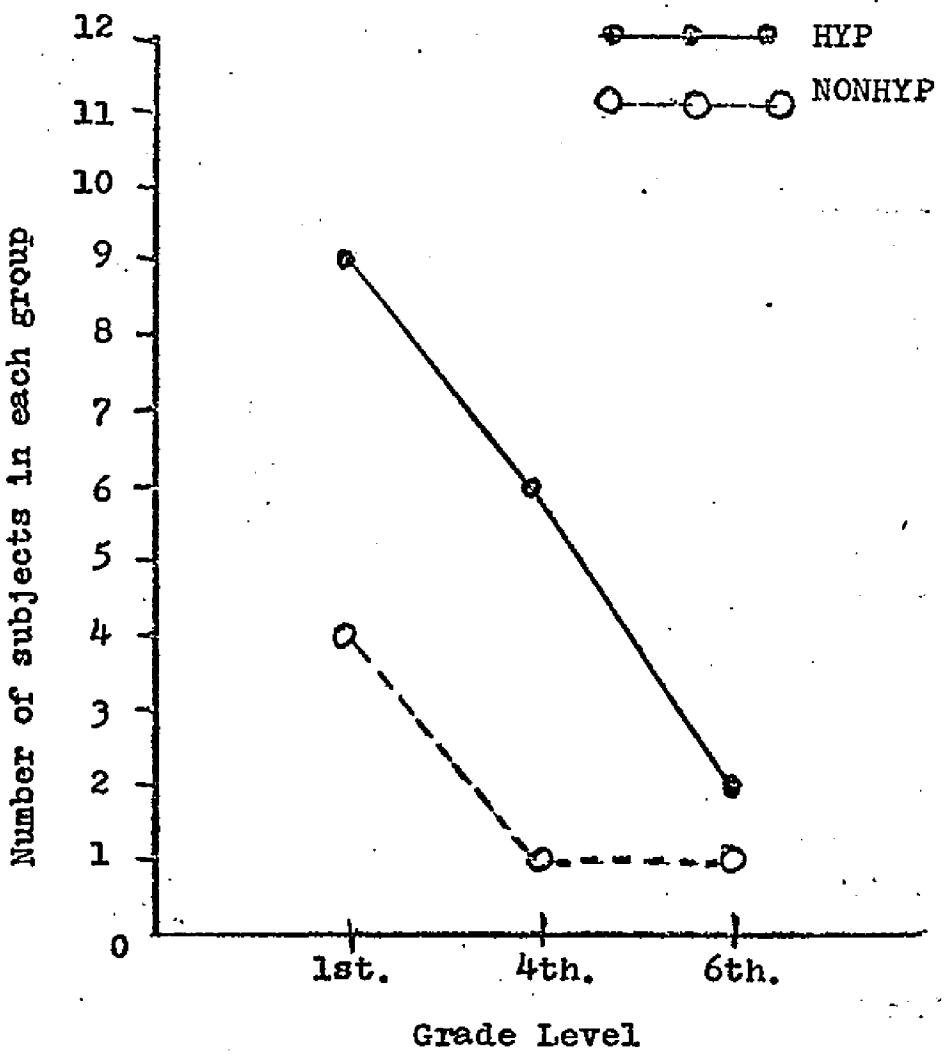

Fig. 8. Number of subjects in each group who evidenced multiple bursts of adventitious movements.

Results for Distraction Variable (D)

Table 14 presents the mean Discrimination and mean Inhibition scores for six groups under the three levels of D variable. Summaries of analyses of variance appear in Tables 15 and 16. Neither the F ratio for Discrimination scores, nor that for Inhibition scores were significant. Significant interactions in Discrimination scores were contributed largely by differences among groups. On the first grade level, however, differences between D1 and D3 Discrimination scores were significant for both HYP and NONHYP groups.

Table 14

Mean Discrimination and Mean Inhibition Scores for Six Groups Under Three Levels of D Variable

Group	N	Mean Discrimination			Mean Inhibition		
		D1	D2	D3	D1	D2	D3
1st gr. HYP	12	.778	.772	.748	.440	.457	.430
1st gr. NONHYP	12	.923	.894	.895	.480	.475	.487
1st gr. Mean	24	.851	.833	.822	.460	.466	.459
4th gr. HYP	12	.908	.930	.915	.453	.466	.457
4th gr. NONHYP	12	.947	.957	.949	.474	.478	.475
4th gr. Mean	24	.928	.944	.932	.464	.472	.466
6th gr. HYP	12	.928	.949	.939	.440	.478	.473
6th gr. NONHYP	12	.960	.963	.970	.472	.482	.488
6th gr. Mean	24	.944	.956	.955	.456	.480	.481
HYP Mean	36	.871	.884	.867	.444	.467	.453
NONHYP Mean	36	.943	.938	.938	.475	.478	.483

Table 15

Summary of Analysis of Variance[1] of Discrimination Scores of Six Groups Under Three Levels of D Variable

Source	df	Mean Square	F
Total within	144		
D	2	.0013	
AD (HYP-NONHYP X D)	2	.3559	34.6*
BD (Grade X D)	4	.1115	10.8*
ABD	4	.1891	18.7*
Error	132	.0103	

* Significant at<.01 level

Table 16

Summary of Analysis of Variance[2] of Inhibition Scores of Six Groups Under Three Levels of D Variable

Source	df	Mean Square	F
Total within	144		
D	2	.0029	
AD (HYP-NONHYP X D)	2	.0025	
BD (Grade X D)	4	.0041	
ABD	4	.0066	
Error	132	.0033	

[1]These analyses and those in Tables 18,19,21 and 22 represent the "within" portion of a three-way analysis of variance with repeated measures on one variable. (Winer, 1962). The "between" portion appears in the presentation of results for Groups.

[2]Ibid.

Results for Configuration Variable (C)

Table 17 presents the mean Discrimination and mean Inhibition scores for the six groups under the four levels of the C variable. The summaries of the analyses of variance of these scores appear in Tables 18 and 19.

Discrimination: The F ratio for the C variable (Cols) is 22.6 (<.01 level). Duncan analysis indicates that whereas C1 and C2 were not significantly different, differences between C3 and C4, and between C3 and both C1 and C2, were significant. (See Fig. 9). An important finding from the analysis of significant interactions is that differences between HYP and NONHYP groups for all three grade levels were significant for C3. Differences between the two first grade groups was also significant for C4. (See Fig. 10).

Inhibition: The F ratio for the C variable was not significant. However, two important findings are worth noting. (a) On C4, the mean Inhibition score for the 1st grade NONHYP group was higher than that for the 4th grade HYP group, although their Discrimination scores were lower than those of the 4th grade HYP group. (b) On C4 the mean Discrimination score for the 1st grade HYP group was relatively low (.579) while their Inhibition score was relatively high. (.480). This would seem to indicate that on C4, the 1st grade HYP group achieved a level of Inhibition not previously evidenced by them. These trends will be discussed more fully in a later section.

Table 17

Mean Discrimination and Mean Inhibition Scores for Six Groups Under Four Levels of Configuration Variable

Group	N	Mean Discrimination				Mean Inhibition			
		C1	C2	C3	C4	C1	C2	C3	C4
1st gr. HYP	12	.889	.888	.712	.579	.467	.454	.373	.480
1st gr. NONHYP	12	.962	.930	.901	.801	.493	.485	.487	.493
1st gr. Mean	24	.926	.909	.807	.690	.480	.470	.430	.492
4th gr. HYP	12	.962	.920	.896	.882	.490	.468	.450	.436
4th gr. NONHYP	12	.963	.980	.957	.911	.490	.495	.486	.452
4th gr. Mean	24	.963	.950	.927	.897	.490	.482	.468	.444
6th gr. HYP	12	.957	.967	.910	.919	.480	.486	.466	.476
6th gr. NONHYP	12	.970	.981	.968	.925	.490	.497	.490	.470
6th gr. Mean	24	.964	.974	.937	.922	.490	.491	.478	.478
HYP Mean	36	.936	.925	.839	.793	.480	.469	.430	.467
NONHYP Mean	36	.965	.967	.942	.879	.491	.492	.488	.472
Total Mean	72	.951	.946	.890	.836	.485	.481	.459	.469

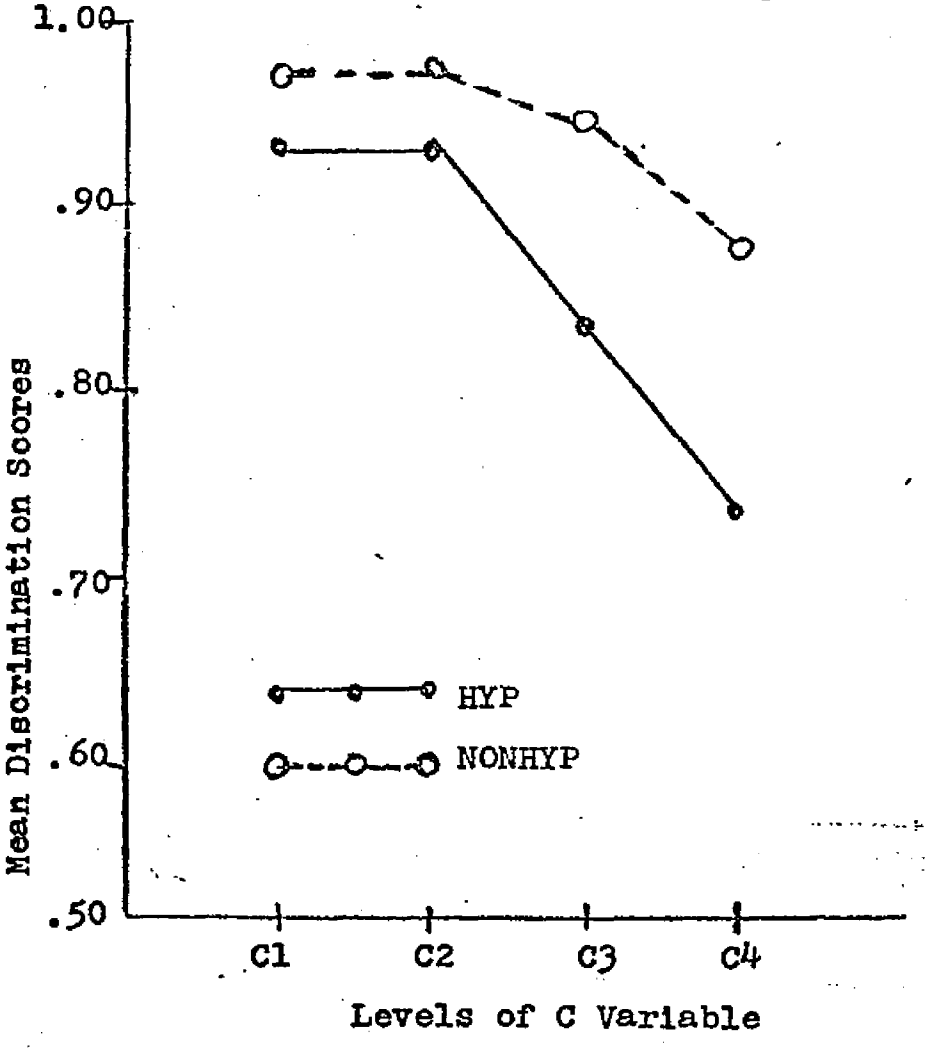

Fig. 9. Mean Discrimination scores of hyperactive (HYP) and nonhyperactive (NONHYP) groups on four levels of Configuration (C) variable.

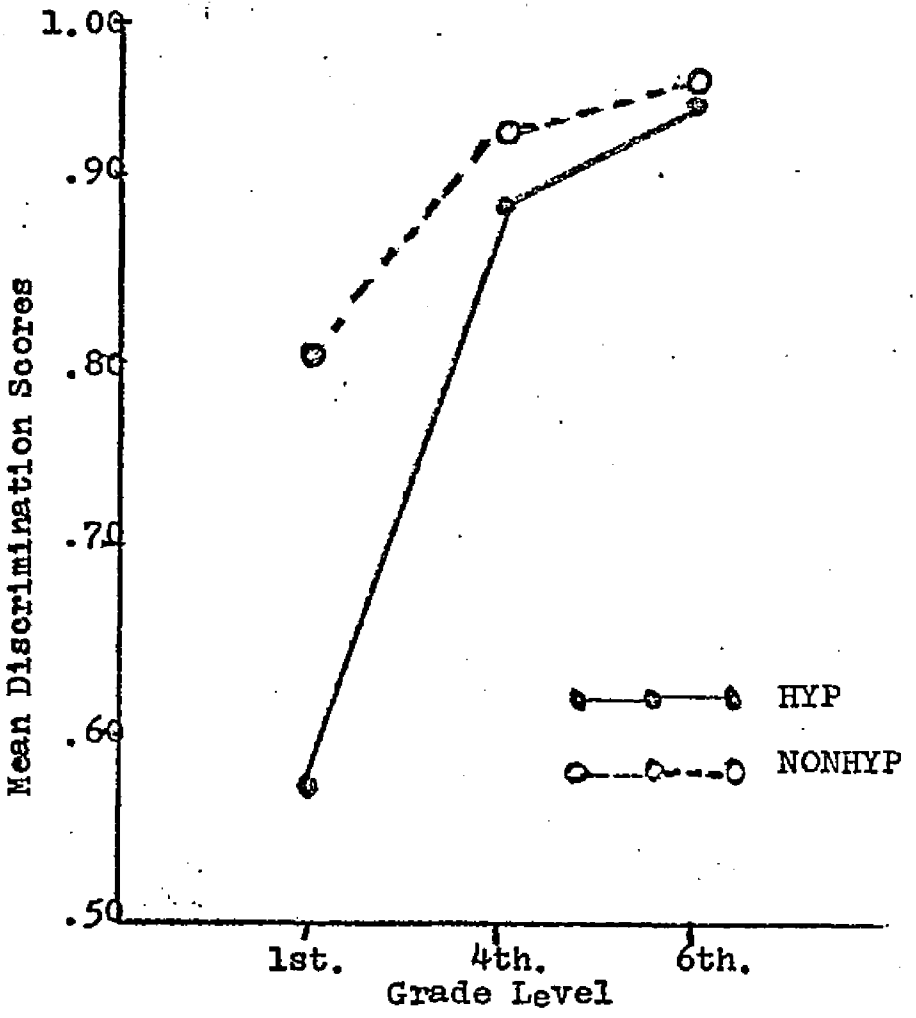

Fig. 10. Mean Discrimination scores of six groups on fourth level of Configuration variable (C4)

Table 18

Summary of Analysis of Variance[1] of Discrimination Scores for Six Groups Under Four Levels of C Variable

Source	df	Mean Square	F
Total within	216		
C	3	.2079	22.6*
AC (HYP-NONHYP X C)	3	.0700	7.5*
BD (Grade X C)	6	.0063	
ABC	6	.1954	21.2*
Error	198	.0092	

* Significant at <.01 level

Table 19

Summary of Analysis of Variance[2] of Inhibition Scores for Six Groups Under Four Levels of C Variable

Source	df	Mean Square	F
Total within	216		
C	3	.0096	
AC (HYP-NONHYP X C)	3	.1408	27.*
BD (Grade X C)	6	.1220	23.5*
ABC	6	.1239	23.8*
Error	198	.0052	

* Significant at <.01 level

[1]This is the within portion of a three-way analysis of variance with repeated measures on one variable. (Winer, 1962). The between portion appears in the presentation of the results for groups.

[2]Ibid.

Results for Shorter Exposure Interval (E)

Table 20 presents the mean Discrimination and mean Inhibition scores for the six groups for the three levels of the E variable. (The effect of the shorter exposure interval is measured by comparisons between E2 and E3). Analyses of variance of these scores are summarized in Tables 21 and 22.

Discrimination: Differences between E2 and E3 were significant (.05 level), for both 1st grade groups and both 4th grade groups, but was most dramatic for the 1st grade HYP group.

Inhibition: Differences between E2 and E3 were significant for the 1st grade HYP and for both 4th grade groups. (There was a nonsignificant reduction of scores on E3 for the 1st grade NONHYP group). On E3 the 4th grade HYP and 1st grade NONHYP groups had almost identical Discrimination scores, but the Inhibition score of the younger group was significantly higher than that of the older group (.05 level). (See Figures 11 and 12).

Table 20

Mean Discrimination and Mean Inhibition Scores for Six Groups for Three Levels of E Variable

Group	N	Mean Discrimination			Mean Inhibition		
		E1	E2	E3	E1	E2	E3
1st gr. HYP	12	.821	.807	.652	.489	.449	.389
1st gr. NONHYP	12	.891	.953	.847	.498	.489	.460
1st gr. Mean	24	.856	.880	.749	.494	.469	.425
4th gr. HYP	12	.967	.940	.848	.485	.467	.406
4th gr. NONHYP	12	.970	.975	.910	.483	.495	.448
4th gr. Mean	24	.969	.958	.879	.484	.481	.427
6th gr. HYP	12	.953	.963	.906	.479	.484	.460
6th gr. NONHYP	12	.980	.980	.925	.494	.493	.458
6th gr. Mean	24	.967	.972	.916	.487	.489	.459
HYP Mean	36	.914	.903	.802	.484	.467	.418
NONHYP Mean	36	.937	.969	.894	.492	.492	.455
Total Mean	72	.925	.936	.848	.488	.479	.437

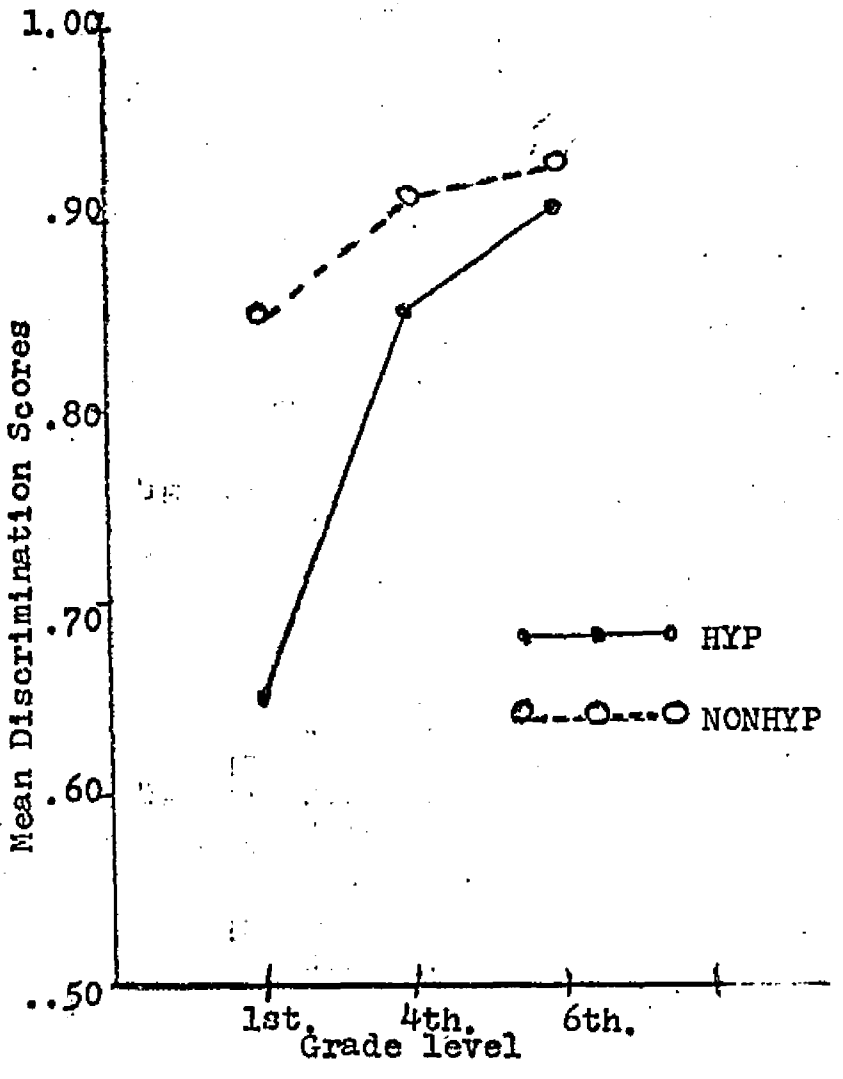

Fig. 11. Mean Discrimination scores for six groups under Block E3

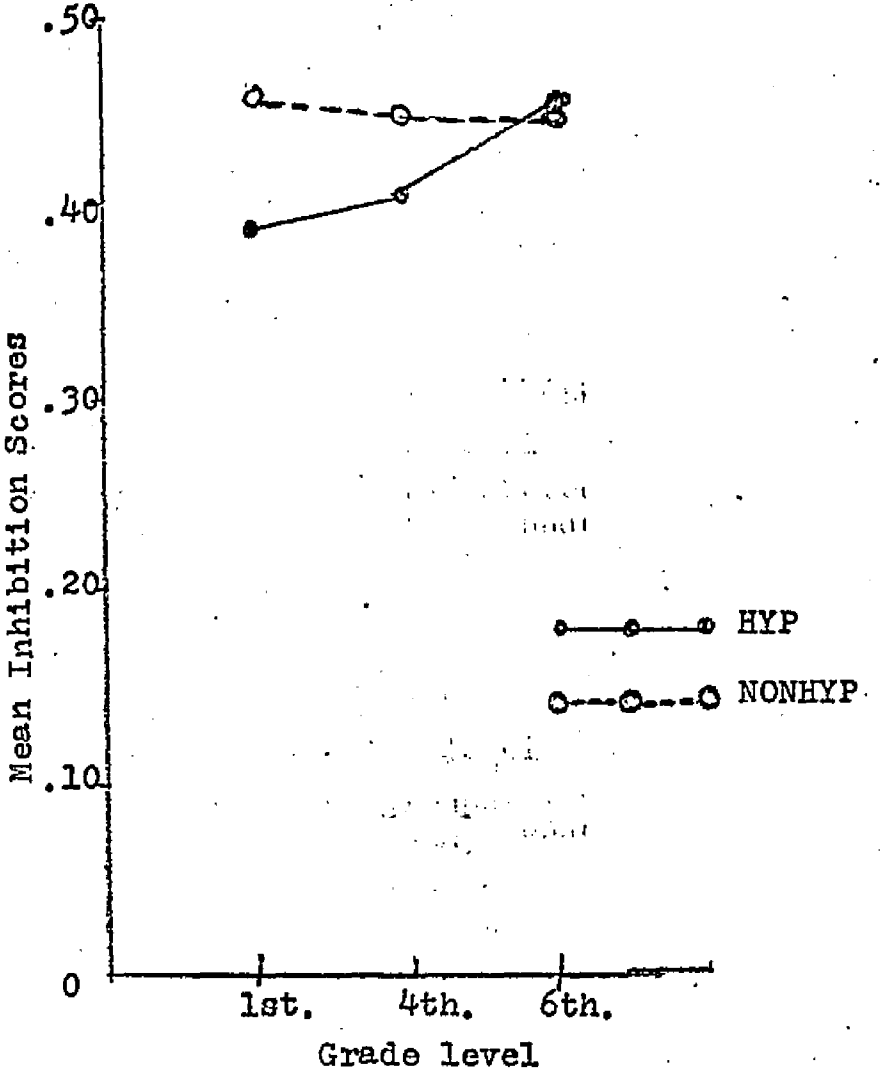

Fig. 12. Mean Inhibition scores for six groups under Block E3

Table 21

Summary of Analysis of Variance[1] of Discrimination Scores of Six Groups Under Three Levels of E Variable

Source	df	Mean Square	F
Total within	144		
E	2	.1860	33.2**
AE (HYP-NONHYP X E)	2	.0103	
BE (Grade X E)	4	.0098	
ABE	4	.1849	33**
Error	132	.0056	

** Significant at <.01 level

Table 22

Summary of Analysis of Variance[2] of Inhibition Scores of Six Groups Under Three Levels of E Variable

Source	df	Mean Square	F
Total within	144		
E	2	.0547	17.09**
AE (HYP-NONHYP X E)	2	.0041	
BE (Grade X E)	4	.0028	
ABE	4	.0683	21.3**
Error	132	.0032	

** Significant at <.01 level

[1]This is the within portion of a three-way analysis of variance with repeated measures on one variable. (Winer, 1962). The between portion appears in the presentation of results for groups.

[2]Ibid.

DISCUSSION

Discrimination and Inhibition Scores

The results on Discrimination and Inhibition scores have indicated that in school-aged children, (a) age is more important than hyperactivity as a determinant of discrimination ability, and (b) hyperactivity is more important than age as a determinant of impulsive responding. However, these findings appear only in the main effects of the two variables. The interaction between grade and hyperactivity presents a different picture, particularly with respect to the first grade groups. Therefore, the following discussion will deal, first, with the major trends in the variables of age and hyperactivity, and, second, with the interaction of these two variables.

The main effects of grade: Fourth graders had significantly higher Discrimination scores than first graders[1] but they did not have significantly higher Inhibition scores. This indicates that although the younger group made more errors (of both types) they did not necessarily make more "go" errors. This was due to the fact that the fourth grade hyperactive group made even more "go" errors (as

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[1]Unfortunately the stimuli presented a low ceiling of difficulty for most sixth grade subjects. This resulted in a considerably narrowed range of Inhibition scores. Moreover, the differences in age between first and fourth graders and fourth and sixth graders did not represent equal increments.

evidenced by their lower Inhibition scores) than the first grade non-hyperactive group. This inability of the fourth grade hyperactive group (relative to the first grade nonhyperactive group) to inhibit impulsive responding was also evident in the data on perseverative errors and adventitious movements and will be discussed more fully later.

The main effects of hyperactivity

Data for the total hyperactive and nonhyperactive groups (irrespective of grade) indicated that differences in impulsive responding were significant, but differences in discrimination ability were not. Although the hyperactive group had lower Discrimination scores than the nonhyperactive, the differences were not statistically significant and were not sufficient to explain the differences in Inhibition scores.

Interaction: The findings noted above must be qualified by virtue of significant differences in Discrimination scores which occurred between the two first grade groups. Here, the superior discrimination ability of the nonhyperactive group was not only evident in the data on group performances alone, but also was reflected in the scores on every level of all the stimulus variables. It thus appears that in these two groups which were selected on the basis of behavioral hyperactivity (rather than perceptual ability), there was a significant and unhypothesized difference in discrimination ability. This is paralleled in the significantly different scores obtained by these two groups on the reading readiness tests as well. This finding is not surprising however, since

it corroborates the evidence from clinical studies which indicates that there is a high correlation between hyperactivity and visuo-perceptive difficulties. (Anderson, 1963; Prechtl and Stemmer, 1962; Werry et al, 1964; 1966). However, the hyperactive groups at the fourth and sixth grade levels also obtained lower I.Q. scores than the nonhyperactive groups. (This was significant at > .01 level for the sixth grade).

These differences in standardized test scores would seem to imply that there is a relationship between hyperactivity and intellectual functioning. Maccoby et al (1965) have recently suggested that appropriate inhibition of motor activity may be related to intelligence. Although it is logical to assume that motoric impulsiveness and visuo-perceptive difficulties will handicap a child in the attainment of academic and intellectual skills, the specific relationship of poor inhibitory ability and intellectual functioning in hyperactive children has not yet been demonstrated.

Luria suggests that intellective ability can develop independently of the motoric reactive system, but that in "the cerebro-aesthenic" syndrome, the regulatory aspects of speech on the motoric system is not accomplished. Kendler and Kendler (1961; Kendler, 1963) have suggested the importance of verbal mediation in the solution of discrimination tasks. It is entirely conceivable that mediation processes related both to intellectual ability and inhibitory ability will prove to be the common denominator in linking these two areas of functioning.

One approach to the exploration of such a relationship might be to match hyperactive and nonhyperactive subjects for I.Q. scores, and in that way isolate the factor of poor inhibition of motoric impulsiveness. However, there is a correlation between hyperactivity and visuo-perceptive difficulty, and both of these factors can have an adverse effect on school achievement and on I.Q. scores on standardized tests. It would follow that a given I.Q. score for an older hyperactive child would reflect the extent to which he was able to compensate for earlier difficulties. Thus, equating for I.Q. would tend to operate more selectively in the upper grades than in the lower grades. Therefore, it would seem desirable to explore the relationships among verbal mediation, poor inhibitory ability and intellectual and perceptual functioning within a group of young hyperactive children. This might serve to "tease out" differences in responsiveness and behavior, as well as in the conditions which elicit these differences. A longitudinal follow-up could then indicate which patterns of behavior are altered with time (perhaps through compensatory means) and which are more persistent.

One facet of the performance of the first grade groups was contrary to expectations, however. The first grade hyperactive group obtained higher Inhibition scores <u>relative to their Discrimination scores</u> than did the nonhyperactive group.[1] This means that although

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[1]This is a function of the interdependence of Discrimination and Inhibition scores noted earlier. The scores for the two groups ar given below with the approximate lowest possible Inhibition score . r

the hyperactive group made more errors of both kinds than the non-hyperactive group, the proportion of those errors which were of an impulsive nature were fewer than in the nonhyperactive group.[1] The apparent ability of the hyperactive first grade group to inhibit responsiveness is even more evident in the data on the C variable. (Table 17). On C4 stimuli, the first grade hyperactive group obtained a Discrimination score hardly better than chance (.579) but an Inhibition score which was the highest for the four levels of the C variable (.480).

In an effort to determine the reasons underlying these unexpected findings, the profiles of individual performances of members of the first grade hyperactive groups was undertaken.[2] There were two subjects in that group whose scores were relatively low for Discrimination (below the mean of their group) but high for Inhibition. This indicates that those subjects made numerous "no go" errors but very few "go" errors. Analysis of their records of responding indicate that both of them had responded to C1, C2 and C3 stimuli with a

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the obtained Discrimination score:

Group	D score	Lowest possible I score	Obtained I score
Hyp	.765	.26	.442
Nonhyp	.901	.40	.458

[1]This would indicate that the significant difference in Inhibition score between these two groups was merely a function of the significant difference between the Discrimination scores.

[2]Individual profiles of subjects appear in the appendix.

preponderance of "go" responses (an expected performance for this group) but had made very few "go" responses to C4 stimuli. Moreover, despite the fact that the overall records of these subjects reflected a considerable number of adventitious movements, there were no such movements in response to C4 stimuli which indicates a substantial decrease of all forms of motoric responding to C4 stimuli.[1] This led to consideration of what characteristics of C4 stimuli and/or the first grade hyperactive group gave rise to this performance.

The C4 stimuli included one characteristic not present in other stimuli: the figures were placed in the periphery of the field, rather than in the center, so that the subject was required to scan the field. One possible effect of this placement might be that the task was rendered more difficult (as evidenced by the lower D scores) and some S's in the first grade hyperactive group may simply have "given up" because the task was beyond their ability. (This behavior is reminiscent of a catastrophic reaction). A second explanation relates to a speculative but intriguing theoretical premise that hyperactivity and distractibility may be the result of exploratory, stimulation-seeking behavior in an over-aroused organism. A state of over-arousal resulting from defective cortical inhibition might cause an organism to attempt a reduction of arousal level by seeking stimulation. In such a

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[1]A more detailed analysis of individual performance relative to this also appears in the appendix.

case, Hyperactivity would represent this sort of stimulation-seeking behavior. Multi-sense stimulation from the environment produced by such behavior eventually would induce cortical inhibition and reduce arousal level. Support for this notion might be derived from a number of investigations focussing on the arousal function of the reticular activating system and cortico-reticular inhibition of arousal (Magoun, 1963), as well as some clinical observations (Zuk, 1962; 1963) that hyperactive, brain-injured children exhibit marked attenuation of hyperactivity when viewing television or riding in moving vehicles. The concept of equilibrium in the state of arousal has been put forth by Berlyne (1960) as follows:

> There is an optimum influx of arousal potential. Arousal potential which deviates in either an upward or a downward direction from this optimum will be drive inducing or aversive. The organism will thus strive to keep arousal potential near its optimum. (Ibid, p. 194).

According to this formulation, the scanning of the stimulus configuration of C4 stimuli would provide proprioceptive stimulation thus reducing arousal level and motoric activity.

Regardless of the explanation for the effect of C4 stimuli, however, the fact remains that there are certain situations in which individual lability and group variability are heightened in young hyperactive children. Thus, ostensible similarities in overt behavior may, in fact, be due to a variety of patterns of neurological difficulties. Individual differences might be demonstrated with further refinements in

experimental techniques designed to elaborate these differences.

Perseverative Responding

Perseverative responding may best be described as the inappropriate persistance of a response pattern. (In the present study interest focused primarily on perseveration of motoric responses). The fact that only one subject made a perseverative "no go" error indicates that the tendency to make perseverative "go" errors was greater for all subjects. However, as indicated by the data, this tendency was much more evident in younger than in older groups, and in hyperactive than nonhyperactive groups. Moreover, the fourth grade hyperactive group made many more perseverative errors than the first grade nonhyperactive group, a fact which indicates that the hyperactive nine-ten year old subjects were less able to discontinue a motoric response pattern than six-seven year olds. This evidence supports the findings of Luria, noted earlier.

Adventitious Movements

Adventitious movements occurred during the response interval but were not necessarily in response to the stimuli. In this sense, such movements represent involuntary motoric activity rather than impulsive responding. The data on adventitious movements generally supports the findings on Inhibition scores and perseverative errors

with respect to age, hyperactivity and the similarity of performance between fourth grade hyperactive and first grade nonhyperactive subjects. (Where significant differences did not occur, the trend was in the predicted direction).

The conclusions apparent from the foregoing discussion are:

1. Within a regular school, since there is a sizeable number of children of normal intelligence who have many of the symptoms of the hyperactive impulse disorder. These children differ from their nonhyperactive contemporaries, not only with respect to overt behavior indicating a high activity level, but with respect to impulsive responding to particular stimuli, and their ability to discriminate certain stimuli. These differences in discrimination ability between hyperactive and nonhyperactive children are much greater in the first grade than in the fourth grade. Difference in impulsive motoric responding do not seem to decrease to the same extent in the older grade.

It might be tempting to speculate that discrimination ability in hyperactive children improves considerably between first and fourth grade but the ability to inhibit impulsive responding does not improve to the same extent. However, such a notion would fail to take account of the obvious fact that the fourth grade hyperactive group in the present study probably contained only those youngsters who were able to meet the demands of a regular academic program. It is conceivable that some subjects in the first grade hyperactive group might

subsequently have to be transferred into special remedial classes, because they could not meet those demands. Although the first grade groups in the present study had already been screened for overt signs of brain damage, mental retardation and emotional disturbance, it is obvious that the group was far more heterogenous than the fourth grade group. Those factors which influenced Discrimination scores and reading readiness scores may also influence subsequent educational achievement.

2. At the fourth grade level, hyperactive children are no more able (and sometimes less able) to inhibit impulsive responding than nonhyperactive first graders. This clearly supports Luria's conclusions as to the performance of older hyperactive and younger nonhyperactive children. Hyperactive children seem less able to stop a motoric response pattern once it begins. This is particularly true in the first and fourth graders.

3. Hyperactivity and impulsive responding to particular stimuli seem to be related because hyperactive children do respond more impulsively to stimuli than nonhyperactive children. However, this relationship is complicated with respect to the performance of first grade hyperactives by virtue of factors such as individual lability in performance, individual differences within the group and visuoperceptive difficulties.

These conclusions indicate only equivocal support for the first

two hypotheses in this study, and unfortunately do not resolve the question of the distinction between hyperactivity and impulsive responding. However, there is very clear-cut support for the third hypothesis, and for the contention that hyperactivity does reflect delayed development in the reactive motor system.

Distraction Variable

This variable was designed such that attention to irrelevant figures would result in more errors on D3 stimuli where irrelevant stimuli were misleading. This was the case in both first grade groups, indicating that younger subjects were more distracted by the irrelevant figures. However, expected differences between hyperactive and nonhyperactive groups failed to materialize. The failure of this aspect of the study to isolate or identify "distractibility" in hyperactive children relates to the problem posed earlier: What specific behavioral patterns does the term "distractibility" describe? Is distractibility an artificial construct? Can distinctions really be made among the behavioral patterns called distractibility, short attention span and impulsive responsiveness? There are several possible reasons why this study failed to provide answers to those questions in terms of the differences between hyperactive and nonhyperactive groups.

First, in this, as in other studies of the relationship between hyperactivity and distractibility, the distractors were identified as such by the experimentor based on his own estimate of what constitutes a distraction. For example, the relevant-irrelevant dimension in this study was just such an arbitrary designation, so that rather than adding a distraction to the stimulus field, it may simply have made the total stimulus pattern more complex.

Second, if it is assumed that the irrelevant figures constituted a distraction, and, as such, received undue attention, a measure of response latency might have been the best indication of this, rather than error score.[1] Third, the measurement of one gross motor response fails to take account of the separate components of the response pattern, such as autonomic measures, orienting reaction, eye movements and, as noted above, response latency. Studies of these response variables have been rare, particularly with regard to children of normal intelligence. Since distractibility remains an important descriptive term, high on the list of symptoms of the hyperactive impulse disorder, it should be explored further, with more refined and sophisticated techniques than those thus far employed.

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[1]It was an original intention to use latency measures as one of the response variables. However, during the course of the experiment, it was discovered that the recording equipment was functioning inconsistently, and therefore was not recording latency accurately. Although the data is available, it cannot be utilized for this reason.

Configuration Variable

There was no difference in Discrimination scores between the single geometric figure of C1 and the three dot pattern of C2, but all groups had more difficulty with discrimination of the three geometric figures on C3 and C4. The C3 pattern in particular, (where three geometric figures were grouped together) seemed to differentiate between hyperactive and nonhyperactive groups. This not only points up the differences in discrimination ability between these two types of children, but also helps to identify the type of stimulus that presents the most difficulty.

Exposure Interval

The one-second exposure interval in Block E3 made discrimination difficult for most subjects. This conclusion is supported by the lower Discrimination scores on that block in both first grade groups and in the fourth grade hyperactive group. In addition, the shorter exposure interval served to highlight the relationship between the fourth grade hyperactive and the first grade nonhyperactive groups. These two groups had almost identical Discrimination scores on E3 (Table 20) but the younger group had a significantly higher Inhibition score. This is a reflection of the consistent "nonimpulsive" behavior of the nonhyperactive first grade group.

The findings on the Configuration variable and those on the Exposure interval indicate that it would be interesting and instructive to explore some of the parameters of stimulation which elicit the greatest differences in performance between hyperactive and non-hyperactive subjects. Such an exploration could be invaluable to educators who are faced with the problem of planning the structure and content of curriculum appropriate to the individual needs of children.

SUMMARY

This study explored the relationship between visual stimulation and impulsive responding in hyperactive first, fourth and sixth graders of normal intelligence. Hypotheses predicted: (1) the ability to inhibit impulsive responding would be an increasing function of age, (2) hyperactive subjects would be less able to inhibit impulsive responding than nonhyperactive subjects and (3) older hyperactive subjects would respond in a manner similar to younger nonhyperactive subjects. In general these hypotheses received support from the data on a variety of response variables.

An unhypothesized but highly significant finding that hyperactive first graders evidence much poorer discrimination ability than nonhyperactive first graders also was reported and discussed in terms of its importance as an interacting variable.

The relationships between age, hyperactivity and several parameters of visual stimulation were also explored. Findings were reported and discussed in terms of possibilities for future research.

APPENDIX

Table A

RAW SCORES FOR FIRST GRADE HYPERACTIVE GROUP

Subject	Age	Reading Readiness Percentile	Discrimination	Inhibition	Adventitious Mvmnts.	Multiple Bursts	Failure to Break Response Set
1101	7-4	.66	.81	.41	9	1	2
1102	6-10	.50	.79	.39	2	0	2
1103	6-8	.84	.94	.50	3	0	0
1104	6-7	.54	.70	.36	30	15	2
1105	6-10	.45	.74	.49	4	0	2
1106	6-10	.27	.70	.50	21	7	1 (1)
1107	6-6	.75	.65	.51	16	4	1
1108	6-11	.52	.70	.44	7	1	1
1109	6-4	.45	.86	.47	12	0	2
1110	6-8	.39	.76	.31	8	1	2
1111	6-6	.41	.79	.37	6	3	2
1112	6-10	.31	.73	.50	8	2	0
Mean	6-7	.51	.77	.44	10.5	2.8	1.4

Table B

RAW SCORES FOR FIRST GRADE NONHYPERACTIVE GROUP

Subject	Age	Reading Readiness Percentile	Discrimination	Inhibition	Adventitious Mvmnts.	Multiple Bursts	Failure to Break Response Set
2101	6-11	.91	.77	.53	8	1	2
2102	6-7	.69	.92	.47	5	0	1
2103	7-1	.99	.92	.49	11	1	0
2104	7-1	.99	.96	.49	6	0	1
2105	7-3	.97	.94	.46	2	0	1
2106	7-4	.93	.92	.49	17	2	0
2107	6-11	.93	.85	.44	9	0	2
2108	7-4	.80	.94	.47	3	0	1
2109	6-10	.91	.88	.51	6	0	0
2110	6-9	.96	.97	.50	8	0	0
2111	7-3	.90	.96	.48	10	2	1
2112	6-9	none	.84	.48	9	0	0
Mean	7	.89	.91	.48	7.8	.5	.75

Table C

RAW SCORES FOR FOURTH GRADE HYPERACTIVE GROUPS

Subject	Age	Group I.Q. Score	Discrimination	Inhibition	Adventitious Mvmnts	Multiple Bursts	Failure to Break Response Set
1201	9-9	117	.85	.41	17	2	2
1202	9-10	109	.89	.44	10	3	1
1203	9-9	97	.95	.46	13	0	1
1204	10-1	94	.98	.50	4	1	1
1205	10	126	.89	.44	2	0	2
1206	9-8	111	.95	.47	5	2	1
1207	9-5	111	.93	.46	5	0	1
1208	10-4	108	.96	.48	5	0	1
1209	9-5	91	.89	.44	5	0	1
1210	10-4	97	.96	.48	1	0	1
1211	9-10	none	.89	.45	15	3	2
1212	9-5	119	.89	.44	7	3	2
Mean	9.8	107	.92	.46	7.5	1.2	1.3

Table D

RAW SCORES FOR FOURTH GRADE NONHYPERACTIVE GROUPS

Subject	Age	Group I.Q. Score	Discrimination	Inhibition	Adventitious Mvmnts	Multiple Bursts	Failure to Break Response Set
2201	9-10	none	.90	.45	10	0	1
2202	9-10	120	1.00	.50	5	0	0
2203	9-9	103	.90	.41	4	0	1
2204	9-11	108	.98	.50	4	0	1
2205	9-8	120	.95	.47	11	0	1
2206	9-10	124	.98	.49	0	0	0
2207	9-4	none	.96	.48	14	3	1
2208	10-4	117	.98	.49	0	0	1
2209	10	none	1.00	.50	5	0	0
2210	10-3	109	.90	.45	2	0	1
2211	9-4	none	.98	.49	3	0	1
2212	9-11	none	.92	.45	10	0	0
Mean	9-8	114	.950	.47	5.7	.25	.58

Table E

RAW SCORES FOR SIXTH GRADE HYPERACTIVE GROUP

Subject	Age	Group I.Q. Score	Discrimination	Inhibition	Adventitious Mvmnts	Multiple Bursts	Failure to Break Response Set
1301	12-3	92	.92	.47	3	0	1
1302	11-7	117	.91	.46	15	4	1
1303	12-5	96	.92	.47	7	0	0
1304	12-3	114	.99	.49	1	0	1
1305	11-7	126	.98	.49	20	2	0
1306	11-6	116	.92	.47	3	0	1
1307	12-5	none	.96	.48	3	0	2
1308	12-5	none	.97	.49	4	0	0
1309	11-8	112	.93	.47	1	0	0
1310	11-7	107	.98	.50	4	0	0
1311	11-6	107	.89	.47	13	0	2
1312	12	none	.94	.46	3	0	0
Mean	11-9	109.6	.948	.477	6.4	.5	.68

Table F

RAW SCORES FOR SIXTH GRADE NONHYPERACTIVE GROUP

Subject	Age	Group I.Q. Score	Discrimination	Inhibition	Adventitious Mvmnts	Multiple Bursts	Failure to Break Response Set
2301	11-6	none	.98	.49	1	0	1
2302	12-1	126	.98	.50	3	0	0
2303	11-4	120	.96	.49	6	1	1
2304	12-1	122	.99	.49	1	0	0
2305	11-9	126	.98	.49	2	0	0
2306	12-1	120	.96	.46	1	0	1
2307	12-1	120	.98	.49	1	0	0
2308	12-1	131	.96	.49	0	0	1
2309	12-1	105	1.00	.50	6	0	0
2310	12-1	129	.88	.43	5	0	1
2311	12-2	122	.94	.43	10	0	1
2312	12-4	none	1.00	.50	3	0	0
Mean	12	122	.97	.48	3.25	.08	.5

ORDER OF PRESENTATION OF STIMULI ON THE THREE BLOCKS OF TRIALS

The first small letter "s" or "d" indicates the sameness or differentness of relevant, black figures. The second small letter "s" or "d" indicates the sameness or differentness of irrelevant colored pictures. For example, the notation C1, D3 sd would indicate the first level of C variable, the third level of D variable, (black, relevant figures the same, but irrelevant colored pictures different). D1 slides will only have one "s" or "d" notation, since no irrelevant stimuli are present.

E1

Slide no.	C	D		Slide no.	C	D	
1	1	2	ss	13	3	1	s
2	1	1	d	14	3	3	ds
3	1	3	sd	15	3	2	dd
4	1	2	dd	16	3	1	d
5	1	3	ds	17	3	2	ss
6	1	1	s	18	3	3	sd
7	2	1	s	19	4	2	dd
8	2	3	ds	20	4	1	d
9	2	3	ds	21	4	2	ss
10	2	1	d	22	4	3	ds
11	2	2	dd	23	4	3	sd
12	2	2	ss	24	4	1	s

E2 * Indicates stimulus on which perseverative error could occur

Slide no.	C	D		Slide no.	C	D	
1	1	3	sd	13	1	2	dd
2	2	3	sd	14	2	3	sd
3	2	2	ss	15	4	3	ds
4	4	1	d	16	3	2	ss
5	3	2	dd	17	2	1	s
6	1	1	d	18	1	2	ss
7	2	2	dd	19	3	1	s
8	4	2	dd	20	4	1	s
9	1	1	s*	21	3	1	d*
10	3	3	ds	22	2	2	dd
11	4	2	ss	23	4	3	sd
12	3	3	sd	24	1	3	ds

E3 * Indicates stimulus on which perseverative error could occur

Slide no.	C	D		Slide no.	C	D	
1	2	3	sd	13	1	2	dd
2	1	3	ds	14	3	3	sd
3	3	2	dd	15	4	2	ss
4	4	3	sd	16	3	3	ds
5	2	3	ds	17	4	2	dd
6	2	1	s	18	3	1	d
7	1	2	ss	19	1	1	d
8	3	1	s	20	2	1	d
9	4	1	s	21	2	2	dd
10	3	2	ss	22	1	1	s*
11	4	1	d*	23	2	2	dd
12	4	3	ds	24	1	3	sd

Analyses of Response Patterns for C4 and E3

Three S's in the first grade hyperactive group (1106, 1107 and 1112) obtained Discrimination scores below the mean for the group, yet had very high Inhibition scores. The pattern of responding of these S's on C variable is as follows:

Subject 1106: On C1, C2 and C3, he responded with 61% "go" responses. On C4 responded with only 17% "go" responses.

Subject 1107: Responded with 59% "go" responses to C1, C2 and C3. On C4 reversed responses ("go" response to "no go" stimuli and "no go" response to "go" stimuli) on 88% of the stimuli.

Subject 1112: As in the case of 1106, he responded with 59% "go" responses to C1, C2 and C3 but with only 22% "go" responses to C4.

Records of subjects in the five other groups indicated that only one other subject (2101) in the 1st grade nonhyperactive group reacted to C4 by substantially reducing his "go" responses. Recalculation of the mean Inhibition score for 1st grade nonhyperactive group excluding that S did not reduce the mean to any appreciable extent and did not effect the relative superiority of this group of 1st grade hyperactive or fourth grade hyperactive groups.

The response patterns to E3 were also examined, since this had also proved a difficult condition. The findings were that: (1) whereas Inhibition scores on C4 for the first grade hyperactive groups were relatively high, Inhibition scores on E3 were relatively low and (2) Not a single subject in any group evidenced a preponderance of "no go" responses on Block E3.

THE CIRCULAR FOR TEACHERS REQUESTING NAMES OF HYPERACTIVE CHILDREN

Dear Teacher:

Below, is a list of behavioral characteristics which certain children have, particularly in the lower grades. Please read the list and write the names of any children in your class at the present time who might be described by the terms listed below. If many or most of the behavioral characteristics listed below apply, please include the child's name. It is not necessary that all apply.

distractible
short attention span
low frustration tolerance
moves about constantly
very fidgity
poor concentration
impulsiveness

Now would you please list the names of children in your class who are the opposite. In other words, children who seem to possess the following behavioral characteristics.

not easily distracted
reasonably long attention span
do not frustrate easily
able to sit still for reasonable periods of time
not fidgity
good concentration
not impulsive

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AUTOBIOGRAPHICAL NOTE

I was born in New York in 1929 and attended New York City public schools. I was graduated from Washington Square College, New York University in June, 1949 with honors in Psychology. Effective September, 1949, I was awarded a teaching fellowship at the University of Pennsylvania, where I began graduate work in Psychology. I was married in December of 1949 and subsequently found it necessary to return to New York to live. Therefore I had to terminate my position and studies at the University of Pennsylvania in January, 1950. I took courses in Psychology at Columbia and C.C.N.Y. during the next year, and finally left school in order to facilitate my husband's attendance at law school. Subsequently, until 1961, I spent time caring for my two children, now aged 16 and 12. During that time I was actively engaged in a variety of civic activities. I returned to school in 1961 as a matriculant in the School Psychology program at Queens College and received official state certification in June, 1965. While a student in the School Psychology program, I took several courses in the Psychology department both as a requirement for the School Psychology program and as preparation for my planned matriculation as a doctoral candidate in experimental psychology. For the last several years I have been employed part-time in the Educational Clinic at Queens College where I have assistant taught the Individual Intelligence Testing course in the School Psychology program and currently am teaching Educational