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ABSTRACT

A series of studies on hyperkinesis in learning disabled children conducted at Texas Tech University over the past 10 years is reviewed. The research is described to have included three phases: the development of a basic vigilance task for assessing hyperkinesis and attentional deficits (a computer controlled series of regularly occuring events to which students were asked to respond); attempts to modify or improve the vigilance performance of hyperkinetics (using knowledge of results); and the application of these results to a classroom setting. Basic procedures in the classroom application are said to include the provision of feedback when students are not attending to the task. Findings are described which indicate that feedback alone is sufficient to decrease the non-attending behavior of students with attention deficits and motoric restlessness. (CL)

The Assessment and Modification of Hyperkineses: A Review of Programmatic Research at Texas Tech University

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We have been involved with research in the field of Learning Disabilities at Texas Tech University for approximately ten years. My interest in the area started as an aftermath of earlier work with diagnositc and remedial problems which first emerged in 1960. Most of the studies over the years have been carried out as doctoral dissertations. The initial studies explored gross differences in multiple variables between LD's and normal children (Bean, 1967; Lewis, 1969; Bell, 1969). Other studies have examined concept formation (Parucka, 1972), the effects of psychotherapeutic intervention (McCollum & Anderson, 1974) differences between the chronically unemployed and employed (Condren, 1972), the development of the CGI Inventory to differentiate LD children on the bases of history (Chaney, 1973) and differences between schizophrenic adolescents with reading problems and those without (Gottlieb, 1972). In 1970 my colleague Dr. Charles Halcomb and I initiated a series of studies initially concerned with the exploration of a methodology for the measurement of attentional problems and/or for distractibility. Again a great deal of this work has been carried out by our doctoral students and is represented in their dissertations. It is this series of studies that we are going to review for you today.

The studies have been supported by the Graduate School and College of Arts and Sciences at Texas Tech. Our recent investigations are supported by generous grants from the Hogg Foundation for Mental Health, Austin, Texas.

In order to liven up the presentation we decided to make a visual presentation, hence, the slides. The time is some what limited so we are going to move along at a rather fast pace. Before proceeding I would like to acknowledge the contributions of Doyle (1976), Ozolins (1974), Mack (1975), Hopson (1975), and of course my young colleagues who have contributed to the development of this presentation.

The first phase of our work began with the development of a basic vigilance task for exploring the parameters of the distractibility/short attention span aspect of the MBD/LD syndrome. Vigilance performance may be defined as the behavior required to detect infrequently occurring signals over a prolonged period of time when those signals are embedded in a background of regularly occuring events. In the vigilance task, the child is instructed to monitor a series of events over time. A random series of signals are interspersed among these events. The child is instructed to respond only to the designated signals.

The vigilance task we developed is computer controlled and is housed in our University laboratory. In order to remove the sterile impression of a laboratory, a waiting room was constructed; the subject could not see the PDP8E Digital Equipment Corporation computer. The experimental booth was entered from the waiting area. The subject sat before a console in the 4' X 4' booth. A schematic of the booth depicts the task.

The subject was instructed to attend to a pair of flashing lights which appeared on the display. The task continued for 30 minutes. During this period there were 840 events, and 60 signals flashed at the rate of one each 2 seconds; the exposure was two tenths (.2) of a second. The events were red-red or green-green lights; the signals were designated by red-green (green-red) lights. The red-green signals were randomly dispersed within the 30 minute pre-set program. The child was instructed to push a button when a red-green light combination appeared. The handle bar grip with the response button is shown here.

When the child responds to the red-green combination he/she is credited with a correct detection (CD). Pressing the button to the red-red or green-green combinations is considered a false alarm (FA). It should be apparent that a subject must "pay attention" in order to achieve a high correct detection rate and must ignore the distracting light combinations.

The entire task is under complete computer control. Instructions were presented by means of an audio tape.

In the initial study (Anderson, Halcomb, & Doyle, 1973) we examined 30 LD boys, ranging in age from 8 to 11 years and 30 normal boys. As noted, the LD's were differentiated from the normals on both correct detections and false alarms. The LD's as a group had a lower CD rate and higher FA rate than the normals. Moreover, the LD's were differentiated into hypoactives, normoactives and hyperactives. The lowest CD rate and highest FA rate was found among our sample of hyperactives.

The next study (Doyle, Anderson, Halcomb, 1976) examined the effects of a visual distractor. A seven frame visual display was located to the lower left of the task display. A total of 15 sequences of vari-colored numerical signals were presented every 20 seconds throughout the 30 minute vigilance task. A total of 70 boys divided between LD's and normals were examined. The LD's were differentiated in terms of activity level. The differences between LD's and normals were still evident along with differences within the LD group. The slide shows these differences in terms of the false alarm variable. Most of the LD-normal differences were attributed to the hyperactive children. By the way, as noted previously (Doyle, et al, 1976; Anderson, 1975; Doyle, 1976) the hyperactives seemed to be aware of their susceptibility to the distraction. As noted through the booth observation window they tended to block off the distractor from view by shifting body position or putting a hand up as a blinder to cover the periphery of the left visual field.

We then examined the effects of an auditory distractor (Anderson, Halcomb, Ozolins and Hopson, 1974). Again a sample of LD and normal children were tested. This time two conditions were presented: random or white noise and classroom noise. The distracting noise was presented by means of a signal generator and audio tape. Due to increased difficulty in obtaining subjects we failed to signal out the S's in terms of activity level. Generally, the LD children made fewer correct detections under conditions of classroom noise than the normal controls. There were no differences between the groups under the white noise conditions. FA'a did not differentiate between the two groups.

Following these studies we decided to move to a practical application of the vigilance/distractibility task (Anderson, Halcomb, Gordon, Ozolins, 1974). If medication had a positive effect on attention span/distractibility, then this effect should be noted in response to the task. A small group of boys were tested twice, once while on meds and once while off. Most of them were on Ritalin (methylphenidate). The results demonstrated that CD's provided a measure of medication effects for the younger but not older group. The false alarm variable was affected by age but not drugs. Subsequently some of the pediatricians in our area have used the task as one means of assessing the need for meds and the effects of meds. Clinical data has demonstrated a marked difference in performance after meds are initiated. A lack of response to meds can also be objectively noted. Obviously, much more work needs to be done in this area but can best be carried out in a controlled medical setting.

The next phase of our studies was pushed forward by Ozolins (Ozolins, Anderson, & Halcomb, 1974). He reasoned that hyperactive were over aroused and lacking in inhibition; on the other hand, hypoactives were under aroused and inhibited responding. Time doesn't permit a detailed explanation. Ozolins reasoned that knowledge of the results of (KR+) CD's would increase response rate of hyperactives thus increasing errors while knowledge of FA's or errors, would encourage a more cautious type of responding. With the hypo's it was assumed that knowledge of CD's would enhance their performance by increasing their level of excitation; knowledge of FA's would increase their inhibition and slow them down even more.

The LD children were tested under three conditions:

1. Normal run - no knowledge of results
2. Knowledge of false alarms - provided by an auditory signal
3. Knowledge of correct detections - provided by an auditory tone.

The group was differentiated in terms of hyper's and hypo's. We have elected to summarize the results utilizing a Total Error (TE) measure derived from the number of CD's missed plus the total number of FA's. Note that the hyperactives show the highest error score under conditions of KR+, akin to positive reinforcement, and lowest error score under conditions of KR-, akin to telling the child when he/she is incorrect. The hypos showed improved performance under KR+ conditions and tended to slack off under KR-. An implication from these results is that certain "positively" reinforcing contingencies may have the effect of increasing hyperkinetic symptoms; inadvertently one may reinforce responding tendencies rather than teaching the child to inhibit responding.

Mack (1975) confined his study to hyperkinetics and normals. Knowledge of results conditions were varied from full knowledge of CD's at one end of the continuum to full knowledge of false alarms at the other end of the line. Again, note the results utilizing the total error variable. Under 2/3 KR- and full KR- the hyperactive children approached the performance of normals. As expected the total error score was lowest for the normals under KR+ but highest for the hyperactive LD's.

Our next step in the evolving programmatic series involved adapting these findings to a classroom situation. Thus, a series of studies are currently in progress utilizing the framework provided by Ozolins and Mack. Could we train hyperkinetic children to pay attention, using a feedback type of procedure? What would happen when children were given information for not paying attention? The procedure is related to Douglas' stop-look-listen method (1972).

Thus far three studies have been completed. The instrumentation and basic procedure was similar in each. We would like to acknowledge the contributions of Dr. William Jarzembski, Associate Professor of Bio-medical Engineering, Texas Tech University School of Medicine for developing the instrumentation.

A small 2" X 4" box with five functional light emitting diodes is placed on the child's desk. The light box is connected to a control unit capable of handling four desk light boxes. The master control unit, or magic box as we described it to the youngsters, is battery operated with time-counter displays, remote activation switches and reset buttons. When an LED box is activated, the timer starts counting in one second increments; when the LED is off the timer holds and then starts counting again when the light box is turned on. We can time non-attending from one second to as many hours as needed.

Procedurally, an experimenter/trainer works with four children. The LED box is turned on when the child is not paying attention. Thus, one experimenter/trainer controls the training sessions and can obtain a record of non-attending behavior (This can be turned around obviously so that a record is obtained of attending behavior). The children were told the purpose of the training, the rules, and how to chart their progress. Training sessions were one-half hour, five days per week. During the sessions the youngsters worked on busy work; we have switched to arithmetic assignments because of the relative ease of control. Each child maintained a chart of his progress from day to day. Thus, no concrete rewards were given. The rewards were intrinsic; the child could note he is doing "better."

We are going to summarize the findings very quickly, leaving out some details reported in previous papers. (Anderson, Sherman, Williamson, 1976A; Anderson, Sherman, Williamson, 1976B).

In the first experiment eight boys, ages 7-8, were chosen by their teachers as the most "hyperactive" children in their classrooms. The four most extreme cases, as perceived by the teachers, were designated the experimental group. Three of the four experimental children paid strict attention to their assigned work during the training sessions. From the very first training session, in fact, these three children consistently remained on task for more than 29 of the 30 possible minutes!

Independent observers rated classroom behavior of all 8 children both before and after the attention training. Statistical analysis of these ratings revealed no significant changes in classroom behavior after training for the experimental group; likewise, there was no change in the control group's classroom behavior as measured by independent observers. Teachers evaluations, however, indicated that members of the experimental group became more attentive and less distractible after training.

The second study was conducted to correct a few procedural errors. In this go around seven boys, ages 9-10, were referred by their teachers as hyperactive. These seven boys were tested on the vigilance task to verify the reported attentional deficit. The four boys who performed most poorly based on norm tables were selected as experimental subjects. These boys were then paired with "normal" control subjects of the same age in the same classroom.

Nonattending behavior in the experimental group significantly decreased during the training period ($F = 3.76$, $p < .001$). In addition, work output during training increased with no loss in work accuracy. In the classroom, however, no significant change in attending behavior occurred in the experimental group. For the control subjects this was not the case; the control group significantly increased their non-attending behavior in the classroom following the training period ($t = 3.37$, p .001). Since this increase in non-attending behavior coincided with the approaching holiday season, we labelled this phenomenon "the Christmas effect."

Sherman initiated a third study. Based on clinical observation and research, it was thought that potential hyperkinetics could be categorized as either 1) having an attentional deficit and motoric restlessness, or 2) having no attentional deficit but being motorically restless. While the vigilance task provided a measure of attention, the dimension of motoric restlessness presented a problem. It was resolved by developing a modification of Sprague's stabilimetric cushion which could provide a measure of motoric restlessness (Sprague and Toppe, 1966). The child sat on the cushion while attending to the vigilance task. The seat was hooked electronically into the PDP8-e computer vigilance program. Thus, three dependent measures were available to assess hyperactivity and/or attentional deficits; they were, correct detections and false alarms from the vigilance task, and seat-movements or an activity count from the stabilimetric cushion. Using these measures, two groups were identified among the total group tested. Group A included the kids with attentional deficits plus motoric restlessness; Group B included those who were just motorically restless. A third group C was also identified; these kids showed no evidence of motoric restlessness or of an attentional deficit. These "normal" children were included in the present study as a comparison group.

Using an operant design, the objective was to train children to pay attention in the classroom. All three groups of children were observed in their classrooms for five days; non-attending behavior was recorded during a half-hour math period. In order to demonstrate the functional control of the treatment, a short ABA phase was implemented. A five day baseline period was used to record the non-attending behavior of the experimental children under conditions similar to treatment conditions, i.e., the experimenters sitting near the children's study area. The experimental children again showed high rates of non-attending during this phase. The first treatment period was then implemented. During the three days of treatment the children received feedback concerning their non-attending behavior. This period was followed by a withdrawal of treatment, or extinction, phase during which conditions similar to the baseline period were reinstated.

During and following the three day treatment period, the experimental children displayed a significant decrease in non-attending behavior. However, they were still significantly more non-attentive than the Group C children.

After the ABA phase and a second observation of the groups, the final baseline and treatment periods were started. The experimental children again displayed a high level of non-attending behavior under baseline conditions. The final treatment period lasted 13 days. After this treatment period, the experimental and control children were observed for five days.

The preliminary results indicated that feedback alone is sufficient to reduce the non-attending behavior of children identified as having an attentional deficit plus motoric restlessness. Observations indicated that as a group, the experimental children showed a significant reduction in non-attending behavior ($X^2 = 10.47$, $p < .001$).

Where do we go from here? Our next series of studies are going to move us into rural school settings. We are adapting the vigilance task to a mobile lab. This slide shows a schematic of the trailer. We are simplifying the equipment for the vigilance task so the PDP8E won't be necessary. Since some other studies, not reported here, have demonstrated possible cultural differences in regard to hyperkinesis, we intend to try our procedures with youngsters from diverse cultural and/or ethnic backgrounds. Finally, one may well ask, have the children really learned to pay attention?

Our evidence does suggest that they appear to do better, without medication, and that the effect has some staying power. We think we've demonstrated that children can assume some degree of responsibility for controlling their own behavior. This is our ultimate objective -- to help children cope with their own behavior and assume increasing self control.

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