THE DIFFERENTIAL EFFECTS OF VISUAL BACKGROUND AND FATIGUE ON AUTOMATIZED TASK PERFORMANCE IN LEARNING DISABLED AND NORMAL CHILDREN

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CHAPTER I

INTRODUCTION

Although the term "learning disabilities" is of recent origin, the thinking underlying it is not. Learning disorders have been a source of interest since the 1890s (Hinshelwood, 1895; Kerr, 1897; Morgan, 1896). In 1896, Morgan coined the term "word-blindness" when he reported the case of a lad, aged 14, who was bright, intelligent, yet unable to learn to read. From that time, the paradox of adequate capacity and inadequate performance has led to an abundance of diagnostic labels, such as strephosymbolia (Orton, 1925), Strauss Syndrome (Strauss & Lehtinen, 1947), hyperkinetic syndrome (Laufer & Denhoff, 1957), cerebro-asthenic syndrome (Luria, 1961), and minimal cerebral dysfunction syndrome (Bax & MacKeith, 1964). Despite the variety of labels, similar behavioral signs and symptoms often emerge. The ten characteristics of a child with a learning disability most frequently cited are: hyperactivity, perceptual-motor impairments, emotional lability, general coordination deficits, disorders of attention (short attention span, distractibility, perseveration), impulsivity, disorders of memory and thinking, specific learning disabilities (reading, arithmetic, writing, spelling), disorders of speech and hearing, equivocal neurological signs and electroencephalographic irregularities (Clements, 1966). From the similarities of the various syndromes, the concept of learning disabilities--or the medical equivalent, minimal brain dysfunction--has recently evolved to encompass the heterogeneous group of children who display one or more of the above characteristics and whose academic problems cannot be accounted for by: a lack of intelligence; primary sensory, motor, or emotional disorders; or lack of environmental stimulation (Clements & Peters, 1962). The most widely accepted definition is the following formulated by the National Advisory Committee for the Handicapped:

> Children with special learning disabilities exhibit a disorder in one or more of the basic psychological processes involved in understanding or in using spoken or written language. These may be manifested in disorders of listening, thinking, talking, reading, spelling, or arithmetic. They include conditions which have been referred to as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, developmental aphasia, etc. They do not include learning problems which are due primarily to visual, hearing, or motor handicaps, to mental retardation, emotional disturbance, or to environmental disadvantage (USPHS, 1969).

In spite of the apparent consensus among clinical reports (Benton, 1962; Birch, 1964; Bradley, 1957; Burks, 1960; Clements & Peters, 1962; Denhoff, Laufer, & Holden, 1959; Ingram, 1956; Johnson & Myklebust, 1967; Paine, 1962; Strauss & Lehtinen, 1947) and behavior ratings of teachers and parents of children with learning disabilities (Keogh, Tchir, & Windeguth-Behn, 1974; McCarthy & Paraskevopoulos, 1969; Paraskevopoulos & McCarthy, 1972) that common characteristics are observed in these children, the absence of a fixed pattern of behavior and deficits which would be manifest by <u>all</u> children with learning disabilities has been a source of no small amount of confusion in dealing with this type of disorder. Empirical efforts have focused on a search for underlying commonalities in pathology, etiology, or response to remediation. Some authors state that the basic deficit, fundamental to other behavioral characteristics attributed to these children, is impaired perceptual functions (Birch, 1964; Frostig, LeFever, & Whittlesey, 1961), while others contend that attentional deficits (Dykman, Ackerman, Clements, & Peters, 1971) or distractibility (Cruickshank & Paul, 1971) are the cardinal symptoms basic to the specific disability exhibited by the child. However, the results of research studies have yet to establish the validity of a general and pervasive behavioral or cognitive trait which differentiates children with learning disabilities from normal children.

It appears that no characteristic of learning disabled children is either unique to the population or exhibited within the population in all situations. The findings that children with learning disabilities were able to perform as well as normal controls on a visual discrimination learning task under a distracting peripheral visual stimulus condition (Browning, 1967); on a simple auditory discrimination task (Doehring & Rabinovitch, 1969); and on an attention demanding task under a constant stimulus condition (Atkinson & Seunath, 1973) suggest that there are circumstances under which these children do not demonstrate the attributed behavioral or cognitive deficits. Observations of classroom behaviors lend further support to this contention (Bryan, 1974; Bryan & Wheeler, 1972; Werry & Quay, 1969). Bryan (1974) conducted an observational analysis of classroom behaviors and found that while the learning disabled children spent significantly less time engaged in task-oriented behavior in the regular classroom, the reverse was true when they were in sessions with the learning disability specialist. The implication was that attending behavior is situation specific.

Thus, it seems that an area worthy of investigation is the interaction of the learning disabled child's approach to problem solving with the type of task and environmental condition. Although clinical data suggest that children with learning disabilities have a pervasive trait of "distractibility" or "short attention span," there are indications that the child's performance on a task under distracting conditions is a function of the degree of match between the requirements of the task and the cognitive style of the child. The purpose of the present study is to investigate the learning disability child's approach to problem solving while performing automatized tasks in differing environmental conditions.

CHAPTER II

REVIEW OF THE LITERATURE

Automatization Cognitive Style

The distinctive ways in which the individual perceives and deals with his world have been described as "cognitive styles" (Klein, 1951). Essentially, the concept of cognitive styles views cognition as an active process which is influenced by motivational and personality factors. That is, the manner in which an individual receives, processes, and responds to environmental stimuli is governed not only by the nature of the stimuli but also by the past experiences of the individual. It is assumed that cognitive functioning, life experiences, and personality makeup are intimately interrelated.

Cognitive styles are thought to reflect individual differences in the approach one takes to a new problem rather than differences in intelligence or in specific cognitive abilities. Recent data have related problem solving to several cognitive styles, among them, individual differences in the speed of decision making (Kagan, 1966; Kagan, Rosman, Day, Albert, & Phillips, 1964); the ability to structure a stimulus field (Witkin, 1959; Witkin, Dyk, Faterson, Goodenough, & Karp, 1962); and the ability to respond rapidly to simple repetitive tasks, ignoring distracting and contradictory clues (Broverman, 1960; Broverman, Broverman, & Klaiber, 1966; Klein, 1954; Santostefano & Paley, 1964;

Santostefano, Rutledge, & Randall, 1965). The particular style or approach employed in a problem solving situation appears to depend upon the nature or demands of the task and to be a pervasive aspect of the individual's problem solving behavior.

The essence of the automatization cognitive style is the ability to concentrate and persist while performing simple repetitive tasks (Broverman, 1960; Broverman, et al., 1966). This style appears to reflect differences in the ability to over-learn routine material. Broverman, et al. (1966) define automatized behaviors as those

> .....which have been so well practiced and over-learned that a minimum of conscious effort is required for their successful, efficient execution. Such behaviors include the bulk of everyday activities, e.g., maintaining one's balance, walking, writing, reading, talking, maintaining perceptual constancies, etc. (p. 419).

The phenomenon of automatization (practice effect) has been a confounding problem to researchers for a number of years. Introspectionists, studying attention processes, noted that with repeated performance of a task the act tended to fade from consciousness (Ach, 1905). Ford (1929), in a study of this process, noted the change toward more efficiency in each successive trial of a learning task and concluded that there was a transition from attention to automatization. He found that distraction became less disruptive over time, and interpreted this as habituation obeying the same law of automatization as acquisition. Ford, further, postulated that the function of learning is to reduce the amount of attention required for the performance of a given task in order to make more attentional energies available for the attainment of new behaviors.

Bryan and Harter (1899) conducted a series of studies on the acquisition of telegraphic skills. They formulated a "Hierarchy of Habits" theory which held that the ability to automatize a given task may be a prerequisite to the acquisition of new higher level habits in which lower level automatized habits are sub-units. They felt that the ability to automatize successively ever more complex levels of behavior can result in an escalation of the general level of intellectual functioning.

Indices of strong versus weak automatization ability have been derived from an individual's speed of response to a stimulus involving overlapping and conflicting stimuli. The most frequently used instrument has been the Stroop Word Color Interference Test (Stroop, 1935; Jensen & Rohwer, 1966) which consists of three cards: (A) speed of reading repeated color names; (B) speed of reading color hues; (C) word-color interference. The derivations of the indices have varied depending upon the definition of strong and weak automatizers. Broverman's (1960) early conceptualization of a strong automatizer was one who responded more rapidly to task-relevant while ignoring task-irrelevant stimuli (Card C) than would have been predicted from the speed of response to a simple repetitive task (Card B). A weak automatizer was one who responded more slowly than predicted.

Using the above formulation of strong versus weak automatizers, Broverman (1960) sought to determine if cognitive styles are uniquely related to certain classes of behavior. Strong versus weak automatizers and conceptually versus perceptual-motor dominant subjects were compared while performing conceptual and perceptual-motor concentration demanding tasks (difficult arithmetic problems and tracing a difficult pattern) and conceptual and perceptual-motor automatized tasks (simple addition problems and tracing a straight line) under conditions of verbal, motoric, and no distractions. Broverman found that the automatization cognitive style was only manifest in well-learned behaviors regardless of whether the task was conceptual or perceptual-motor in nature. Further, the conceptual versus perceptual-motor cognitive style was limited to conceptual and perceptual-motor tasks which were novel, difficult, or demanded concentration. There were no differences between the four groups in the performance of any of the tasks under the no distraction condition. Broverman concluded that an individual's performance on a task under distracting conditions is not a function of some overriding trait of "distractibility" but more a function of both the requirements of the task and the cognitive style of the individual.

Broverman (Broverman, 1964; Broverman, et al., 1966; Broverman, Vogel, Broverman, Palmer, & Klaiber, 1964) later came to view the automatization cognitive style as an expression of intraindividual variation in abilities and redefined strong automatization as

> .....performance of simple repetitive tasks faster than might be expected from the individual's general level of performance. Conversely, performance of such tasks slower than might be expected from the individual's general level of performance is termed Weak Automatization (Broverman, et al., 1966, p. 420).

From this point, automatization cognitive style indices were derived from ipsative scores, i.e., the differences of the individual's normalized scores on each task from his mean level of performance on a battery of heterogeneous cognitive tasks. The Stroop Word Color Interference Test was included in the battery and loaded positively on the automatization factor.

Broverman, et al. (1966) assessed the validity of the newly formulated automatization index to predict an individual's performance on an originally novel but intrinsically simple task. Twenty cognitive tests, used to compute cognitive style indices, were administered to 50 male undergraduates. The subjects also solved a series of coded addition problems during each of four distributed practice and three massed trials followed by a cue reversal with another four distributed practice and three massed trials. They found that the subject's classification by the automatization index, i.e., strong or weak automatizer, did not predict his performance when the novel task was first presented nor during the first distributed practice trials, but it did predict his performance during the massed practice trials and the cue reversal trials. Strong automatizers were less affected by fatigue and better able to learn responses of cues whose significance had been reversed than weak automatizers. Broverman, et al. concluded that resistance to fatigue was a critical factor and plays an important role in the development of the differential abilities of strong and weak automatizers. It follows that if extended practice is necessary for a behavior to be automatized, then a given response must occur repeatedly for automatization to take place. Thus, if an individual fatigues readily, certain behaviors will tend to occur infrequently and automatization of these behaviors will be difficult.

Other work of Broverman and his associates has been directed toward determining the physical and social factors related to the automatization cognitive style. Using the automatization indices derived from ipsative scores and correlation analyses, they found that male strong automatizers appear to mature earlier, to have more body hair, to be more mesomorphic in physique, and to have higher levels of androgen (Broverman, et al., 1964). Adult, normal, male strong automatizers have been found to have more effective life styles, economic and social, and to have higher level occupations than weak automatizers, matched for age, education, and general level of ability (Broverman, 1964).

Santostefano (1964) conducted a study to determine whether test methods could be devised to measure in children the cognitive styles which had been identified in adults and whether these cognitive principles could differentiate among populations of children who assumedly had different life experiences and personality development unique to each. The Fruit-Distraction Test, which is similar to the Stroop Word Color Interference Test, was devised as a measure of the constricted-flexible cognitive style. Santostefano defined flexible control as the ability to selectively withhold attention from intrusive information and not be disrupted by it, while constricted control was seen as the inability to avoid response to the nonrelevant stimuli resulting in disruption of the central task (Santostefano, 1964, p. 214). The method of measurement and conceptualization of constricted-flexible control is similar to Klein's ideas (1951, 1954) and Broverman's (1960) thoughts of the automatization cognitive style. The strong automatizers (flexible control) have been found to be less distractible and better able to inhibit responses to nonrelevant stimuli than weak automatizers (constricted control).

The Fruit-Distraction Test was administered to 44 brain damaged children, 38 orphaned children, and 44 public school children, mean ages 11 years, 9.5 years, and 10 years, respectively. It was found that this procedure differentiated among the groups, the orphaned group being more constricted, the public school group being more flexible, and the brain damaged group falling between. An analysis of covariance, with intelligence the controlled variable, yielded the same results, suggesting intelligence is not a critical factor. This finding is consistent with the findings reported by Jensen and Rohwer (1966), Santostefano, et al. (1965), and Hurwitz, Bibace, Wolff, and Rowbotham (1972).

Santostefano and Paley (1964) studied the developmental course of two cognitive styles, focusing-scanning and constricted-flexible. Three age groups (6, 9, and 12 year-olds), each comprised of 10 boys and 10 girls matched for intelligence, were randomly selected from a public school. The findings indicated the two cognitive controls do operate in children and reflect a developmental course from scanning to focusing and constricted to flexible with an increase in age. The progression on the constricted-flexible dimension was from attending to peripheral information to withholding attention from all information except that which was central. No sex differences were found which is contrary to findings of other investigators (Gardner, Holzman, Klein, Linton, & Spence, 1959; Broverman, Klaiber, Kobayaski, & Vogel, 1968; Witkin, et al., 1962). Broverman, et al. (1968) found that females were stronger automatizers than males, i.e., females were superior in tasks that required speed and accuracy in repetitive responses. They conclude that these cognitive sex differences are related to underlying physiological factors, in particular, the sex steroid hormones.

Automatization Abilities of Children With Learning Disabilities

The ability to automatize appears to be an important aspect of acquiring ever more complex behaviors, irrespective of intellectual or cognitive abilities. Combining this with the requirement that a child perform over-learned repetitive tasks under distracting conditions as part of the daily activities in the classroom, the description of a child who is a weak automatizer would be one who lags behind his peers in learning new concepts or skills and is unable to sustain attention on simple tasks. Such a description matches the classroom observational reports of children with learning disabilities. The characteristics listed from clinical data further support the assumption that learning disabled children are weak automatizers. Logically, a child who has not as yet automatized his basic motor or perceptual skills would find it extremely difficult to master the complex behavior of writing or reading.

Empirical evidence in support of this assumption is sparse. First, there is a paucity of research studies and, secondly, the definitions of the samples in research studies of learning disabilities are inconsistent, being either overly general, e.g., children who are 1½ or more years below grade level on a standardized reading achievement test, or excessively specific, e.g., hyperactive children, reading disabilities. To generalize the findings of these studies to the heterogenous group of children classified as learning disabilities within the schools is certainly risky. However, if weak automatization is pervasive within this group, it is felt that regardless of the defined population, this characteristic should be apparent.

In examining three cognitive styles (focusing-scanning, leveling-sharpening, and constricted-flexible), Santostefano, et al. (1965) compared 24 boys with reading disabilities (mean age 10.94) and 23 boys without reading problems (mean age 9.91) on their performance on the Fruit-Distraction Test. They found that only the constricted-flexible control distinguished between the two groups. The reading disabled were unable to withhold attention from the intrusive or contradictory information and were more distracted by it.

Campbell, Douglas, and Morgenstern (1971) perceived the problem of poor school performance of hyperactive children as the type of cognitive style which they typically employ in problem solving and which differentiates them from normal children. A study was conducted to investigate four cognitive styles (reflection-impulsivity, field dependence-independence, automatization, constricted-flexible control) of children diagnosed as hyperactive and the effects of methylphenidate (ritalin) on the cognitive style of these children. In the comparison of 19 hyperactive and 19 normal controls, matched on age (mean 7 years 9 month), sex, socio-economic level, and WISC I.Q., the hyperactive were significantly more impulsive, field-dependent, and weak automatizers, but there were no significant differences on the constricted-flexible control dimension. However, the performances of the hyperactive children on the constricted-flexible measurements were in the direction of more constricted control than that of the normal subjects. The lack of significance was perhaps the result of young normal children tending toward constricted control as reported in the developmental study of Santostefano and Paley (1964).

Each hyperactive subject served as his own control in a double-blind drug placebo design. Campbell, et al. (1971) found the only effect of methylphenidate was that the hyperactives were more reflective under the drug condition. The lack of effect on automatization behaviors is at variance with other studies. In adults, automatization behaviors were stimulated by amphetamine and caffeine (Broverman, et al., 1968; Hollingworth, 1914) and depressed by chlorpromazine (Broverman, et al., 1968). A possible explanation is that stimulants have different effects on hyperactive children than on adults (Laufer, 1971)--that is, they do not act as stimulants. The inability of methylphenidate to change automatization abilities in hyperactive children perhaps explains why, although stimulant drug studies have consistently reported improvement in such behaviors as hyperactivity, short attention span, and impulsivity (Conners, Eisenberg, & Barcai, 1967; Conners, Eisenberg, & Sharpe, 1964; Denhoff, Davids, & Hawkins, 1971; Knights & Hinton, 1969; Steinberg, Troshensky, & Steinberg, 1971), they have not reported improvement in academic performance on such tasks as reading and spelling (Conners, Rothschild, Eisenberg, Stone, & Robinson, 1969; Freeman, 1966).

In an effort to delineate the factors underlying the hyperactive's continuing academic retardation in spite of reported decrease in hyperactivity and distractibility with the onset of adolescence (Laufer, 1962; Weiss, Minde, Werry, Douglas, & Nemeth, 1971), Cohen, Weiss, and Minde (1972) replicated the Campbell, et al. (1971) study with teenagers who five years previously had been diagnosed as hyperactive. They found the 20 hyperactive boys (mean age 15.0 years) were significantly more impulsive and field-dependent than the normal controls (mean age 15.1 years), matched on age, I. Q., and socio-economic class. The Stroop Word Color Interference Test was used to measure both the dimensions of automatization and constricted-flexible control, and the measurements of the performance of the two groups were similar. Cohen, et al. (1972) offered the explanation that by adolescence, color naming and reading of color words are highly over-learned skills. Theoretically, this should not be a factor. Perhaps a more plausible explanation is that the raw scores on the Stroop Word Color Interference Test are not sensitive measurements for differentiating the automatization abilities between groups. At least for adults and possibly for teenagers, this test appears to be more appropriately used in a battery of cognitive tests to compute an individual's automatization index, i.e., an individual's performance corrected for his general level of ability (Broverman, et al., 1966). It is also possible that there was no difference in automatization abilities or constricted-flexible control between these two groups, and if the hyperactive group ever were weaker automatizers, they had overcome the developmental lag. This would be an acceptable explanation based on the developmental findings of Santostefano and Paley (1964), but Broverman's contention that an individual is constitutionally a weak or strong automatizer, and one does not start off weak and develop toward stronger automatization, would refute such a conclusion.

Comparing delinquent boys, boys with learning problems, and normal boys on a broad spectrum test of motor development, Hurwitz, et al. (1972) found that the two clinical groups performed consistently poorer than normal subjects on the tasks demanding temporal sequential organization, i.e., rhythmical repetition. Based on these findings, they assumed that the two clinical groups were identical and labeled differently due only to differences in socio-economic class. Thus, in a more detailed comparison of temporal sequencing and spatial abilities, they contrasted only 13 delinquent boys (mean age 11.67 years) with 13 normal boys (mean age 11.33 years). Hurwitz, et al. contended that tasks requiring the automatization cognitive style are analogous to measures of sequencing ability. Therefore, tapping measures and automatization measures (naming repeated objects, The Stroop Word Color Interference Test) were obtained to determine sequencing skills, while perceptual restructuring tasks (memory for designs, visual-motor integration, etc.) were used for measures of spatial abilities. The delinquent boys were significantly slower on the tapping and automatization tasks than the normals, with no differences found between the two groups on the spatial ability tasks.

Along this line, Rugel (1974a) reviewed 25 studies which reported WISC subtest scores of disabled readers and/or learning disabilities. The subtests were reclassified according to Bannatyne's (1968) categories of Spatial (Block Design, Object Assembly, and Picture Completion), conceptual (Comprehension, Similarities, and Vocabulary), and Sequential (Digit Span, Coding, and Picture Arrangement), and the disabled learners and normal controls were ranked as to their relative strength in these three categories. No significant pattern was found in the normal groups. The disabled children showed a significantly consistent pattern of Spatial>Conceptual>Sequential. Although Rugel was working with group means, the ranking of the category in relation to the group's performance on the other subtests is similar to Broverman's (1966) thinking of automatization abilities in relation to the individual's other cognitive performances. Broverman, et al. (1966) also ascertained that the automatization factor loaded positively on naming repeated objects, reading color hues, word-color interference, reading color names, and naming unrepeated objects and loaded negatively on WAIS Block Design, Object Assembly, Similarities, and the Witkin Embedded Figures Test. A weak automatizer would be expected to perform better on spatial tasks than his performance on sequential tasks.

Factor analytic studies of the WISC subtest scores have consistently found a verbal factor which corresponds to Bannatyne's Conceptual category and a spatial-performance factor which corresponds to Bannatyne's Spatial category. However, the subtests which load most consistently on the Sequential category have been found to be Digit Span, Coding and Arithmetic, particularly in brain-damaged, emotionally disturbed, retarded, and disabled reader populations (Baumeister & Bartlett, 1962; Bortner & Birch, 1969; Rugel, 1974b). Picture Arrangement appears to be unrelated to Digit Span and Coding and loads most often on the spatial factor. Bortner and Birch (1969) felt that Digit Span, Coding, and Arithmetic loaded on a distractibility or memory factor, and Glasser and Zimmerman (1967) believed that the Digit Span and Arithmetic subtests measure the ability to attend. Dykman, et al. (1971) found that the subtests which best differentiated learning disabled children from normal controls were Digit Span and Arithmetic. Based upon the preceding evidence, it appears that children with learning disabilities tend to be weak automatizers.

The Effects of Distraction and Fatigue on Attending Behavior

There is research evidence in support of the viewpoint of defective attention as central to children with learning disabilities (Anderson, Halcomb, & Doyle, 1973; Boydstun, Ackerman, Stevens, Clements, & Dykman, 1968; Dykman, Walls, Suzuki, Ackerman, & Peters, 1970; Silverman, Davids, & Andrews, 1963; Stevens, Boydstun, Dykman, Peters, & Sinton, 1967), but there are also empirical studies that refute these findings (Alwitt, 1966; Atkinson & Seunath, 1973; Browning, 1967a; Carter & Diaz, 1971). These equivocal findings appear to have resulted as much from the aspect of the attentional process, e.g., distractibility, alerting, vigilance, that was under study as from the nature of the task, measurements taken, and distracting conditions imposed. Because of the differential effects of distractibility and fatigue on weak and strong automatizers, the attentional studies reviewed will be classified under studies of distractibility and studies of attention span.

Studies of Distractibility

Investigators who have questioned the hypothesis that children with learning disabilities are more distractible than normals, have used one of two types of distracting conditions, stimuli peripheral to the task or stimuli within the task. For the most part, the distracting stimuli have been visual, but a few studies have used auditory distractors.

Silverman, et al. (1963) compared the performance of 10 underachievers (mean age, 15.5 years) and 10 high-achievers (mean age, 16.3 years) on the Stroop Color-Word Test. The measurements were time required to name the 100 colors (no-distraction task); time required to read the names of colors, printed in ink other than the color indicated, on the first and fifth trials (distraction task); and number of errors made. High-achievers required less time and made fewer errors on both tasks. In an effort to determine the effects of distraction, the group differences in speed of performance on the no-distraction task were statistically partialled out. No differences were found between the two groups on the first trial of the distraction task, but the high-achievers performed with significantly greater speed on the fifth trial. Silverman, et al. concluded that high-achievers have the ability to respond more rapidly and accurately than their underachieving peers. Further, that when the influence of rapidity of response was removed, the underachiever appears to have the same ability to attend in the face of distraction as the high-achiever; however, he lacks the ability to improve with practice. Thus, although the two groups do not appear to differ in terms of powers of attention, there does appear to be a difference in their ability to persist in the exercise of attention.

Using a non-reading variation of the Stroop Color-Word Test, Alwitt (1966) compared 18 children with reading disability and 18 individually age-matched normal readers on four measurements, time to name a set of black on white pictures, to name colored circles, to name the pictures in appropriate colors, and to name the pictures in inappropriate colors. The reading disability group was slower than the normals on all measurements, but these differences did not reach significance.

There was a significant interference effect in both groups, the mean time to name the pictures in inappropriate colors being longer than the time to name the items in appropriate colors. Alwitt concluded that children with reading disabilities are no more distracted by competing elements in the stimulus field than are normal readers, and although disabled readers are deficient in a temporal aspect of attention, as measured by digit span tests, they do not appear to be deficient in a spatial aspect of attention, as measured by this study.

In a study to determine the effects of varying degrees of visual and auditory background distractions on a reading performance task, Carter and Diaz (1971) administered three reading achievement tests to 42 learning disability and 42 normal sixth grade boys. The three distracting visual stimuli were within the reading material, progressing from one-fourth of the total page to the total page to the total page with a light green jigsaw puzzle as background. The three auditory distractions were peripheral and progressed from silence to low simulated (taped) typical classroom sounds to louder taped classroom sounds. Neither the learning disability group nor the normal group showed any significant change on reading achievement scores under any of the nine experimental conditions. Carter and Diaz (1971) felt that these results should raise questions about the assumptions of short attention span and distractibility as characteristic of children with learning disabilities.

Browning (1967a) compared the performance of 54 children with learning disabilities with that of 54 normals while learning three-choice discrimination problems, both with and without the distracting condition of task-irrelevant peripheral visual stimuli (flashing lights). Each correct response was reinforced with candy corn, and the measurement taken was the number of trials to attain the criterion of 10 consecutively correct responses. It was found that when differences in intelligence level were controlled statistically, there were no differences among the four groups. Atkinson and Seunath (1973) suggested that Browning's findings resulted from the use of stimuli peripheral to the task of the distracting conditions. Thus, they investigated the possibility that learning disabled children are distracted by stimuli within the task. Eighteen boys with learning disorders were compared with 18 normal boys on an attention demanding task, which required the children to make a push-button response whenever a dark dot appeared on the red square in an array of 12 squares. Performance (errors of omission, errors of commission, and visual fixations) was measured under two conditions, a constant condition in which the squares remained in the same position on every trial and a stimulus change condition with the array randomly changing positions. Only under the stimulus change condition were between group differences in performance found. Atkinson and Seunath suggested that the differences in attending behavior between the learning disabled and normal children were a function of specific stimulus factors rather than a general attentional deficit in the learning disorder group. They believed that the stimulus change condition created more irrelevant stimuli in the visual task with the learning disabled less able to concentrate on the central task. A similar conclusion was reached by Tarver and Hallahan (1974) in a review of 21 experimental studies of attention deficits in learning disabled children. They contended that children with learning disabilities were found to be distractible only when the measures of distractibility were congruent with Cruickshank's definition of distractibility--the "inability to filter out extraneous stimuli and focus selectively on the task" (Cruickshank & Paul, 1971, p. 373). That is, learning disabled children are no more highly distracted than normal controls by lights, noises, or extraneous color cues, but they do have difficulty in distinguishing between those aspects of a stimulus situation which are relevant and those which are irrelevant.

Another explanation of these findings is offered in the hyporesponsiveness hypothesis formulated by Browning (1967b) in which he states that the deficiencies in discrimination learning are due to fewer responses to cues unique to each of the stimuli. This is interpreted as decreased stimulus generalization resulting in less responsiveness to similarities in stimuli. This explanation is congruent with the findings of Blum and Broverman (1967) in the study of the relationship between automatization cognitive style and response generalization in a free, unstructured situation. The ipsative scores of three automatization tasks and of three restructuring tasks and an index of cognitive style of 40 fourth-grade boys were correlated with their performance on the Child Transition Test, which consists of a reversible series of five cards containing first a line drawing of a cat, three cards of transitional figures, and a picture of a dog on the fifth card. It was found that strong automatizers exhibit greater response generalization than weak automatizers, that is, they were less likely to alter their responses in the presence of transitional changes. Blum and Broverman concluded that strong automatizers are better able to inhibit responses to nonrelevant stimuli resulting in their being less distractible than weak automatizers.

Studies of Attention Span

Most of the studies of the ability of learning disabled children to sustain attention have used the vigilance paradigm. The vigilance task requires the subject to detect infrequently occurring signals over a prolonged period of time when the signals are embedded in a background of regularly occurring events. The measurements most frequently taken are reaction time or correct detections and false alarms.

In a study contrasting 82 boys with learning disabilities with 34 controls, ranging in age from 8 years to 11 years 11 months, Dykman, et al. (1970) recorded response latencies under three conditions, simple conditioning (press on red light, release on white), differentiation (press on red light, ignore green light, release on white), and differentiation in the presence of a distracting stimulus (a loud hooter occasionally sounded before or during the colored lights). They found that children with learning disabilities had longer press and release latencies than normal controls. Although both groups tended to have longer latencies with the increasing complexity of the task, there was no tendency for either group to respond more slowly over trials within a task. The slower reaction times and postulated shorter attention spans were explained in part by an hypothesized organically based deficiency in arousal. These findings were supported in a study of Anderson, Halcomb, and Doyle (1973) in which 30 learning disabled and 30 normal controls, ranging in age from 8 years 2 months to 11 years 4 months, were compared on a vigilance task. They found that children with learning disabilities made fewer correct detections and more false alarms than controls when required to press a button when a particular combination of colored lights appeared during a 30-minute period.

The findings of Atkinson and Seunath (1973) of no attentional deficit on a visual vigilance task under the constant stimulus condition appears to be contradictory to these results. A possible explanation is that age was a factor. Dykman, et al. (1970) found that there were no differences in performance between the groups of normal and learning disabled over 10 years of age. The subjects in the Atkinson and Seunath study were between the ages of 10 and 11.6 years. Perhaps older children with learning disabilities have better automatized simple visual-motor responses, or are more highly motivated to perform well on experimental tasks, or can perform for longer periods of time without fatiguing. Atkinson and Seunath also compared the performance of the two groups over three equal time intervals. They found no interactions in the performance of the two groups over time for either errors of omission or errors of commission. They did find that significantly more errors of commission were committed by both groups during the first block of time relative to the two remaining periods, which they felt reflected an increased readiness to respond on initial trials.

In a study conducted by Morgan (1974) to determine whether the characteristics of verbal fluency and defective attention could differentiate learning disability, normal, and educable mentally handicapped populations, the subjects, boys between the ages of 7 years 6 months and 9 years 6 months, were required to respond to a word-naming task, i.e., name as many words as they could. It was found that the learning disability and retarded groups demonstrated problems in alerting and sustaining attention, as expressed in their inability to process the instruction and to initiate the task quickly and their inability to maintain responding, that distinguished them from the normal controls.

According to Tarver and Hallahan (1974) in their review of attention studies, disabled learners are deficient in their ability to sustain attention over prolonged periods of time. The majority of the studies cited reported that the performance of children with learning disabilities deteriorated more seriously over time than the normal controls. Keogh and Donlon (1972) compared performance on the portable rod and frame test, a pattern walking test, and the Matching Familiar Figures Test and found that the performance of severe learning disability subjects became increasingly poorer across trials, whereas normals tended to improve with experience. Douglas (1972) obtained measurements on a continuous performance task and also found that learning disability children were more subject to fatigue.

It is possible that the findings of vigilance studies reflect individual differences in automatization cognitive style. The requirements for vigilance performance is an ability to maintain a physiological or psychological readiness to respond to an infrequently occurring stimulus, whereas performance on an automatized task requires the ability to maintain continuous responding on a simple, over-learned task. Vigilance performance would be affected by a lack of concentration, but this should not be true of well automatized performance. However, as the automatization cognitive style is on a continuum, what would be considered automatized behavior, that which requires a minimum of mental and physical effort, for a strong automatizer would not necessarily be so considered for a weak automatizer. It is probable that the execution of a simple, repetitive task does require effort and concentration on the part of the weak automatizer. Also, most consider a vigilance task easy, merely watching for the stimulus to be detected and then making a simple motor response when it appears. Therefore, it is probable that a weak automatizer would perform poorly on a vigilance task and a strong automatizer would do well.

Circle Drawing and Word Naming

Objective task requirements for an automatized task are difficult to state. The attributes that distinguish between concentration demanding tasks and tasks which are overlearned and require little or no conscious effort, i.e., automatized tasks, are phenomenal in nature. Rapaport (1951) has the following comments on these different phenomenal experiences:

> When the subject-matter is new, requiring organization of material or building of abstractions, the subjective experience usually changes to that of a voluntary effortful concentration.....It appears that these organizing processes create new quasi-stable thought patterns..... Once such new patterns have been created and stabilized, and are in continuous use, their employment may become involuntary and effortless; this suggests that here the voluntary effort has created an autonomous, automatized pattern (pp. 716-717).

Thus, the criteria for classifying a task on this dimension must by necessity depend upon assumptions based upon indirect evidence.

A further consideration is the methodological problems in research with disabled learners. It is conceivable that obtained differences between children with learning disabilities and other populations may not reflect differences on the independent variable but, instead, reflect the group differences in the ability to understand task instructions; in the ability to retain information relevant to the task; or in perceptual-motor or language skills. It is important that the instruction and the structure of the task be equally within the capabilities of all involved populations.

It is the author's contention that Circle Drawing and Word Naming are automatized tasks and of such a nature to be within the repertoire of all children who can manipulate a pencil and who have language. It is also possible for the instructions for these tasks to be of such a simple nature that comprehension should be relatively easy and the information to be retained, minimal.

The Circle Drawing task (H. S. Caldwell, personal communication, March 20, 1974) consists of the child drawing circles in lined off squares on a sheet of paper. The only skill required for this task is that the child be able to make some approximation of a circle and that at least some part of the approximation be somewhere within a square. As children with pervasive motor problems are excluded by definition from the learning disability group, it is felt that all children with learning disabilities should have the capacity to manipulate a pencil and make some form of a circle. Subjectively, this simple repetitive task appears to require a minimum of conscious effort and, therefore, is considered to be a perceptual-motor automatized task.

The Word Naming task is similar to the fifth subtest at the 10-year level of the Stanford-Binet Intelligence Scale, Form L-M (Terman & Merrill, 1960). It is a free response task that requires the child to name as many words as he can. It is felt that this type of task is within the capabilities of all children with the ability to use language. As children with learning disabilities score equally as well as normal children on the WISC vocabulary subtest (Rugel, 1974a), it appears that not only do they have the ability to use language but also some degree of verbal fluency. The child possibly will be required to give some mental effort to thinking of words to say, but it is not believed that this effort would be of such a nature to consider this a concentration demanding task. Therefore, the Word Naming task is considered to be an auditory-vocal automatization task.

Furthermore, once the instructions are understood and the initial response given, the child provides the stimuli for each succeeding response. There are no requirements of either of these tasks that the child perceive, understand, or remember environmental stimuli presented during the task. The learning disability child's specific perceptual, conceptual, or academic deficit should not be a factor in performance on either the Circle Drawing or Word Naming Tasks.

CHAPTER III

STATEMENT OF THE PROBLEM

It has been recommended that teachers working with children with learning disabilities make relevant cues more distinctive, present information bit by bit, remove all distractions in the classroom, using cubicles or screens, and dress in plain clothes (Cruickshank, Bentzen, Ratzeburg, & Tannhauser, 1961; Myklebust, 1954; Strauss & Lehtinen, 1947; Trabasso, 1968; Zeaman & House, 1963). These efforts to circumvent distractibility and attentional deficits have not been based on empirical findings. It remains to be determined in what ways the school environment affects the task productivity of learning disabled children. It also seems that little consideration has been given to the problem solving approach of the child to a particular task. In an effort to provide information in this area, the present study sought to determine whether task-irrelevant, peripheral, visual stimuli of a regular classroom had a differential effect on the performance of learning disability and normal children when engaged in automatized tasks and whether the nature of the automatized task (perceptual-motor or auditory-vocal) had a differential effect.

Based on the assumption that children with learning disabilities are weak automatizers, it was expected that the performance of learning disabled children on automatized tasks would be significantly inferior to the performance of normal children under distracting conditions, regardless of whether the task is perceptual-motor or auditory vocal, and that there would be no differences between the learning disabled and normal groups under the no distraction condition.

The present study also sought to determine whether extended responding had a differential effect on the automatized task performance of learning disabled and normal children. Based on the evidence that weak automatizers fatigue more readily, it was expected that the performance of children with learning disabilities on automatized tasks would be progressively more inferior across the time compared to the performance of normal children when the requirements of the task are continuous response for an extended period of time, regardless of the distracting condition imposed or the nature of the task.

Furthermore, in an effort to determine the degree to which a child's performance on the Sequential category subtests of the WISC, Digit Span, Coding, and Arithmetic (Rugel, 1974b) was related to his automatization abilities, Sequential Ipsative Scores were correlated with performance on the automatized tasks. It was expected that there would be a significant positive correlation between the Sequential Ipsative Scores and performance on the automatization tasks, i.e., a child with a high Sequential Ipsative Score would perform well on both tasks, while the child with a low score would perform poorly.

The normal controls were chosen to approximate as many possible relevant variables of the learning disability group as feasible. Individual subjects in the two groups were matched on age, sex, and I. Q. The age range was also controlled to preclude a developmental effect. The differences in performance between the normals and children with learning disabilities were expected to be the result of the different automatization cognitive style (strong vs. weak) employed by the groups when engaged in automatized tasks under distracting conditions.

Finding that children with learning disabilities approach automatized tasks as weak automatizers and that their performance varies according to the environmental condition and task requirements imposed would suggest that teaching methods for working with these children consider the requirements of the task, the environmental conditions, and the problem solving approach of the child. By considering the factors which affect the performance of a child with a weak automatization cognitive style, methods could be devised which circumvent distractibility and fatigue when the child is required to perform an automatized task. It is also possible that methods could be found to remediate the weak automatization abilities, i.e., help the child to become a stronger automatizer. The Sequential Ipsative Score, as a means of identifying a child who is a weak automatizer, would aid in determining those children who would benefit from these methods. A further implication of this study would be that learning disabled children have difficulty in overlearning simple skills and there probably has been a delay in automatizing basic skills, e.g., balance, visual-motor coordination, perceptual constancies, beginning in infancy. Thus, for younger children there would be a need for remedial techniques which take into consideration the child's cognitive style.

CHAPTER IV

METHOD

Subjects

Ten children, four boys and six girls between the ages of 7 years 5 months and 9 years 7 months, classified as learning disabilities were contrasted with 10 normal children. The subjects were selected from a south-central United States public school system. All children were from adequate homes and were in good physical health. Learning disabled children were defined as those who had been so labeled by the Regional Education Service Center, who were receiving special assistance from a learning disability teacher in a self-contained classroom, and who had normal or potentially normal intelligence (I. Q. 90 or above) as determined by the Wechsler Intelligence Scale for Children (WISC) (Wechsler, 1949). One male subject was dropped from the learning disability group, who, although meeting the above criteria, was found to be atypical of this group. His performance on the automatized tasks was equal to or better than the best performance by a normal on all variables. Upon further investigation, it was found that this was his third year to receive special assistance and that he was presently considered to be highly motivated, to be using his hyperactivity productively, and to have only minimal, residual, auditory problems, mainly, difficulty in processing complex verbal instructions. Furthermore, it was being recommended that he be returned to a regular classroom.

The comparison children were selected from regular classrooms within the school which the learning disability subjects attended. They were recommended by the teachers as average achievers with no known academic or social problems. Only children who matched a learning disability child on sex, age (± 7 months), and WISC Full Scale I. Q. (± 13 points) were included in the final control group. Table I presents the comparison of learning disability and normal children on selection criteria and of verbal and performance abilities as measured by the WISC. There were no significant group differences on any of the selection variables. There were also no significant differences between the means of the two groups on the WISC Verbal I. Q. and on the WISC vocabulary subtest, suggesting a similarity in the degree of verbal fluency, nor was there a significant group difference on the WISC Performance I. Q.

Procedure

The Circle Drawing and Word Naming tasks were administered individually to all children in a small room located within their particular school under two environmental conditions (see Appendix B for blueprint of the room and pictures of the environmental conditions). The two conditions were: (V) visual background--the child was seated at a desk within the room and typical visual items (calendar, bulletin board, pictures, etc.) found in a normal classroom were displayed around the room; (NV) no visual background--the child was seated at a desk within the room with the walls bare to minimize the visual stimuli. A repeated measures design was used with the order of presentation of the tasks and of the environmental conditions being counterbalanced. Each matched pair of subjects was measured under one condition and order of tasks, e.g., visual condition, circle drawing then word naming, and then measured again, one week later, under the other condition with a reverse order of tasks, e.g., nonvisual condition, word naming, then circle drawing.

TABLE I

COMPARISON OF LEARNING DISABILITY AND NORMAL POPULATIONS OF SELECTION CRITERIA AND OF VERBAL AND PERFORMANCE ABILITIES

Variable	Learning Disability (N =9)	Normal (N=10)	t
Age (months)			
Mean	99.555	101.300	- .40 NS
S. D.	8.368	9.416	
WISC FSIQ			
Mean	102.444	105.400	- .82 NS
S. D.	7.161	7.706	
WISC VIQ			
Mean	97.444	103.600	-1.39 NS
S. D.	9.095	10.110	
WISC Vocabulary			
Mean	9.888	10.800	-1.28 NS
S. D.	1.453	1.810	
WISC PIQ			
Mean	107.666	106.500	- .29 NS
S. D.	10.489	7.075	

Circle Drawing Task

The Circle Drawing task involved the presentation of 8½" x 11" sheets of paper. On each was a grid of 300, 12.7 mm squares (see

Appendix C for a sample of the sheets used). The children were required to draw as many circles as they could, placing one in each square. Each child was given the following instructions verbally:

> I want to see how many circles you can draw. I want you to draw a circle in each square on this sheet of paper (hand child sheet of grid paper). If you wish, you may use this second and third sheet (hand child second and third sheet of grid paper). Be sure to draw a circle in each square. When I say "go," you may begin. Draw as quickly as you can. Do you have any questions about what I want you to do? (Answer any questions.) "Ready?" (pause) "Go!"

Two stop watches were immediately started with the "go" signal. Drawing time was recorded when the child completed the first sheet and again when he stopped responding all together with a maximum of eight minutes imposed. The maximum limit was based on the findings of a pilot study that few children were able to sustain responding beyond eight minutes--most discontinued response between six and eight minutes. Variables scored were:

1. Time to draw first page. Speed of drawing was considered to reflect the effects of distraction on individual differences in automatization cognitive style. The number of circles drawn, being constant, offered a standard base for comparison among subjects performing under different environmental conditions.

2. Total number of circles drawn.

3. Total time drawing circles. Both variables 2 and 3 required extended responding, for the child was allowed to respond as long as he was able or for eight minutes. They were considered to represent the child's automatization style and his susceptibility to fatigue.

4. Number of circles drawn per minute. This ratio was believed to reflect the motivational level of the child to perform a simple,

repetitive perceptual-motor task.

Word Naming Task

The Word Naming task involved having the child name as many words as he could with a maximum limit of eight minutes imposed. In a pilot study, eight minutes was found to be the time limit beyond which few children continued to respond. The following taped instructions were played to each child:

> I want to see how many different words you can say. Just any words will do, like "clouds," "dog," "chair," "happy." I am going to record on this tape recorder what you say. When I say "go," you say as many words as you can. Do you have any questions about what I want you to do? (Stop tape player and answer any questions.) "Ready?" (pause) "Go!"

The subjects' responses were tape recorded with a high quality microphone on a Sony, model 850, tape recorder. All recordings were made at a tape speed of 7½ i.p.s. The recorder picked up the warning signal, "ready," the reaction signal, "go," and the child's responses on the same channel. The recorded samples were later transferred to a Bruel and Kjaer power level strip-chart recorder, model 2305, for obtaining latency, vocalization, and pause measurements. Signal amplitude settings on both the Sony tape recorder and the Bruel and Kjaer recorder were uniform for all subjects' taped responses. Paper speed was 30 mm/sec.

To obtain measurements, all strip-chart recordings were carefully monitored visually while listening to the auditory signal from the tape recorder. All questions, sentences, non-words, respirations, or subvocalizations which were printed out as signals were deleted. They were not counted as words but were included in pause time. Variables scored were:

1. Latency. Latency was defined as the time (in sec.) from the midpoint of the reactional signal, "go," to the onset of the first response. The reaction signal was identified on the strip-chart recording as the point of a sharp increase in amplitude from the base line and a return to the base line. The midpoint was half the distance between these points. The onset of word production was identified as the initial increase in amplitude from the base line after the offset of the reaction signal. This measurement reflected the ability of the child to process the instructions and to initiate the task.

2. Time to say 30 words. This was defined as the time (in min.) from the midpoint of the reaction signal, "go," to the offset of the vocalization of the thirtieth word. Pilot data showed that the large majority of children were able to respond with at least thirty words and that this number of words allowed a measure of variability in time responding across children. Therefore, thirty words was selected as the standard base for comparison among children and was believed to represent the effects of distraction on individual differences in automatization congnitive style.

3. Total words. Total words was defined as the total number of intelligible, separate words uttered by the child. This variable represented a measurement of extended responding, for the child was allowed to respond for as long as he was able or for eight minutes, and was considered to reflect the child's automatization style and his susceptibility to fatigue.

4. Words each minute. This was the number of words said by each child in each minute of responding. It was believed that by breaking

down the child's total response minute by minute that it could be determined when the effects of distraction and fatigue occurred; that is, the pattern would reflect the differential effects of the automatization style, distraction, and fatigue.

5. Total time of naming words. Total time was defined as the time (in min.) from the midpoint of the reaction signal to the offset of the vocalization of the last word.

6. Pause mean. The pause mean was the total time (in sec.) of silence divided by the number of pauses. Each pause was identified on the strip-chart recording as the distance between the offset of one vocalization and the onset of the next. Variables 5 and 6 represent measurements of extended responding and were considered to reflect the child's automatization style and the effects of fatigue.

7. Number of words per minute. This ratio represented the motivational level of the child to perform an auditory-vocal task.

8. Total variance. A pause variance was computed for each child for the total time of responding. This measurement represented the overall pattern of response, that is whether the child responded rhythmically with equivalent pauses between words or whether there were bursts of responding with long pauses in between. It was believed to reflect the differences in response patterns among subjects.

Sequential Ipsative Scores

If the WISC had been given to the child within the past twelve months, the scaled scores attained were used; otherwise, the WISC was administered according to standard instructions. Each child's scaled scores on the sequential category (Digit Span, Coding, Arithmetic) and the spatial category (Block Design, Object Assembly, Picture Completion) were summed and divided by six to provide the child's mean level of performance. Ipsative scores were computed for each child by subtracting that child's mean score from each of his three scaled scores on the sequential category. The sum of these ipsative scores gave the individual's Sequential Ipsative Score, which reflected the extent and direction of the individual's variation in ability on automatization tasks. Fifteen points was added to each individual's Sequential Ipsative Score (SIS) in order to avoid negative values.

Statistical Analyses

The statistical treatment of the Circle Drawing and Word Naming data was a two factor (2 x 2) repeated measures analysis of variance--unweighted-means solution (Kirk, 1968). The between subjects factor was learning-disability normal, and the within subjects factor was visual-no visual conditions. A separate analysis was run for each of the 11 dependent variables--the four measurements on the perceptual-motor automatized task (time to draw first page, total number of circles drawn, total time drawing circles, number of circles drawn per minute) and the seven measurements on the auditory-vocal automatized task (latency, time to say 30 words, total words, total time of naming words, pause mean, number of words per minute, total variance). The treatment of the words each minute data was a three factor (2 x 2 x 8) repeated design (unweighted-means solution). The between subjects factor was learning disability-normal, and the two within subjects factors were visual-no visual conditions and the eight minutes of responding.

Pre-planned orthogonal comparisons were used to determine the simple main effects of the two factor analyses of variance. It was expected that the normal group would demonstrate superior performance, as compared to the learning disability group, in the visual condition, with no differences between the groups in the nonvisual condition. Further, the normals would demonstrate superior performance in the visual condition as compared to their own performance in the nonvisual condition, whereas the learning disability children would perform more poorly in the visual condition than in the nonvisual condition.

A two-tailed, matched pairs, t test was used to compare learning disabilities and normals on the Sequential Ipsative Scores. In addition, the intercorrelations of the three ipsative scores on the WISC sequential category subtests, of the Sequential Ipsative Scores, of age, of the WISC FSIQs and of the 11 variables of the two automatized tasks under the visual and nonvisual conditions were determined for the combined learning disability and normal groups and for the learning disability and normal groups separately. That is, three 28 x 28 correlation matrices were computed. Furthermore, in order to determine whether there were any trial (first-second) or order of condition (V-NV--NV-V) effects, a three factor (2 x 2 x 2) repeated measures analysis of variance--unweighted-means solution was computed for each of the 11 automatized task variables. The two between subjects factors were learning disability-normal and V-NV order-NV-V order, and the within subjects factor was trial 1-trial 2.

CHAPTER V

RESULTS

Circle Drawing and Word Naming Variable Analyses

The means and standard deviations for the nine variables on the Circle Drawing and Word Naming tasks for the learning disability and normal groups in the visual and nonvisual conditions are contained in Table II. As all subjects in both groups responded on the Circle Drawing task for the full eight minutes, and a total number of circles drawn variable was included, no statistical analyses were performed for the total time drawing circles and the number of circles drawn per minute variables. Any information obtained from the number of circles drawn per minute variable would be redundant with the information gained from the analysis of the total number of circles drawn variable.

On the Circle Drawing automatization task, the results of the analyses of variance for time to draw the first page and total circles drawn are presented in Table III and Table IV, respectively. There was a significant main effect for groups on both variables. The learning disability group took longer to draw the first page of circles and drew fewer circles than the normal subjects. Two male learning disability children were unable to complete the first page within the eight minute time limit, one on the first trial in the visual condition and the other on both trials. Their scores were estimated by prorating the rate

TABLE II

GROUP MEANS AND STANDARD DEVIATIONS OF CIRCLE DRAWING AND WORD NAMING VARIABLES FOR VISUAL AND NONVISUAL CONDITIONS

	Normal (N=10)		Learning Disability (N=9)	
Variables	Visual	Nonvisual	Visual	Nonvisual
Circle Drawing				
Time to Draw First Page (sec.)				
Mean	303.09	312.80	475.00	452.89
S.D.	62.34	62.42	220.10	133.77
Total Circles				
Mean	492.50	474.40	331.88	339.56
S.D.	105.71	94.51	86.84	87.84
Word Naming				
Latency (sec)				
Mean	1.25	1.33	1.20	1.03
S.D.	.97	.76	.74	.43
Time to say 30 Words (min.)				
Mean	1.24	1.49	3.41	3.28
S.D.	.38	.52	3.01	2.87
Total Words				
Mean	128.80	110.70	70.78	83.44
S.D.	39.53	21.91	40.45	45.26
Total Time (min.)				
Mean	7.80	7.90	5.93	6.95
S.D.	1.60	.10	2.59	2.16
Pause Mean (sec.)				
Mean	3.01	3.63	6.00	5.61
S.D.	.92	.90	4.90	4.55
Words/Minute				
Mean	16.49	13.99	11.66	12.74
S.D.	4.90	2.68	4.76	5.80
Total Variance (mm.)				
Mean	15958.40	23007.00	53654.33	65726.44
S.D.	11791.99	20561.24	66053.12	75829.06

TABLE III

ANALYSIS OF VARIANCE - UNWEIGHTED-MEANS SOLUTION - TIME TO DRAW FIRST PAGE OF CIRCLES COMPARISON

Source	Sum of Squares	df	Mean Square	F Ratio
A (Group)	230432.270	1	230432.270	7.34 *
Subjects within groups	534033.900	17	31413.750	
B (Conditions)	365.472	1	365.472	.09 NS
AB	2399.260	1	2399.260	.61 NS
B X Subjects within groups	66737.490	17	3937.617	

* $p<.05$

TABLE IV

ANALYSIS OF VARIANCE - UNWEIGHTED-MEANS SOLUTION - TOTAL CIRCLES COMPARISON

Source	Sum of Squares	df	Mean Square	F Ratio
A (Group)	206863.321	1	206863.321	13.64 **
Subjects within groups	257746.570	17	15161.562	
B (Conditions)	267.279	1	267.279	.01 NS
AB	1573.461	1	1573.461	.60 NS
B X Subjects within groups	44183.850	17	2604.932	

** $p<.01$

attained on the number of circles they did draw to include 300 circles. This was considered to be a conservative estimate. No significant effects for conditions and no significant interaction were found for either variable. The pre-planned orthogonal comparisons of the means of the learning disability and normal groups in the visual and in the nonvisual conditions revealed significant differences (see Table V). The learning disability group demonstrated inferior performance on both variables in both conditions. The comparison of the means of the conditions revealed no significant differences for either the learning disability or normal groups.

In summary, based upon the superior performance of the normal group, it appears that the normals were stronger automatizers than the learning disability children on this type of task. However, the lack of an interaction and the orthogonal comparisons suggest that neither group was affected while performing a perceptual-motor task in the visual condition. The specific effects of fatigue are difficult to determine. As all subjects responded for eight minutes, any fatigue effects, i.e., performance of the learning disability group deteriorating more seriously over time than the normal group present in the total circles measurement were confounded with the effects of the cognitive style.

On the Word Naming automatization task, significant differences were found between the groups on time to say thirty words (see Table VI), with the learning disability group taking longer to say the first thirty words. Two female learning disability children stopped responding before they had said thirty words, one on the second trial in the visual condition and the other on both trials. They were given the score eight minutes for their performance on this variable, which was considered a conservative estimate. Across both subject population, there were no significant condition differences. There was also no significant interaction effect. The only significant difference found in the orthogonal comparisons was between the means of the normal and learning disability group in the visual condition (see Table V), which was in the expected direction.

TABLE V

PRE-PLANNED ORTHOGONAL COMPARISONS FOR SIMPLE EFFECTS - t VALUES

	Conditions		Groups	
	Visual	Nonvisual	Learning Disability	Normal
Variables	Nor vs. LD df=17	Nor vs. LD df=17	V vs. NV df=16	V vs. NV df=18
Circle Drawing				
Time to Draw First Page	-2.82*	-2.30*	.75	-.35
Total Circles	3.71***	3.11**	-.32	.79
Word Naming				
Latency	.14	.30	.48	-.24
Time to say 30 Words	-2.31*	-1.90	.62	-1.24
Total Words	3.36**	1.58	-1.22	1.84
Total Time	2.48*	1.26	-2.22*	-.23
Pause Mean	-1.97	-1.30	.98	-1.65
Words/Minute	2.26*	.58	-.77	1.88
Total Variance	-163.18****	-184.93****	-121.08****	-74.50****

* p<.05 ** p<.01 *** p<.005 **** p<.001

TABLE VI

ANALYSIS OF VARIANCE - UNWEIGHTED-MEANS SOLUTION - TIME TO SAY THIRTY WORDS COMPARISON

Source	Sum of Squares	df	Mean Square	F Ratio
A (Group)	37.2428	1	37.2428	4.56*
Subjects within groups	138.8948	17	8.1702	
B (Conditions)	.0426	1	.0426	.21 NS
AB	.3184	1	.3184	1.56 NS
B X Subjects within groups	3.4691	17	.2040	

* $p < .05$

Further, a significant difference was found between the two groups on the total words variable (see Table VII). The normal group responded with significantly more words than the learning disability group. There were no significant condition differences. Figure 1 illustrates the significant interaction effects due to the combination of population and environmental conditions factors. The comparison of the means of the learning disability and normal groups in the visual condition revealed a significant difference (see Table V), with the normal group saying more words than the learning disability group. There was no significant difference between the groups in the nonvisual comparison, and no significant differences were found between the means of the conditions for either the learning disability or the normal groups. Thus, it seems that the interaction stems from the combination of the increased productivity of the normal group and the decreased productivity of the learning disability group in the visual condition, with the opposite occurring in the nonvisual condition.

TABLE VII

ANALYSIS OF VARIANCE - UNWEIGHTED-MEANS SOLUTION - TOTAL WORDS COMPARISON

Source	Sum of Squares	df	Mean Square	F Ratio	
A (Group)	17232.207	1	17232.207	7.38 *	
Subjects within groups	39674.030	17	2333.760		
B (Conditions)	69.938	1	69.938	.14	NS
AB	2242.987	1	2242.987	4.65 *	
B X Subjects within groups	8189.449	17	481.732		

*p<.05

In an effort to further determine the differential effects of the environmental conditions and of extended responding, a further analysis of the total words said was conducted by comparing the number of words said in each of the eight minutes of possible responding. The results of the analysis of variance for words each minute are presented in Table VIII. The information obtained on the differences between the means of the groups and conditions and of the interaction of the groups by conditions is redundant with the preceding analysis. However, a significant difference was found among the means of each minute for the

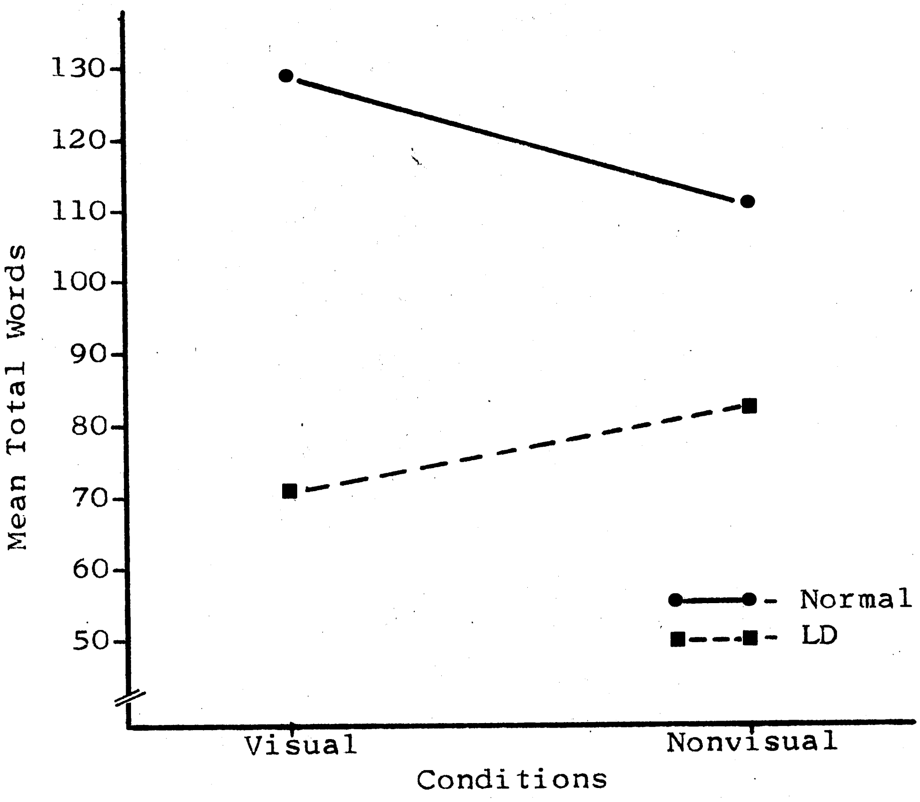

Figure 1. Interaction Between Group Means for Total Words and Environmental Conditions

TABLE VIII

ANALYSIS OF VARIANCE - UNWEIGHTED-MEANS SOLUTION - WORDS EACH MINUTE COMPARISON

Source	Sum of Squares	df	(Conservative F df)	Mean Square	F Ratio
A (Group)	2144.226	1	(1)	2144.226	7.35 *
Subjects within groups	4959.249	17	(17)	291.720	
B (Conditions)	9.402	1	(1)	9.402	.16 NS
AB	283.998	1	(1)	283.998	4.73 *
B X Subjects within groups	1023.687	17	(17)	60.216	
C (Minutes)	6520.655	7	(1)	931.522	42.34 **
AC	100.713	7	(1)	14.387	.65 NS
C X Subjects within groups	2617.837	119	(17)	21.998	
BC	33.011	7	(1)	4.715	.30 NS
ABC	238.419	7	(1)	34.059	2.15 NS
B X C X Subjects within groups	1884.420	119	(17)	15.835	

* $p<.05$ ** $p<.01$

combined groups. There was a decrease in the number of words said for each succeeding minute. No significant interaction was found for groups by minutes, for conditions by minutes, or for groups by conditions by minutes. The groups' pattern of responding is shown in Figure 2. The ordering of the means generally remained the same for the entire eight minutes. The environmental effects were most noticeable in the second minute, with the normals in the visual condition attaining the highest mean, while the learning disability children in the visual condition attaining the lowest, with the means of both groups in the nonvisual condition falling in between and being similar. A similar phenomenon occurred in the sixth minute. The effects of the extended responding becomes noticeable in the third minute, with the means of the normal group in the visual and non-visual conditions becoming similar and the means of the learning disability group in the visual and nonvisual conditions also becoming more alike. Although the responding of both groups declined over time, the normal group was able to maintain its initially higher rate throughout the eight minutes. Of further interest is the similarity of the pattern of means for the normals in the visual condition and the learning disability children in the nonvisual condition and for the normals in the nonvisual condition and the learning disability children in the visual condition.

Finally, the results of the analysis of variance for the total time variable are presented in Table IX. There was a significant difference between the means of the groups. The normals responded for a longer time. For the most part, all normals in both the visual and nonvisual conditions attempted to respond for the full eight minutes. This

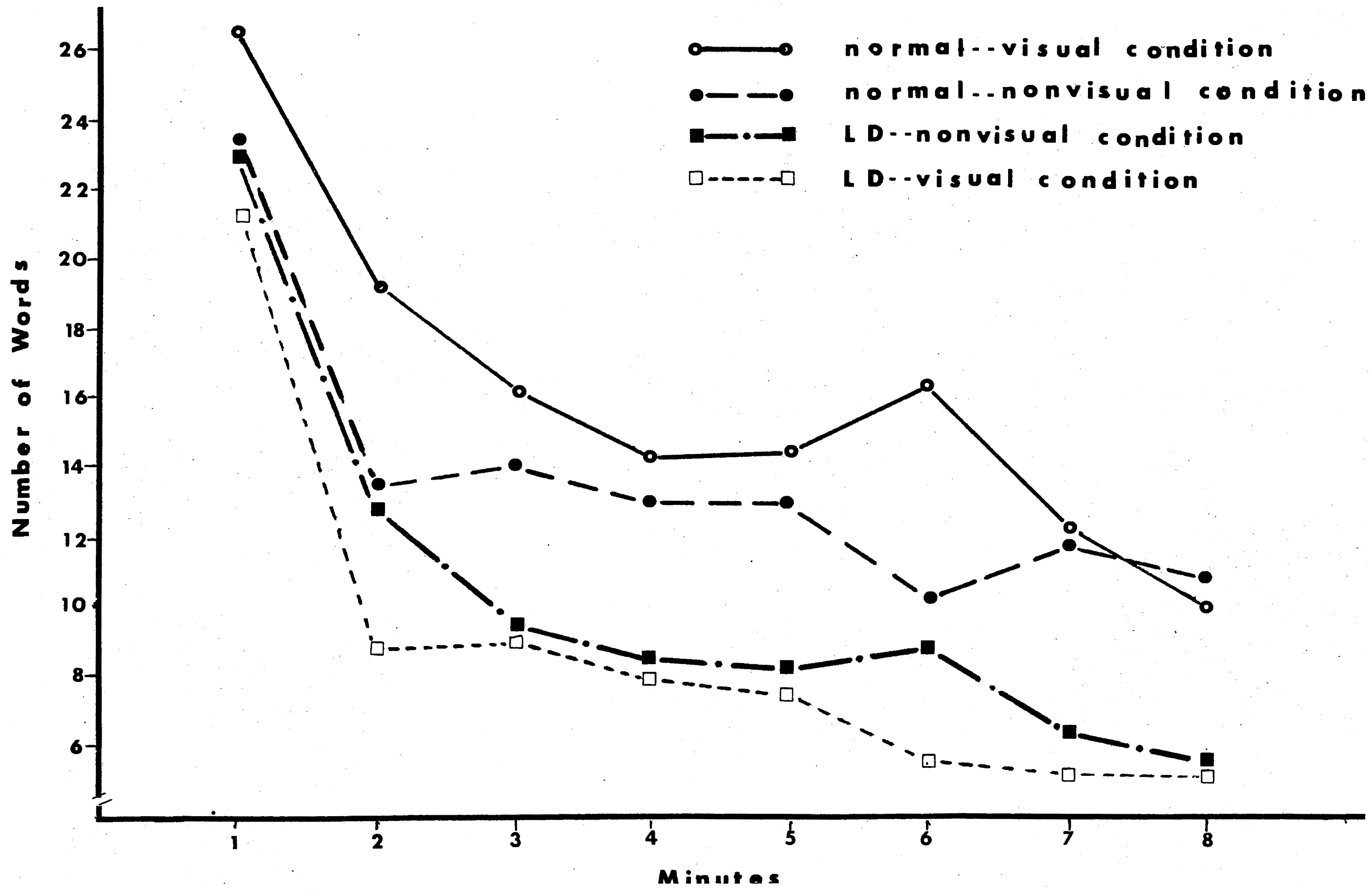

Figure 2. Group Means of Words Each Minute for Visual and Nonvisual Conditions

was also true of the learning disability children in the nonvisual condition with the exception of one female stopping at the beginning of the second minute. However, in the visual condition, four learning disability children, two females and two males, were unable to maintain responding; all had stopped by the end of the sixth minute. Furthermore, one female and one male stopped during their first trial and the other two stopped during their second trial. It is probable that these children ceased responding because of distraction rather than fatigue, for three of these same children continued to respond for almost eight minutes in the nonvisual condition. Across both subject populations, there were no significant condition or interaction effects. The orthogonal comparisons (see Table V) further reflect the inability of some of the learning disability group to maintain responding in the visual condition.

TABLE IX

ANALYSIS OF VARIANCE - UNWEIGHTED-MEANS SOLUTION - TOTAL TIME COMPARISON

Source	Sum of Squares	df	Mean Square	F Ratio	
A (Group)	18.8716	1	18.8716	4.24 †	
Subjects within groups	75.6038	17	4.4472		
B (Conditions)	2.9373	1	2.9373	3.07	NS
AB	1.9941	1	1.9941	2.08	NS
B X Subjects within groups	16.2258	17	.9544		

† $p<.06$

The results of the analysis of variance for the latency variable revealed that there were no significant differences found for main effects, group or condition, and no significant interaction was found (see Table X). There were also no significant differences found in the orthonogal comparisons (see Table V). These findings indicate that both learning disabled children and normals showed comparable facility in understanding the instructions and in initiating the Word Naming task. There were also no significant main effects for the variables of pause mean, words per minute, and total variance, or other significant interactions (see Tables XI, XII, and XIII). There was, however, a tendency ($p<.10$) for an interaction between the groups and conditions on the pause mean and words per minute variables and for a main effect for groups on the total variance variable. Although no significant differences were found on the pause mean variable in the orthogonal comparisons (see Table V), it appears that the trend toward an interaction resulted from the normals demonstrating longer pauses in the nonvisual condition and the learning disability group demonstrating longer pauses in the visual condition. This probably reflects the differential negative effects of the conditions on the two groups, the normals lacking a resource for words in the nonvisual condition and the learning disability group being distracted in the visual condition. The lack of significant main effects between groups on the pause mean indicates that the learning disability group did not tend to fatigue more than the normal group. The tendency for an interaction on words per minute appears to be the result of the increased productivity of the normals in the visual condition rather than a differece in the motivational level. This is further reflected in the significant difference found

TABLE X

ANALYSIS OF VARIANCE - UNWEIGHTED-MEANS SOLUTION - LATENCY COMPARISON

Source	Sum of Squares	df	Mean Square	F Ratio	
A (Group)	.2739	1	.2739	.46	NS
Subjects within groups	10.0361	17	.5903		
B (Conditions)	.0208	1	.0208	.04	NS
AB	.1516	1	.1516	.27	NS
B X Subjects within groups	9.4000	17	.5529		

TABLE XI

ANALYSIS OF VARIANCE - UNWEIGHTED-MEANS SOLUTION - PAUSE MEAN SOLUTION

Source	Sum of Squares	df	Mean Square	F Ratio	
A (Group)	58.6240	1	58.6240	2.76	NS
Subjects within groups	360.4265	17	21.2015		
B (Conditions)	.1251	1	.1251	.18	NS
AB	2.4443	1	2.4443	3.41	NS
B X Subjects within groups	12.1686	17	.7158		

TABLE XII

ANALYSIS OF VARIANCE - UNWEIGHTED-MEANS SOLUTION - WORDS PER MINUTE COMPARISON

Source	Sum of Squares	df	Mean Square	F Ratio	
A (Group)	87.9729	1	87.9729	2.58	NS
Subjects within groups	580.3289	17	34.1369		
B (Conditions)	4.7427	1	4.7427	.53	NS
AB	30.2253	1	30.2253	3.40	NS
B X Subjects within groups	150.9544	17	8.8796		

TABLE XIII

ANALYSIS OF VARIANCE - UNWEIGHTED-MEANS SOLUTION - TOTAL VARIANCE COMPARISON

Source	Sum of Squares	df	Mean Square	F Ratio	
A (Group)	1532330.533	1	1532330.533	3.32	NS
Subjects within groups	7837885.000	17	461052.050		
B (Conditions)	86686.356	1	86686.356	1.94	NS
AB	5940.241	1	5940.241	.13	NS
B X Subjects within groups	761112.190	17	44771.305		

in the comparison of the means of the normal and learning disability groups in the visual condition, with no significant difference between the groups in the nonvisual condition. Also, no significant differences were found between the means of the conditions for either the learning disability or the normal groups (see Table V). The finding of no significant main effect for groups on this variable indicates that both groups were equally motivated. The trend toward a difference in the group means on the total variance variable resulted from the learning disability group demonstrating greater variability in their pattern of responding. It appears that the normals tended to be more consistent in their response patterns, as seen in the significant difference between the means of the normal and learning disability groups in both the visual and nonvisual conditions (see Table V). The normals demonstrated smaller variances than the learning disability children in both conditions. Both groups also had smaller variances in the nonvisual condition. For the normal group, this further reflects the difficulty of word production in the nonvisual condition. However, this finding was not in the expected direction for the learning disability group. The four learning disability children who were unable to maintain response may have accounted for the attenuated variance in the visual condition.

In summary, based on the superior performance of the normal group on the time to say thirty words, total words, and total time variables, it appears that the normals were stronger automatizers than the children with learning disabilities on this type of task. Further, there are indications that both groups were equally motivated, understood the instructions, and initiated the task equally well, as demonstrated in the similarity of the group means on the latency and words per minute variables. The initial equal level of motivation was again demonstrated in the similarity of the group means of words each minute for the first minute of responding. This is perhaps the reason no differential environmental effects were demonstrated on the time to say thirty words variable. It does appear, however, that the nature of the environment did have a differential effect on the two groups as seen in the interaction on total words, in the findings of the orthogonal comparisons of significant differences between the groups in the visual condition and no differences in the nonvisual condition, and in the pattern of means on words each minute. Furthermore, both groups appear to fatigue or have a reduction of motivation with extended responding as seen in the significant effect for minutes on the words each minute variable. However, the lack of a significant interaction between the groups and minutes on words each minute and the lack of a significant main effect for groups on the pause mean indicate that the learning disability group's performance did not deteriorate more seriously over time than the normal group.

Ipsative Scores Analyses

The comparison between learning disability and normal subjects' Sequential Ipsative Scores is presented in Table XIV. A significant difference was found between the two groups, with the learning disability group demonstrating the lower mean Sequential Ipsative Scores. This finding is in support of the assumption that learning disability children are weaker automatizers than normals, based on the expectation that a weak automatizer would perform better on spatial tasks than on sequential tasks.

TABLE XIV

MEANS, STANDARD DEVIATIONS, AND VALUE OF t FOR SEQUENTIAL IPSATIVE SCORES

Variable	Learning Disability (N=9)	Normal (N=9)	t
Sequential Ipsative Score			
Mean	10.657	15.508	-5.58**
S.D.	2.497	3.082	

** p<.01

The intercorrelations of the nine variables of the two automatized tasks for the visual and nonvisual conditions and the relationship of age, WISC FSIQ, and the ipsative scores to these variables were determined by computing three 24 x 24 correlation matirices--one for the combined groups, which reflected the relationships within a variable range of performance--and one each for the learning disability and normal groups, which were considered to be restricted ranges (see Appendix D). The relationships among items on the correlation matrices indicated that the variables of the Circle Drawing and Word Naming tasks could be combined into four major groups, Circle Drawing visual (CDV), Circle Drawing nonvisual (CDNV), Word Naming visual (WNV), and Word Naming nonvisual (WNNV). It was found that the CDV and CDNV variables were significantly correlated in the normal, learning disability, and combined populations, whereas the WNV and WNNV variables were significantly correlated for the learning disability and combined populations but not for the normal group. The CDV variable, total circles, correlated significantly with WNV in the combined and normal groups but not in the learning disability group. For that matter, there were no significant correlations of any CDV and CDNV variables with WNV and WNNV variables within the learning disability group. The ipsative scores on the sequential categories correlated significantly with the CDV, CDNV, and Sequential Ipsative Scores for the combined population, but not in the restricted range of the normal and learning disability populations. The Sequential Ipsative Scores significantly correlated with the CDV and CDNV variables in the combined and learning disability populations but not in the normal population. Age was a factor for the WNV and WNNV variables for the combined groups, for WNNV variables for the learning disability group, and for the CDV variables in the normal group. For the most part, WISC FSIQ and latency (V and NV) showed no significant relationship with any of the variables.

In summary, it appears that within the broader range of performance of the combined groups there is a relationship between the Sequential Ipsative Scores and a child's performance on the Circle Drawing task regardless of conditions, but the Sequential Ipsative Scores are not related to performance on the Word Naming task. This is possibly the result of minimal environmental effect on the child's performance on the Circle Drawing task, as further indicated in the significant relationship between CDV and CDNV variables, and the apparent differential environmental effect on Word Naming performance. There may also be a confounding factor of lack of absolute comparability as to the degree of automatization between the tasks. However, there does appear to be a relationship between the two tasks. Total circles (V) is related to performance on both tasks in the visual condition and total circles (NV) is related to performance in the nonvisual condition. This suggests that a common factor was present in both the perceptual-motor and auditory-vocal tasks, a factor which is perhaps only manifest in well-learned behaviors. It further appears that age is a factor on the Word Naming task, that is, the older the child, the better the performance. This is not surprising considering the function of the task in the Stanford-Binet scale. There were also indications that there was no relationship between performance and intelligence.

Within the restricted range of the learning disability population, there were indications that Circle Drawing and Word Naming are not related tasks. Although the group's performance was inferior to normals on both tasks, it appears that the learning disabled child may perform better on one task than on the other. The relationship between WNV and WNNV variables was probably the result of the learning disability group being less able to use the visual environment as a word resource, that is, the individual's performance was not affected by the environmental condition. The opposite was found in the normal population. The two tasks were related but WNV and WNNV were not. Thus, though it appears that a common factor is present in both tasks for the normals, the nature of the environmental condition has differental effects on individual performance on the Word Naming task.

Order and Trial Effects Analyses

The results of the analyses of variance that were conducted to determine the effect of order of the visual conditions and the practice effects over trials indicated that there were no significant order or trial effects for the variables of time to draw first page, latency, time to say thirty words, total time, pause mean, words per minute, and total variance, or other interactions. However, significant effects were found for the total circles and total words variables. The group cell means for orders and trials are contained in Table XV.

TABLE XV

GROUP CELL MEANS FOR ORDER AND TRIALS FOR TOTAL CIRCLES AND TOTAL WORDS AND MEAN SEQUENTIAL IPSATIVE SCORES

Group	Order	Mean SIS	Total Circles Trial 1	Total Circles Trial 2	Total Words Trial 1	Total Words Trial 2
LD	NV-V (N=4)	9.62	292.75	315.00	68.5	63.0
	V-NV (N=5)	11.01	345.40	377.00	77.0	95.4
Normal	V-NV (N=5)	14.70	421.40	469.60	106.8	104.2
	NV-V (N=5)	16.61	479.20	563.60	117.2	150.8

Table XVI presents the results of the analysis of variance for the total circles variable. There was a significant difference between the means of the groups, the normals drawing more circles than the learning disability group. Across both subject populations, there was a significant trial effect, with both groups drawing more circles on the second trial than on the first trial. There were no significant order effects or interactions.

TABLE XVI

ANALYSIS OF VARIANCE - UNWEIGHTED-MEANS SOLUTION - TOTAL CIRCLES COMPARISON FOR ORDER AND TRIALS

Source	Sum of Squares	df	Mean Square	F Ratio	
A (Group)	214308.797	1	214308.797	14.99**	
C (Order)	811.659	1	811.659	.06	NS
AC	41754.339	1	41754.339	2.92	NS
Subjects withing groups	214337.380	15	14389.158		
B (Trials)	20445.342	1	20445.342	16.07**	
AB	3647.320	1	3647.320	2.87	NS
BC	424.019	1	424.019	.33	NS
ABC	1220.189	1	1220.189	.96	NS
B X Subjects within groups	19082.970	15	1272.198		

** p<.01

A correlation analysis was employed to determine whether there was a relationship between the strength of the automatization cognitive style, as defined by the Sequential Ipsative Scores, and the ability to improve over trials, i.e., strength of the practice effects. A significant positive correlation was found between the mean Sequential Ipsative

Scores of the subgroups and the number of circles difference between the means of the first and second trials ($r = .95$, $df = 2$, $p<.05$). By means of a linear regression equation, the predicted circles difference values were computed for each SIS subgroup mean. Figure 3 is a scatter plot of the actual values attained with the regression line drawn through the predicted values. These findings suggest that practice effects may be a function of the strength of automatization abilities.

Significant differences were found between the groups on the total words variable (see Table XVII), with the learning disability group saying fewer words than the normals. There were no significant order or trial effects and no significant interaction for groups by order, for groups by trials, or for trials by order. There was a significant interaction for the unique combination of groups, trials, and order. This interaction is illustrated in Figure 4. On the first trial, the means of the subgroups of normals were similar and the means of the learning disability subgroups were similar, with the normals demonstrating the superior performance. Assuming that the visual environment was positive and the nonvisual negative for the normal subgroups and that the nonvisual was positive and the visual negative for the learning disability subgroups, it can be seen that the ordering of the means on the first trial was not by positive and negative conditions for the particular subgroup, but instead reflected the mean SIS attained by the respective subgroups. Further, the normal and learning disability subgroups which demonstrated improved performance on the second trial had the condition order of negative-positive, whereas the subgroups, whose performance remained essentially the same, had the condition order of positive-negative. This suggests that with the

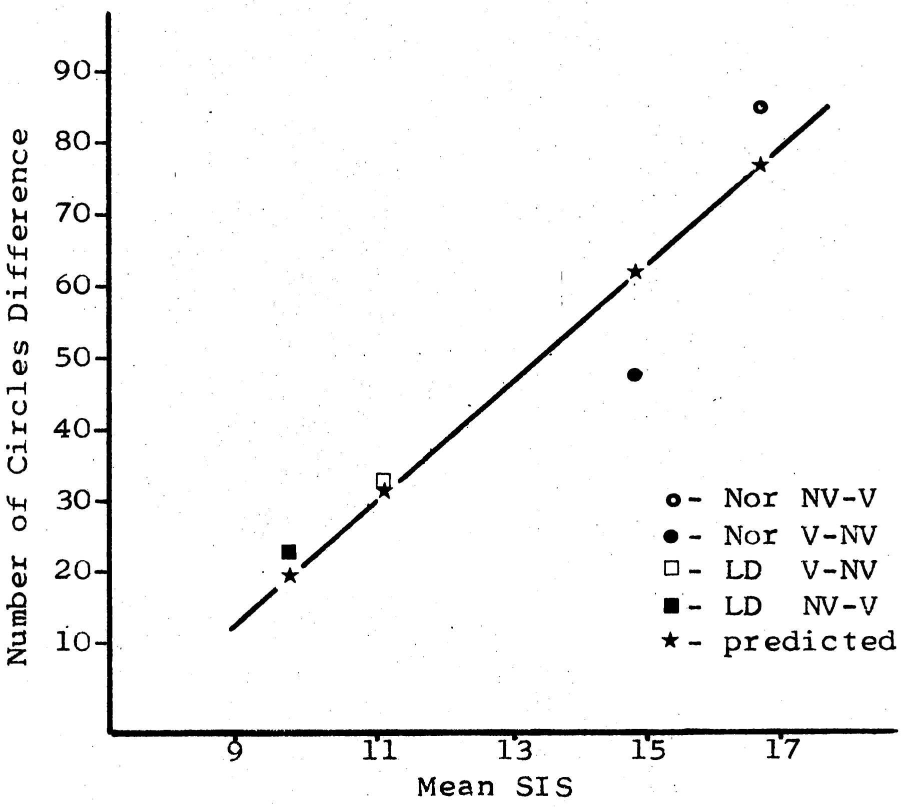

Figure 3. Regression Line of Relationship Between Subgroup Mean Sequential Ipsative Scores and the Increase in Mean Number of Circles Over Trials

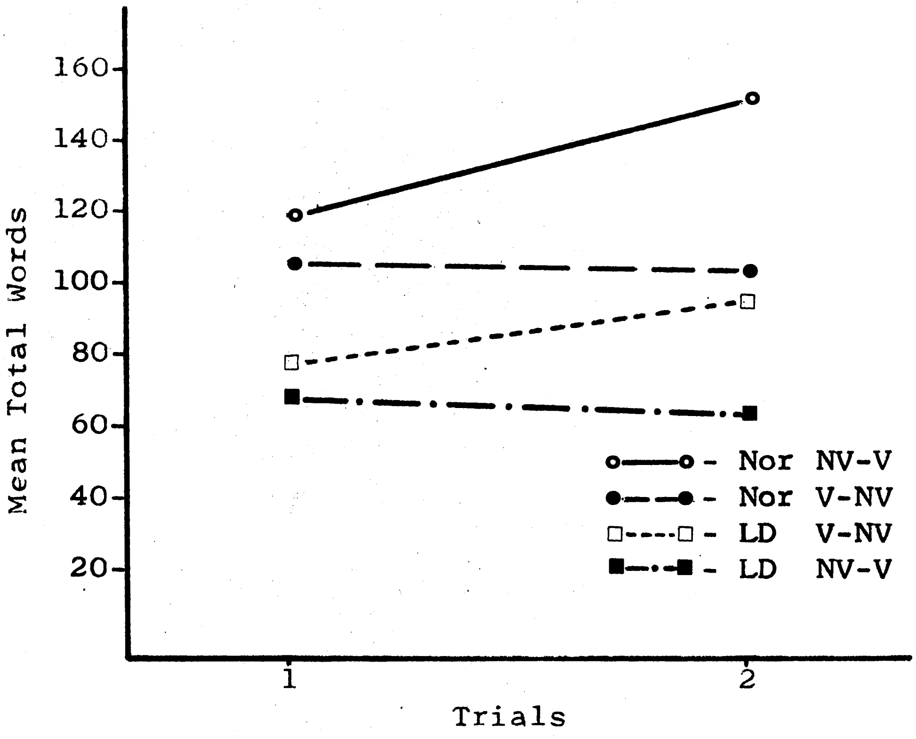

Figure 4. Interaction Between Subgroup Means for Total Words

negative-positive order, the enhanced performance on the second trial is the result of the additive effects of practice, strength of automatization ability, and ideal environment. With the positive-negative order, there is a tendency for the negative environment to equalize the effects of practice and of the automatization cognitive style, that is, performance neither improves nor declines.

TABLE XVII

ANALYSIS OF VARIANCE - UNWEIGHTED-MEANS SOLUTION - TOTAL WORDS COMPARISON FOR ORDER AND TRIALS

Source	Sum of Squares	df	Mean Square	F Ratio	
A (Group)	18031.917	1	18031.917	8.01	*
C (Order)	152.446	1	152.446	.06	NS
AC	5636.834	1	5636.834	2.50	NS
Subjects within groups	33574.100	15	2250.273		
B (Trials)	1133.439	1	1133.439	2.49	NS
AB	192.679	1	192.679	.42	NS
BC	88.980	1	88.980	.19	NS
ABC	2124.307	1	2124.307	4.68	*
B X Subjects within groups	6803.300	15	453.553		

* $p<.05$

To summarize, it appears that order of the visual conditions or practice effects over trials does not affect the ability to initiate the task (latency), fatigue (total time and pause mean), motivation (words per minute), or pattern of response (total variance). It also seems that these effects are not apparent when the measurement of automatization performance is over a short period of time (time to draw first page and time to say thirty words), but they do become a factor when the measurement of automatization performance is over an extended period of time (total circles and total words). The significant effects found for the total circles and total words variables revealed that when practice effects are present and there are no environmental effects, the strong automatizer can improve more than the weak automatizer over trials, but when there are environmental effects, the order of the conditions can either enhance or nullify the practice effects.

CHAPTER VI

DISCUSSION

The results of this study provide support to the assumption that children with learning disabilities tend to be weaker automatizers than normal children. Automatized behaviors are defined as those that have been so well practiced that a minimum of mental and physical effort is required for their efficient execution. If the automatization of simple habits is a prerequisite for the acquisition of new and more complex abilities, then the greater the ability to automatize, the better. The consistently inferior performance demonstrated by the learning disability children on both the perceptual-motor and auditory-vocal automatized tasks suggests that these children do have difficulty in over-learning basic skills and that greater effort is required for the performance of these repetitive behaviors.

Congruent with the above findings are the results of studies that have compared the performance of learning disability children and normal controls on a variety of tasks requiring responding over prolonged periods of time (Anderson, et al., 1973; Atkinson & Seunath, 1973; Douglas, 1972; Dykman, et al., 1971; Noland & Schuldt, 1971). The consistently inferior performance of the learning disability groups has been interpreted as reflecting attentional deficits, i.e., the inability to maintain attention. However, the studies in which the data have been examined over blocks of time indicate that "inattention" (poorer performance) became a factor shortly after the task had begun. This was also found to be true in the present study. An alternative explanation is offered in Browning's (1967b, p. 251) hypo-responsiveness hypothesis which states that children with learning disabilities "emit fewer and less varied responses per time interval per stimulus situation" than normal children of comparable intelligence. This decrement in responsiveness is felt to be the result of decreased stimulus generalization, that is, learning disability children respond to fewer cues in a stimulus complex. A prediction stemming from this hypothesis is that for children with learning disorders, greater stimulus intensity will be necessary for optimal responsiveness to occur. In the present data, the groups' performance on the Word Naming task in the visual condition appears to be in agreement with this hypothesis. The finding that the learning disability children's best performance, though nonsignificant, was in the nonvisual condition is not in keeping with the proposed prediction. Furthermore, decreased stimulus generalization does not provide an adequate explanation for the inferior performance of the learning disability group as compared to the normals on the Circle Drawing task.

In addition to the attention deficit and hypo-responsiveness hypotheses, another interpretation can be suggested. The inferior performance of children with learning disabilities may be the result of the increased effort and concentration required just to perform the task. As weak automatizers, the mechanics of pushing a button, of drawing a circle, or of saying a word would require conscious effort. The behavioral observations of the subjects while performing the Circle Drawing and Word Naming tasks lend credence to this assumption. There were no indications of an attentional deficit or of lack of concentration on the part of the learning disability children. Instead, the opposite was true. They appeared to be exerting more effort than the normal controls as evidenced by the greater pencil pressure on the Circle Drawing task and more "uhs" and "ands" emitted on the Word Naming task. It was also found that the learning disability children were less able to benefit from practice than the normals, suggesting that the increased concentration needed for performance left little energy for developing more efficient strategies. Thus, it is proposed that the lower productivity of learning disability children is the result of basic skills and routine behavior being less well automatized than that of the normals.

Furthermore, the findings that the degree of ability demonstrated by the groups was consistent on both the perceptual-motor and the auditory-vocal automatized tasks and the inter-relationships observed between the variables on the correlation analyses are in support of the contention that there is an idiosyncratic factor present in all highly learned but dissimilar behaviors (Broverman, 1960). It seems reasonable to assume that this factor is related to motor and other physiological abilities, e.g., rate of movement and rate of neural transmission, which by their nature suggest that constitutional differences will determine the individual limits of performance. Broverman, et al. (1964) attributed the differences in automatization abilities to the level of androgens which are thought to affect the resistance to neural fatugue. Within the learning disability population, Dykman, et al. (1970) hypothesized that

> .....organically based deficiencies in arousal explain <u>in part</u> the slower reaction times, the slower learning, the slower assimilation of information, the shorter attention spans, and the decreased physiological activity (p. 775).

Undoubtedly, biological differences are a contributing factor to individual differences in performance of well practiced behaviors, but perhaps of more importance is whether these biological differences are subject to environmental modification.

As the ability to concentrate and resist distraction while performing simple, repetitive tasks should facilitate over-learning, the present study sought to determine the differential effects of visual stimuli on such behavior and the automatization abilities of the child. Although the results are in only partial support of the hypothesis that children with learning disabilities would demonstrate inferior performance in the visual condition but not in the nonvisual condition, regardless of the nature of the task, the indication of a complex interaction between environment, task, and child is of importance and suggests that performance on an automatized task may be modified by the environment.

It appears that the "distraction" stimulus may be uniquely related to the type of task. Specifically, the static visual environment did not affect the performance of either group while performing the Circle Drawing task, but it did have a differential effect on performance on the Word Naming task. Consistent with this assumption is Broverman's (1960) finding that the motoric stimuli was more potent as a distractor than the verbal stimuli on a perceptual-motor automatized task. Further support is found in the inconsistent results of studies of distractibility in children with learning disabilities. It does not appear that children with learning disorders have an overriding trait of distractibility, that is, they are not over responsive to a multiplicity of external stimuli (Alwitt, 1966; Browning, 1967a; Carter & Diaz, 1971), but they have been consistently found to be highly distractible when required to distinguish between the relevant and irrelevant aspects of a stimulus situation and focus selectively on the task (Atkinson & Seunath, 1973; Tarver & Hallahan, 1974). Therefore, for a stimulus to be potentially distracting, it appears that there must be some relationship to the task at hand. The clearest evidence for this in the present study was that the visual stimuli were not an important aspect of drawing circles--merely extraneous, peripheral stimuli. Thus, the visual environment neither enhanced or detracted from the subject's performance. However, the visual environment was a very relevant aspect of naming words as evidenced by the superior performance of the normal children in the visual condition as compared to their performance in the nonvisual condition. The relevancy of the visual environment was also apparent in the auditory review of the tapes. The normal children not only used the visual stimuli as cues to words, but they also used them to generate categories of words, such as citing colors in the room, naming categories of animals, etc. This was an ability that was limited in the learning disability group. Moreover, it appears that the visual environment was also distracting to the learning disabled children as demonstrated in their lower productivity, in the inability of some to continue to respond, and in the inability to benefit from practice when the visual condition was on the second trial. In general, the learning disability children, in contrast to normals, did not productively utilize the visual environment.

The possibility that a given environmental stimulus may function as either distraction or stimulation to the performance of a given task depending upon the cognitive style of the child, or that it may assume a neutral quality if it has no relationship to the performance of the task, suggests that a single learning environment for all may not be the most expedient. Additional research is needed to determine the optimal environment to enhance performance on a particular task for a particular child. There is also need for more realistic environmental stimuli in the experimental situation. It would seem more applicable information could be obtained from the use of animate visual stimuli, e.g., other children, or of auditory stimuli, e.g., classroom sounds, than from the use of flashing lights or buzzers in studies of distractibility. A step in this direction was attempted in the present study through the use of stationary visual stimuli such as would be found in a regular classroom.

Of further interest were the differences in ability to resist fatigue. On the Circle Drawing task, the evidence that learning disability children were more subject to fatigue was equivocal; however, the findings on the Word Naming task indicated that performance of both groups declined over time. There was no evidence that the performance of the learning disability group deteriorated at a faster rate. These findings are consistent with the results of the vigilance performance studies of Noland and Schuldt (1971) and Atkinson and Seunath (1973) but are contrary to the findings reported by Douglas (1972) and Keogh and Donlon (1972). These conflicting results suggest the presence of a factor that may override any tendency to increased susceptibility to fatigue within the learning disability population. It is proposed that the critical factor is motivation. There are both objective and subjective indications that all subjects in the present study were equally and highly motivated to perform well. Previous pilot data indicated that few children would maintain responding on either the Circle Drawing or the Word Naming tasks for the full eight minutes; however, the converse was found to be true with the subjects in this study. Further, the similarity between the groups on the latency and words per minute measurements suggest that at least on the Word Naming task both groups were equally ready to get into the task and maintained a comparable rate of response while responding. Along this line, although Noland and Schuldt (1971) found group differences in correct detections, no significant differences in response latencies were noted, suggesting that both of these groups were equally motivated. Similary, Dykman, et al. (1970) reported that the learning disability children in their study were highly motivated. Neither found evidence that the learning disability children were more subject to fatigue than the normals.

Based upon experimentor observation, both groups of subjects in the present study were eager and cooperative, appeared to enjoy the experience, and the majority verbalized on the second trial a desire to better their previous performance. Of additional interest was the indication that the children were interested in competing with themselves. This was particularly noticeable on the Circle Drawing task, which by its nature allowed the child to have knowledge of the results of his performance.

Another possible explanation of these inconsistent findings on fatigue is in the different methodologies employed in these studies. Broverman, et al. (1966) found no differences in performance between weak and strong automatizers during distributed trials, but there was a difference on the massed trials. The paradigm of vigilance studies which have reported no differences in rate of fatigue include an interstimulus interval, a procedure similar to distributed trials, while those studies which have reported an increased deterioration in performance on the part of the learning disability groups have used tasks that required continuous performance, making the task more of a massed trial. The procedures of the present study required continuous, extended responding, which suggest that perhaps the motivational factor is a more plausible explanation of the fatigue findings. It is possible that a more appropriate measurement of fatigue would be the comparison of performance on massed and distributed trials. The present study has shown that the use of a total time of responding variable may reveal no information on differences in level of fatigue, particularly if a limit is set on the length of time in which subjects may respond.

The conclusion drawn from these findings is that the inferior performance demonstrated by the learning disability children on automatized tasks is not the result of a lack of desire, of a lack of the ability to persist, nor of a deficiency in the ability to concentrate. This paradox of sufficient effort and insufficient performance suggests that the differences in performance are the result of where the effort was centered. It is probable that most of the energies of the learning disability group were vested in the trivia of performance, while the normals executed performance with minimal effort and vested their energies in responding rapidly and in developing more efficient strategies. These differences were most apparent in the second trial of the visual condition on the Word Naming task. The use of the environment was automatic for the normals, but for the learning disability children to do so required that they either exert more effort or direct effort away from performance, whichever resulted in poorer performance. Thus, it appears that the most optimal environment for children with learning disabilities to perform automatized tasks is one which has no relevancy to the task. However, the nature of such environmental manipulation to improve automatization abilities of weak automatizers is unclear and needs explication.

Perhaps the area which holds the most promise for strengthening the automatization of routine behaviors is that of practice. Considering the definition of a strong automatizer, it was not surprising to find that with an equal amount of practice, a strong automatizer's performance improved more than a weak automatizer's. More important is whether there is also a relationship between the number of trials to reach a criterion of performance and the strength of automatization abilities. The existence of such a relationship would have the practical implication that by an appropriate increase in practice, the performance of a weak automatizer could equal that of a strong automatizer. However, the possibility also exists that, regardless of the number of practice trials, the weak automatizer could never attain the level of performance as that demonstrated by the strong automatizer. Some may be unable to ever completely automatize behaviors, while others may be natural automatizers because of their constitutional makeup. Of further interest are the effects that environment may have on practice. The present results indicate that practice effects did accrue in the negative environment, but it remains to be determined whether practice in an optimal environment is more effective than practice in a negative environment for the weak automatizer.

An important implication for education of the existence of the automatization cognitive style is that the strength of a child's automatization ability may profoundly affect his level of success on basic educational tasks. Children who are highly automatized in everyday routine, repetitive behaviors, should have an advantage in the present educational system. For such ability should free attention from the performance of a task and make possible a greater concentration on other aspects of the problem, with the tendency to produce a continual escalation of skills. Therefore, the assessment of these cognitive abilities would seem to be a relevant aspect of any psychoeducational evaluation. The findings of this study have shown that it is not sufficient to merely know how bright a child is to predict success in school; I. Q. is but one aspect of intellectual functioning. Most diagnostic techniques for identifying children with learning disabilities use the WISC, but stress is placed on the scatter of the subtest scores. By going one step further and determining the intra-individual relationship of the scatter, the approximate strength of the individual's automatization abilities is revealed. The Sequential Ipsative Scores appear to reflect the extent and direction of the individual's variation of ability on automatized tasks and may offer an economical means of assessing these abilities.

No doubt, the most desirable remedial efforts would be to train automatization skills in those children who are weak in the ability. With our present knowledge, it is not known if such skills could be trained, but it would seem that some improvement in ability could be accomplished. There are indications, though, that it may be difficult and possibly inefficient to train by environmental pressures. Although it is recognized that cognitive styles have both a constitutional and environmental character, unfortunately, unlike most which place greater weight on the environmental determinants, greater stress is placed on the constitutional determinants of the automatization cognitive style.

An alternative approach is to find means to circumvent any disadvantages and capitalize on any advantages that may come from being a weak automatizer. To do so would require a change in the present educational philosophy of one standard education for all to a more flexible system in which individual differences are allowed to flourish. As we learn more about the cognitive dimensions in which a child's intelligence operates, it becomes apparent that children with differing styles learn different things with individual facility. Each has an individual pattern of strengths and weaknesses. The real paradox of the present educational system is not children with learning disabilities, but that dull children with strong automatization abilities succeed while bright, weak automatizers, fail. The fallacy that has existed far too long is that to succeed, one must demonstrate the ability to learn to read, write, spell, add, and subtract when taught by standard methods, and it is perpetuated by the myth that a score on a standard intelligence test of 90 or above assures that the child has the "capacity." It is probable that the present system is serving only to increase the educational gap between children with learning disabilities and their "normal" peers. By requiring the child to expend the major portion of his energies in the acquisition of basic skills, little is left to invest in acquiring more general educational information and in developing strengths. Rather than continue to remediate the child to conform to set educational expectations, it would seem more economical and efficient to ignore the child's deficits and allow him to specialize in the area of his strengths.

CHAPTER VII

SUMMARY AND CONCLUSIONS

The automatization cognitive style reflects differences in the ability to over-learn simple, repetitive tasks, and the essence of this style is the ability to concentrate and persist while engaged in routine behaviors. Therefore, based on the assumption that children with learning disabilities are weak automatizers, the present study sought to determine whether the peripheral, visual stimuli of a regular classroom had a differential effect on the performance of learning disability and normal children when engaged in perceptual-motor and auditory-vocal automatized tasks and whether learning disability children were more susceptible to fatigue when these tasks required extended responding. In addition, an effort was made to determine the degree to which Sequential Ipsative Scores, computed from subtests of the WISC, are related to performance on automatized tasks. Nine children with learning disabilities and ten normal controls, matched on age, sex, and WISC FSIQ were contrasted on two measures on a circle drawing task and eight measures on a word naming task under two environmental conditions, visual and no visual background.

Repeated measures analyses of variance revealed that the performance of the learning disability group was significantly inferior to that of the normals on both tasks. Differential environmental effects were found on the Word Naming task, the normals demonstrating superior performance in the visual condition with no difference between the groups in the nonvisual conditions. No environmental effects were found on performance on the Circle Drawing task. Further, both groups were found to initiate the tasks with equal facility and to be equally motivated to perform well. There was also no evidence that learning disability children fatigue more readily than normals. Finally, analyses of the effects of order of the visual conditions and practice effects over trials indicated that when there were environmental effects, the order of conditions could either enhance or nullify the effects of practice, but when no environmental effects were present, normals could improve more than learning disability children over trials. The conclusions drawn were: (1) Children with learning disabilities are weaker in automatization abilities than normal children. (2) The inferior performance of the learning disability children on automatized tasks was not the result of deficiencies in desire, in the ability to persist, nor in the ability to concentrate. Rather, it was the result of centering effort and concentration on the performance of poorly automatized behaviors. (3) A given environmental stimulus may function as either distraction or stimulation to the performance of a given task depending upon the cognitive style of the child, or it may assume a neutral quality if it has no relationship to the performance of the task. (4) Performance on an automatized task may be modified by the environment, but the nature of such environmental manipulation to improve automatization abilities is unclear. (5) The area which offers the most promise for strengthening the automatization of routine behaviors is the relationship of environment and practice.

The implication of this study is that automatization abilities can profoundly affect academic achievement. Thus, the assessment of these abilities should be included in psychoeducational evaluations. The correlation analyses indicated that the Sequential Ipsative Scores could provide information on the direction and extent of automatization abilities and be an economical means of such an assessment. Further, there is a need to determine means either to train automatization skills in those children who are weak in the ability or to circumvent any disadvantages of being a weak automatizer.

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APPENDIX A

PARENTAL LETTER AND CONSENT FORM

Dear Parent:

I am a graduate researcher from O. S. U. and I would like to ask your permission for your child to take part in a study that will take place in the Wilson Elementary School in January. The purpose of this study is to find out if the usual classroom setting (pictures, bulletin board, etc.) keeps a child with learning problems from paying attention to his school work. To find this out, it is necessary to have both children with learning disorders and children without learning problems do work in different settings. In this way, it can be determined when the children with learning problems have difficulty in paying attention. It is hoped that the information obtained will be helpful to teachers.

The children that take part in this study will be asked to do two simple tasks, drawing cirles and saying words, under two classroom conditions. One condition will be with no visual materials present and the other will be much like what the child sees in his classroom. Past experience with these tasks has shown that neither are stressful to the children. In fact, the children enjoy doing them. Each child will be seen alone in a room provided by the school, and every effort will be made not to interfere with the child's regular school work.

I would like to stress that the information obtained will not be connected with any child's name, only with the group of which he is a member. Also, no information on how well a child did on a particular task will be made available to anyone.

By signing the enclosed consent form, you will be giving your permission for your child to take part in this study. It states that you understand the purpose of the study and what your child will be asked to do. Your signature will be greatly appreciated. You may return the form to me in the enclosed self-addressed envelope. If you have any questions, please call me at 225-2590 or you may call Buster Meeks at the Regional Education Service Center (225-0481).

Sincerely,

(signed) Patricia Morgan

Patricia Morgan

Consent for Participation in Research Activity and Release of Information

Department of Psychology
Oklahoma State University
Stillwater, Oklahoma

Date:__________________

I hereby voluntary consent to the participation of ____________________ (name of ____________________ child) as a subject in this study on the ability to pay attention. The purpose of this study and data collection procedures have been explained to me. I agree that these procedures do not constitute a violation of my child's personal rights or welfare. However, I am aware that research is not an exact science and I acknowledge that no guarantees have been made to me as to the results of this study.

I further agree that if the Wechsler Intelligence Scale for Children has been administered to my child, the obtained scores may be made available to the researcher, Patricia Morgan, and if the Wechsler Intelligence Scale for Children has not been administered to my child, I give my permission for it to be given and the obtained scores may be made available to the researcher.

I understand that strict confidentiality will be observed of all data collected as a result of my child's participation under the guidelines established by the Public Health Service and the American Psychological Association. Complete anonymity will be preserved and data will be released only to qualified professionals for scientific or training purposes.

This form has been fully explained to me and I certify that I understand its contents.

____
(Parent or guardian for minor child)

APPENDIX B

BLUEPRINT AND ILLUSTRATIONS OF ENVIRONMENTAL CONDITIONS

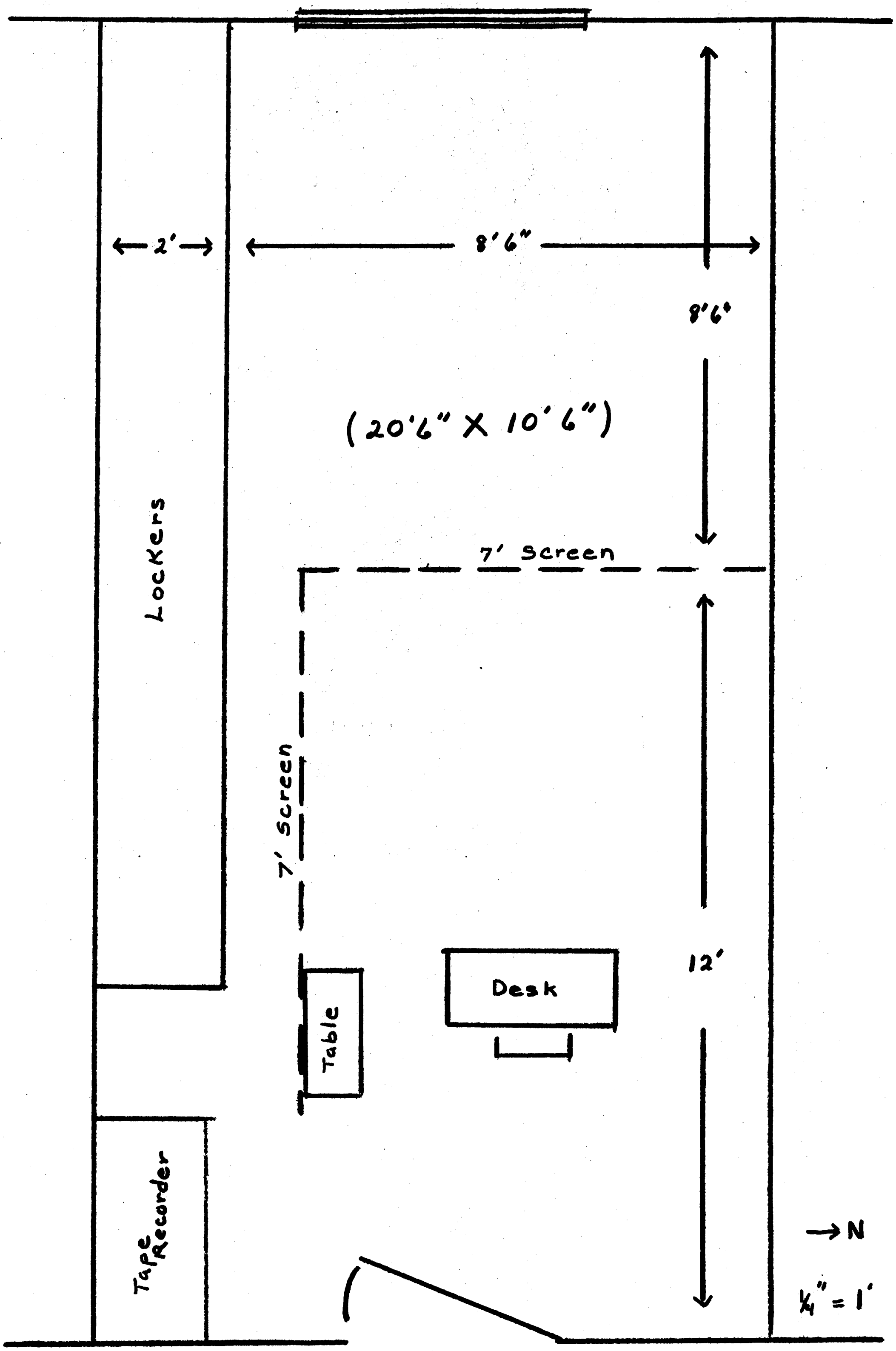

Figure 5. Blueprint of Experimental Room

Figure 6. Visual Environment--South and West Walls

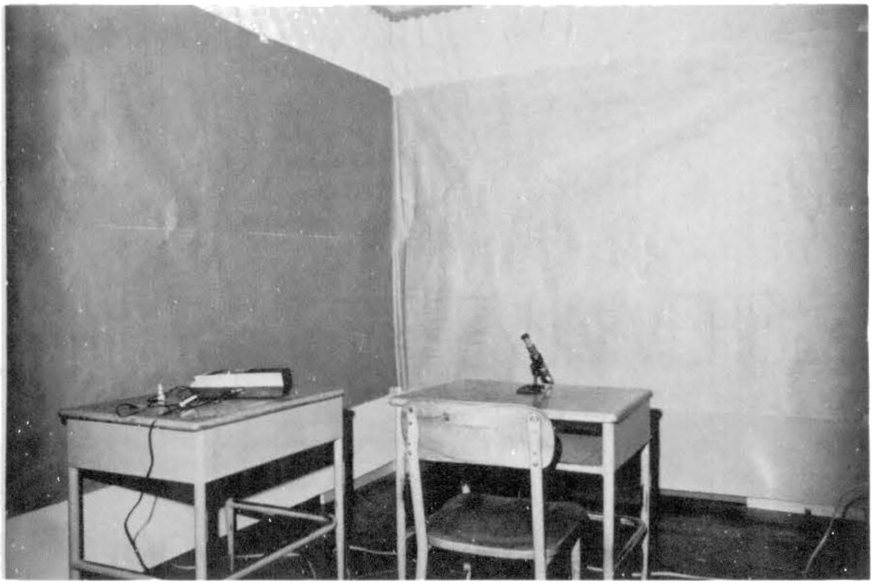

Figure 7. Nonvisual Environment--South and West Walls

Figure 8. Visual Environment--West and North Walls

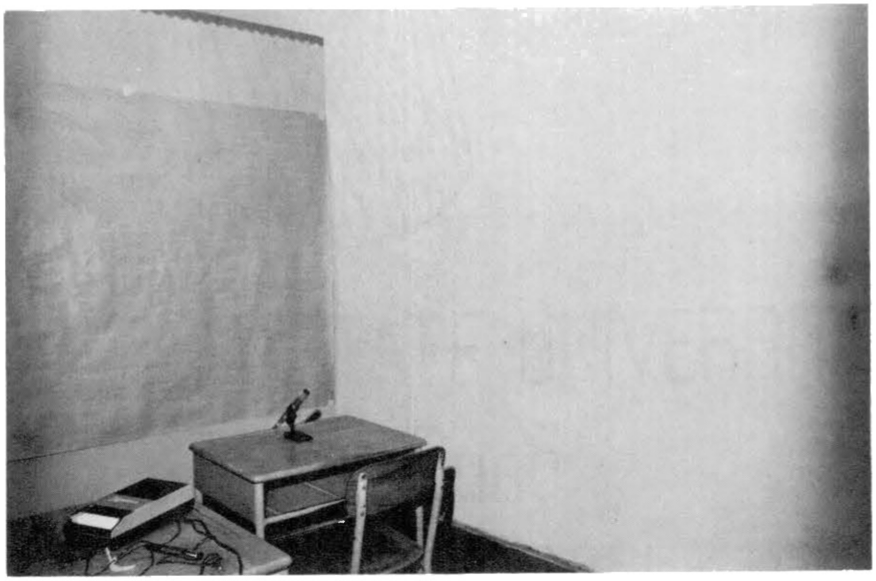

Figure 9. Nonvisual Environment--West and North Walls

APPENDIX C

CIRCLE DRAWING GRID PAPER

APPENDIX D

CORRELATION MATRICES

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BMD02D CORRELATION WITH TRANSGENERATION - REVISED MAY 5, 1969
HEALTH SCIENCES COMPUTING FACILITY,UCLA

PROBLEM CODE ANAL4
NUMBER OF VARIABLES  24
NUMBER OF CASES    19

VARIABLE FORMAT CARD(S)
(7X,F3.0,3F5.2,F6.2,2F4.0,F5.3,F6.3,F4.0,F5.2,2F7.3,F4.0/6X,F7.0/31X,
F4.0,F4.0,F5.3,F6.3,F4.0,F5.2,2F7.3/6X,F7.0)

REMAINING SAMPLE SIZE=   19

SUMS

     1909.0000      79.0500      93.0300      78.0500     250.1499    7306.0000     7912.0000      23.2999
       43.0579    1925.0000     131.4099      84.1129     269.8618    1976.0000   642473.0000    7204.0000
     7800.0000      22.5350      44.5149    1858.0000     141.5299      86.8129      254.6349  821608.0000

MEANS

      100.4737       4.1605       4.8963       4.1079      13.1658     384.5261      416.4209       1.2263
        2.2662     101.3158       6.9163       4.4270      14.2033     104.0000    33814.3672     379.1577
      410.5261       1.1361       2.3429      97.7895       7.4489       4.5691       13.4018   43242.5234

STANDARD DEVIATIONS

        8.7329       1.5179       2.1270       1.7864       3.7949     176.7789      125.4079       0.8446
        2.3101      48.9320       1.9867       3.6673       5.3127       7.4012    48811.7539     122.7435
      112.6111       0.6248       2.1584      36.6902       1.5210       3.2621        4.3545   56984.2812

CORRELATION MATRIX - COMBINED


          COL.          COL.          COL.          COL.          COL.          COL.          COL.          COL.
           1             2             3             4             5             6             7             8
ROW       Age         Ip DS        Ip Cod       Ip Arith        SIS        V - First     V -Total     V -Latency
                                                                             Page        Circles

  1     1.0000        0.0931       -0.0941        0.2909        0.1216       -0.1807        0.4076       -0.2533
  2     0.0931        1.0000        0.2174       -0.1028        0.4732*      -0.3016        0.4181        0.0829
  3    -0.0941        0.2174        1.0000        0.4653*       0.8664**     -0.6034**      0.5859**      0.2779
  4     0.2909       -0.1028        0.4653*       1.0000        0.6907**     -0.5011*       0.5109*       0.2814
  5     0.1216        0.4732*       0.8664**      0.6907**      1.0000       -0.6949**      0.7362**      0.3212
  6    -0.1807       -0.3016       -0.6034**     -0.5011*      -0.6949**      1.0000       -0.8361**     -0.2714
  7     0.4076        0.4181        0.5859**      0.5109*       0.7362**     -0.8361**      1.0000        0.1975
  8    -0.2533        0.0829        0.2779        0.2814        0.3212       -0.2714        0.1975        1.0000
  9    -0.3934       -0.1510       -0.2318       -0.2665       -0.3159        0.0198       -0.2379        0.2290
 10     0.4937*       0.2414        0.2018        0.1850        0.2968       -0.1165        0.5399*      -0.1732
 11     0.1417       -0.0802        0.3781        0.1746        0.2621       -0.0301        0.2176        0.0748
 12    -0.5147*       0.0275       -0.0937       -0.4789*      -0.2670        0.0278       -0.2606        0.1809
 13     0.5857**      0.2731       -0.0167*       0.2632        0.2238       -0.1015        0.5035*      -0.2283
 14    -0.0138        0.2292       -0.1267       -0.2296       -0.0869        0.1056       -0.0740       -0.2252
 15    -0.4259        0.1231       -0.0865       -0.4861*      -0.2281       -0.0053       -0.1815        0.0847
 16    -0.2426       -0.4881*      -0.6142**     -0.4626*      -0.7575**      0.8903**     -0.8040**     -0.1035
 17     0.3720        0.5489*       0.5542*       0.4248        0.7304**     -0.7029**      0.8215**     -0.0172
 18    -0.3384       -0.3373        0.1848        0.1309        0.0299       -0.1210       -0.0745        0.0398
 19    -0.3592       -0.2136       -0.2730       -0.1704       -0.3188        0.0303       -0.2179        0.2431
 20     0.3402        0.1784        0.2919        0.1574        0.3094       -0.0444        0.2793       -0.0948
 21    -0.0407        0.2442        0.3129       -0.1510        0.2021       -0.0026        0.1232       -0.0441
 22    -0.4747*       0.0590       -0.1229       -0.4265       -0.2462        0.0450       -0.2217        0.1689
 23     0.4080       -0.0385        0.0505        0.3187        0.1632       -0.0471        0.2002       -0.0502
 24    -0.4816*       0.1041       -0.1525       -0.3842       -0.2249        0.0327       -0.2133        0.1800

          COL.          COL.          COL.          COL.          COL.          COL.          COL.          COL.
           9            10            11            12            13            14            15            16
ROW      V-30        V-Total       V-Total       V-Pause      V - Words       WISC        V-Total      NV-First
         Words        Words         Time          Mean        per Min         FSIQ       Variance        Page

  1    -0.3934        0.4937*       0.1417       -0.5147*       0.5857**     -0.0138       -0.4259       -0.2426
  2    -0.1510        0.2414       -0.0802        0.0275        0.2731        0.2292        0.1231       -0.4881*
  3    -0.2318        0.2018        0.3781       -0.0937       -0.0167       -0.1267       -0.0865       -0.6142**
  4    -0.2665        0.1850        0.1746       -0.4789*       0.2632       -0.2296       -0.4861*      -0.4626*
  5    -0.3159        0.2968        0.2621       -0.2670        0.2238       -0.0869       -0.2281       -0.7575**
  6     0.0198       -0.1165       -0.0301        0.0278       -0.1015        0.1056       -0.0053        0.8903**
  7    -0.2379        0.5399*       0.2176       -0.2606        0.5035*      -0.0740       -0.1815       -0.8040**
  8     0.2290       -0.1732        0.0748        0.1809       -0.2283       -0.2252        0.0847       -0.1035
  9     1.0000       -0.7630**     -0.7553**      0.7473**     -0.5989**     -0.1892        0.7047**      0.2655
 10    -0.7630**      1.0000        0.6522**     -0.7019**      0.8864**      0.1115       -0.6502**     -0.2930
 11    -0.7553**      0.6522**      1.0000       -0.4633*       0.2972        0.0929       -0.5822**     -0.1935
 12     0.7473**     -0.7019**     -0.4633*       1.0000       -0.7927**      0.0215        0.9513**      0.1910
 13    -0.5989**      0.8864**      0.2972       -0.7927**      1.0000        0.0885       -0.6872**     -0.2439
 14    -0.1892        0.1115        0.0929        0.0215        0.0885        1.0000        0.0399       -0.0963
 15     0.7047**     -0.6502**     -0.5822**      0.9513**     -0.6872**      0.0399        1.0000        0.1569
 16     0.2655       -0.2930       -0.1935        0.1910       -0.2439       -0.0963        0.1569        1.0000
 17    -0.3797        0.5100*       0.3119       -0.3074        0.4416        0.1479       -0.2649       -0.9168**
 18     0.0375       -0.0974        0.1674        0.1123       -0.2118       -0.0618        0.0225        0.0286
 19     0.9601**     -0.7107**     -0.7611**      0.6833**     -0.5227*      -0.2713        0.6502**      0.3396
 20    -0.7995**      0.7189**      0.6368**     -0.6374**      0.5648*       0.1755       -0.5881**     -0.3353
 21    -0.6252**      0.4376        0.7009**      0.0208        0.0448        0.2857        0.0003       -0.1842
 22     0.6489**     -0.5765**     -0.3481        0.9390**     -0.6857**      0.0826        0.8653**      0.2076
 23    -0.3293        0.4131        0.1059       -0.7311**      0.5848**     -0.0640       -0.6701**     -0.2022
 24     0.7167**     -0.6274**     -0.4450        0.9273**     -0.6726**      0.0503        0.8589**      0.1758

          COL.          COL.          COL.          COL.          COL.          COL.          COL.          COL.
          17            18            19            20            21            22            23            24
ROW    NV-Total     NV - Latency     NV-30      NV- Total      NV-Total     NV- Pause     NV- Words     NV-Total
        Circles                      Words        Words          Time          Mean        per Min      Variance

  1     0.3720       -0.3384       -0.3592        0.3402       -0.0407       -0.4747*       0.4080       -0.4816*
  2     0.5489*      -0.3373       -0.2136        0.1784        0.2442        0.0590       -0.0385        0.1041
  3     0.5542*       0.1848       -0.2730        0.2919        0.3129       -0.1229        0.0505       -0.1525
  4     0.4248        0.1309       -0.1704        0.1574       -0.1510       -0.4265        0.3187       -0.3842
  5     0.7304**      0.0299       -0.3188        0.3094        0.2021       -0.2462        0.1632       -0.2249
  6    -0.7029**     -0.1210        0.0303       -0.0444       -0.0026        0.0450       -0.0471        0.0327
  7     0.8215**     -0.0745       -0.2179        0.2793        0.1232       -0.2217        0.2002       -0.2133
  8    -0.0172        0.0398        0.2431       -0.0948       -0.0441        0.1689       -0.0502        0.1800
  9    -0.3797        0.0375        0.9601**     -0.7995**     -0.6252**      0.6489**     -0.3293        0.7167**
 10     0.5100*      -0.0974       -0.7107**      0.7189**      0.4376       -0.5765**      0.4131       -0.6274**
 11     0.3119        0.1674       -0.7611**      0.6368**      0.7009**     -0.3481        0.1059       -0.4450
 12    -0.3074        0.1123        0.6833**     -0.6374**      0.0208        0.9390**     -0.7311**      0.9273**
 13     0.4416       -0.2118       -0.5227*       0.5648*       0.0448       -0.6857**      0.5848**     -0.6726**
 14     0.1479       -0.0618       -0.2713        0.1755        0.2857        0.0826       -0.0640        0.0503
 15    -0.2649        0.0225        0.6502**     -0.5881**      0.0003        0.8653**     -0.6701**      0.8589**
 16    -0.9168**      0.0286        0.3396       -0.3353       -0.1842        0.2076       -0.2022        0.1758
 17     1.0000       -0.2007       -0.4664*       0.4788*       0.2550       -0.2994        0.2982       -0.2533
 18    -0.2007        1.0000        0.1051       -0.2563        0.1628        0.2616       -0.4040        0.1565
 19    -0.4664*       0.1051        1.0000       -0.8716**     -0.6488**      0.6374**     -0.3855        0.6855**
 20     0.4788*      -0.2563       -0.8716**      1.0000        0.5101*      -0.7026**      0.6464**     -0.7369**
 21     0.2550        0.1628       -0.6488**      0.5101*       1.0000        0.1212       -0.3251       -0.0012
 22    -0.2994        0.2616        0.6374**     -0.7026**      0.1212        1.0000       -0.8845**      0.9713**
 23     0.2982       -0.4040       -0.3855        0.6464**     -0.3251       -0.8845**      1.0000       -0.8182**
 24    -0.2533        0.1565        0.6855**     -0.7369**     -0.0012        0.9713**     -0.8182**      1.0000
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** p<.01   * p<.05

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BMD02D CORRELATION WITH TRANSGENERATION - REVISED MAY 5, 1969
HEALTH SCIENCES COMPUTING FACILITY,UCLA

PROBLEM CODE ANALS
NUMBER OF VARIABLES  24
NUMBER OF CASES      9

VARIABLE FORMAT CARD(S)
(7X,F3.0,3F5.2,F6.2,2F4.0,F5.3,F6.3,F4.0,F5.2,2F7.3,F4.0/6X,F7.0/31X,
F4.0,F4.0,F5.3,F6.3,F4.0,F5.2,2F7.3/6X,F7.0)

REMAINING SAMPLE SIZE=     9

SUMS

      896.0000      33.5200      30.5200      29.5200      93.5600    4275.0000     2987.0000        10.8330
       30.6550     637.0000      53.3900      54.0290     104.9389     922.0000   482839.0000      4076.0000
     4056.0000       9.2670      29.6070     751.0000      62.5299      50.4970      114.6440    591538.0000
MEANS

       99.5555       3.7244       3.3911       3.2800      10.3956     475.0000      331.8887         1.2037
        3.4061      70.7778       5.9322       6.0032      11.6599     102.4444    53654.3320       452.8887
      339.5554       1.0297       3.2857      83.4444       6.9478       5.6108       12.7382     65726.4375
STANDARD DEVIATIONS

        8.3633       1.3691       1.5665       1.7682       2.4991     220.1044       86.8368         0.7377
        3.0108      40.4468       2.5950       4.8998       4.7654       7.1608    60053.1250       133.7706
       87.8481       0.4270       2.8732      45.2634       2.1579       4.5521        5.7977     75829.0625
CORRELATION MATRIX  LEARNING DISIBILITY

           COL.        COL.        COL.        COL.        COL.        COL.        COL.        COL.
             1           2           3           4           5           6           7           8
ROW        Age       IP DS      IP Cod    Ip Arith        SIS     V-First     V-Total   V-Latency
                                                                     Page     Circles

  1     1.0000      0.0841     -0.1012      0.3627      0.2392     -0.0032      0.0748     -0.2427
  2     0.0841      1.0000     -0.1549     -0.1088      0.3737     -0.1901      0.0843     -0.2373
  3    -0.1012     -0.1549      1.0000     -0.0044      0.5397     -0.6041      0.7240*     0.1723
  4     0.3627     -0.1088     -0.0044      1.0000      0.6452     -0.3717      0.4264      0.1789
  5     0.2392      0.3737      0.5357      0.6452      1.0000     -0.7463*     0.8023**    0.1047
  6    -0.0032     -0.1901     -0.6041     -0.3717     -0.7463*     1.0000     -0.9559**   -0.3907
  7     0.0748      0.0843      0.7240*     0.4264      0.8023**   -0.9559**    1.0000      0.2893
  8    -0.2427     -0.2373      0.1723      0.1789      0.1047     -0.3907      0.2893      1.0000
  9    -0.5282     -0.0463      0.1440     -0.1115     -0.0139     -0.3114      0.2496      0.4328
 10     0.5049     -0.2318     -0.2036     -0.0709     -0.3050      0.5954     -0.5089     -0.4876
 11     0.1935     -0.3865      0.1268     -0.0817     -0.1899      0.2903     -0.2510      0.1675
 12    -0.6867*     0.3127      0.3499     -0.5001      0.0371     -0.2765      0.2077      0.3928
 13     0.6079     -0.1100     -0.5385      0.3240     -0.1690      0.4662     -0.4183     -0.6333
 14    -0.4573      0.3484     -0.4601     -0.3840     -0.3697      0.3359     -0.5459     -0.1487
 15    -0.6434      0.4141      0.3400     -0.5368      0.0605     -0.2718      0.2344      0.1313
 16    -0.1778     -0.3514     -0.5780     -0.3838     -0.8269**    0.8998**   -0.8442**   -0.1516
 17     0.3042      0.3270      0.5990      0.4095      0.8448**   -0.6905*     0.6888*    -0.0447
 18    -0.6828*    -0.0292      0.2214      0.0298      0.1441     -0.2567      0.1120      0.5983
 19    -0.5119     -0.0349      0.0223     -0.0466     -0.0381     -0.2546      0.2083      0.4328
 20     0.5672     -0.0560      0.1032     -0.0593     -0.0078      0.2728     -0.2018     -0.5424
 21    -0.1090      0.2763      0.2210     -0.4569     -0.0332      0.1965     -0.1929     -0.0967
 22    -0.7469*     0.3244      0.1923     -0.4505     -0.0203     -0.1669      0.0718      0.4648
 23     0.6799*    -0.3514     -0.1014      0.3892      0.0192      0.0975     -0.0280     -0.4243
 24    -0.7831*     0.3373      0.1525     -0.3917      0.0034     -0.2117      0.0958      0.4576

           COL.        COL.        COL.        COL.        COL.        COL.        COL.        COL.
             9          10          11          12          13          14          15          16
ROW       V-30     V-Total     V-Total     V-Pause     V-Words        WISC     V-Total    NV-First
         Words       Words        Time        Mean     per Min        FSIQ    Variance        Page

  1    -0.5282      0.5049      0.1935     -0.6867*     0.6079     -0.4573     -0.6434     -0.1778
  2    -0.0463     -0.2318     -0.3865      0.3127     -0.1100      0.3484      0.4141     -0.3514
  3     0.1440     -0.2036      0.1268      0.3499     -0.5385     -0.4601      0.3400     -0.5780
  4    -0.1115     -0.0709     -0.0817     -0.5001      0.3240     -0.3840     -0.5368     -0.3838
  5    -0.0139     -0.3050     -0.1899      0.0371     -0.1690     -0.3697      0.0605     -0.8269**
  6    -0.3114      0.5954      0.2903     -0.2765      0.4662      0.3359     -0.2718      0.8998**
  7     0.2496     -0.5089     -0.2510      0.2077     -0.4183     -0.5459      0.2344     -0.8442**
  8     0.4328     -0.4876      0.1675      0.3928     -0.6333     -0.1487      0.1313     -0.1516
  9     1.0000     -0.8909**   -0.6936*     0.6853*    -0.6208     -0.1043      0.6415     -0.0179
 10    -0.8909**    1.0000      0.7253*    -0.7268*     0.7047*     0.0919     -0.7021*     0.3173
 11    -0.6936*     0.7253*     1.0000     -0.3372      0.1266      0.0484     -0.4867      0.1475
 12     0.6853*    -0.7268*    -0.3372      1.0000     -0.9237**    0.1471      0.9527**   -0.0872
 13    -0.6208      0.7047*     0.1266     -0.9237**    1.0000      0.0579     -0.8136**    0.2323
 14    -0.1043      0.0919      0.3484      0.1471      0.0579      1.0000      0.1204      0.1440
 15     0.6415     -0.7021*    -0.4867      0.9527**   -0.8136**    0.1204      1.0000     -0.1014
 16    -0.0179      0.3173      0.1475     -0.0872      0.2323      0.1440     -0.1014      1.0000
 17    -0.1899     -0.0482      0.0111     -0.0771     -0.0397     -0.1211     -0.0574     -0.9214**
 18     0.3417     -0.4095      0.1152      0.4962     -0.5712      0.4775      0.2971     -0.2424
 19     0.9745**   -0.8940**   -0.7214*     0.6434     -0.5757     -0.1533      0.6115      0.0830
 20    -0.8464**    0.8907**    0.6225     -0.6304      0.5986      0.0680     -0.5756     -0.0859
 21    -0.5697      0.4489      0.6612      0.1876     -0.2010      0.3548      0.1546     -0.0026
 22     0.6103     -0.6767*    -0.2414      0.9654**   -0.8899**    0.2840      0.8796**    0.0119
 23    -0.3205      0.4868      0.0358     -0.8261**    0.7937*    -0.2765     -0.7531*    -0.0746
 24     0.6719*    -0.7452*    -0.3381      0.9535**   -0.8631**    0.3324      0.8747**   -0.0318

           COL.        COL.        COL.        COL.        COL.        COL.        COL.        COL.
            17          18          19          20          21          22          23          24
ROW   NV-Total  NV-Latency       NV-30    NV-Total    NV-Total    NV-Pause    NV-Words    NV-Total
       Circles                   Words       Words        Time        Mean     per Min    Variance

  1     0.3042     -0.6828*    -0.5119      0.5672     -0.1090     -0.7469*     0.6799*    -0.7831*
  2     0.3270     -0.0292     -0.0349     -0.0560      0.2763      0.3244     -0.3514      0.3373
  3     0.5990      0.2214      0.0223      0.1032      0.2210      0.1923     -0.1014      0.1525
  4     0.4095      0.0298     -0.0466     -0.0593     -0.4569     -0.4505      0.3892     -0.3917
  5     0.8448**    0.1441     -0.0381     -0.0078     -0.0332     -0.0203      0.0192      0.0034
  6    -0.6905*    -0.2567     -0.2546      0.2728      0.1965     -0.1669      0.0975     -0.2117
  7     0.6888*     0.1120      0.2083     -0.2018     -0.1929      0.0718     -0.0280      0.0958
  8    -0.0447      0.5983      0.4328     -0.5424     -0.0967      0.4648     -0.4243      0.4576
  9    -0.1899      0.3417      0.9745**   -0.8464**   -0.5697      0.6103     -0.3205      0.6719*
 10    -0.0482     -0.4095     -0.8940**    0.8907**    0.4489     -0.6767*     0.4868     -0.7452*
 11     0.0111      0.1152     -0.7214*     0.6226      0.6612     -0.2414      0.0358     -0.3381
 12    -0.0771      0.4962     [illegible] -0.6304      0.1876      0.9654**   -0.8261**    0.9535**
 13    -0.0397     -0.5712     -0.5757      0.5986     -0.2010     -0.8899**    0.7937*    -0.8631**
 14    -0.1211      0.4775     -0.1533      0.0680      0.3548      0.2840     -0.2765      0.3324
 15    -0.0574      0.2971      0.6115     -0.5756      0.1546      0.8796**   -0.7531*     0.8747**
 16    -0.9214**   -0.2424     [illegible] -0.0859     -0.0026      0.0119     -0.0746     -0.0318
 17     1.0000      0.1897     -0.3131      0.3613      0.1353     -0.1690      0.2322     -0.1429
 18     0.1897      1.0000      0.2563     -0.3407      0.1904      0.6027     -0.5050      0.6447
 19    -0.3131      0.2563      1.0000     -0.9275**   -0.6086      0.5958     -0.3663      0.6541
 20     0.3613     -0.3407     -0.9275**    1.0000      0.4837     -0.6593      0.5559     -0.7132*
 21     0.1353      0.1904     -0.6086      0.4837      1.0000      0.2576     -0.4572      0.1580
 22    -0.1690      0.6027      0.5958     -0.6593      0.2576      1.0000     -0.9160**    0.9886**
 23     0.2322     -0.5050     -0.3663      0.5559     -0.4572     -0.9160**    1.0000     -0.8781**
 24    -0.1429      0.6447     [illegible] -0.7132*     0.1580      0.9886**   -0.8781**    1.0000
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** p<.01   * p<.05

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BMD02D CORRELATION WITH TRANSGENERATION - REVISED MAY 5, 1969
HEALTH SCIENCES COMPUTING FACILITY,UCLA

PROBLEM CODE ANAL6
NUMBER OF VARIABLES  24
NUMBER OF CASES     10

VARIABLE FORMAT CARD(S)
(7X,F3.0,3F5.2,F6.2,2F4.0,F5.3,F6.3,F4.0,F5.2,2F7.3,F4.0/6X,F7.0/31X,
F4.0,F4.0,F5.3,F6.3,F4.0,F5.2,2F7.3/6X,F7.0)

REMAINING SAMPLE SIZE=    10

SUMS

      1013.0000       45.5300       62.5100       48.5300      156.5900     3031.0000     4925.0000       12.4670
        12.4030     1288.0000       78.0199       30.0840      164.9229     1054.0000   159584.0000     3128.0000
      4744.0000       13.2680       14.9080     1107.0000       79.0000       36.3159      139.9909   230070.0000

MEANS

       101.3000        4.5530        6.2510        4.8530       15.6590      303.0999      492.5000        1.2467
         1.2403      128.8000        7.8020        3.0084       16.4923      105.4000    15958.3984      312.7998
       474.3999        1.3268        1.4908      110.7000        7.9000        3.6316       13.9991    23007.0000

STANDARD DEVIATIONS

         9.4160        1.6064        1.5989        1.5168        2.9445       62.3386      105.7105        0.9705
         0.3827       39.5300        0.2607        0.9152        4.8963        7.7057    11791.9922       62.4247
        94.5130        0.7564        0.5255       21.9142        0.1021        0.8959        2.6849    20561.2422

CORRELATION MATRIX  NORMAL

          COL.          COL.          COL.          COL.          COL.          COL.          COL.          COL.
           1             2             3             4             5             6             7             8
ROW                                                                         V-First       V-Total      V-Latency
          Age         Ip DS         Ip Cod       Ip Arith        SIS          Page         Circles

  1     1.0000        0.0563       -0.3281        0.2005       -0.0440       -0.6727*       0.7002*      -0.2675
  2     0.0563        1.0000        0.1762       -0.4142        0.4270       -0.3594        0.4725        0.2609
  3    -0.3281        0.1762        1.0000        0.4861        0.8887**     -0.0971       -0.0995        0.4874
  4     0.2005       -0.4142        0.4861        1.0000        0.5535       -0.4821        0.2353        0.4116
  5    -0.0440        0.4270        0.8887**      0.5535        1.0000       -0.4969        0.3246        0.6187
  6    -0.6727*      -0.3594       -0.0971       -0.4821       -0.4969        1.0000       -0.9558**     -0.3434
  7     0.7002*       0.4725       -0.0995        0.2353        0.3246       -0.9558**      1.0000        0.2117
  8    -0.2675        0.2609        0.4874        0.4116        0.6187       -0.3434        0.2117        1.0000
  9    -0.5699        0.0898        0.6169        0.2088        0.4910        0.1531       -0.3159        0.2373
 10     0.5822        0.3458       -0.5356       -0.1867       -0.1986       -0.5998        0.7921**     -0.0704
 11    -0.2180       -0.1878       -0.1879        0.0608       -0.1727        0.0393        0.0244       -0.3019
 12    -0.6022       -0.1713        0.4485        0.0403        0.1712        0.5299       -0.6727*      -0.0832
 13     0.6151        0.3731       -0.5202       -0.1928       -0.1786       -0.6162        0.8042**     -0.0377
 14     0.2738        0.0667       -0.3119       -0.3591       -0.3169        0.1526       -0.1050       -0.2920
 15    -0.1111        0.0736        0.3964        0.1209        0.3176        0.0147       -0.1845        0.1879
 16    -0.3649       -0.6341*      -0.0202       -0.0653       -0.3910        0.6198       -0.6354*      -0.0823
 17     0.4596        0.6183       -0.0718        0.0191        0.3085       -0.6653*       0.7139*      -0.0409
 18    -0.2522       -0.6207       -0.0728        0.0228       -0.3672        0.4583       -0.5064       -0.1801
 19    -0.1917       -0.5839        0.1336        0.4843        0.0030        0.1065       -0.2178        0.2190
 20     0.0096        0.3145       -0.0563        0.0687        0.1772       -0.3850        0.4191        0.4516
 21    -0.2150       -0.0820       -0.4509       -0.3810       -0.4853        0.2778       -0.1259        0.0204
 22     0.0073       -0.2431        0.0375       -0.0807       -0.1544        0.3843       -0.4154       -0.4735
 23     0.0219        0.3294       -0.0330        0.0904        0.2092       -0.4122        0.4388        0.4664
 24     0.0083        0.1666        0.3407        0.1229        0.3386       -0.0516        0.0007       -0.2236

          COL.          COL.          COL.          COL.          COL.          COL.          COL.          COL.
           9            10            11            12            13            14            15            16
ROW       V-30        V-Total       V-Total       V-Pause       V-Words        WISC        V-Total       NV-First
          Words         Words         Time          Mean        Per Min        FSIQ        Variance        Page

  1    -0.5699        0.5822       -0.2180       -0.6022        0.6151        0.2738       -0.1111       -0.3649
  2     0.0898        0.3458       -0.1878       -0.1713        0.3731        0.0667        0.0736       -0.6341*
  3     0.6169       -0.5356       -0.1879        0.4485       -0.5202       -0.3119        0.3964       -0.0202
  4     0.2088       -0.1867        0.0608        0.0403       -0.1928       -0.3591        0.1209       -0.0653
  5     0.4910       -0.1986       -0.1727        0.1712       -0.1786       -0.3169        0.3176       -0.3910
  6     0.1531       -0.5998        0.0393        0.5299       -0.6162        0.1526        0.0147        0.6198
  7    -0.3159        0.7921**      0.0244       -0.6727*       0.8042**     -0.1050       -0.1845       -0.6354*
  8     0.2373       -0.0704       -0.3019       -0.0832       -0.0377       -0.2920        0.1879       -0.0823
  9     1.0000       -0.6554*       0.1531        0.7509*      -0.6803*      -0.3729        0.5634       -0.1133
 10    -0.6554*       1.0000        0.1985       -0.8967**      0.9949**     -0.1088       -0.6162       -0.3109
 11     0.1531        0.1985        1.0000        0.0351        0.0986       -0.4861       -0.5407       -0.1240
 12     0.7509*      -0.8967**      0.0351        1.0000       -0.9146**      0.1756        0.6571*       0.0344
 13    -0.6803*       0.9949**      0.0986       -0.9146**      1.0000       -0.0613       -0.5703       -0.3055
 14    -0.3729       -0.1088       -0.4861        0.1756       -0.0613        1.0000        0.4055       -0.1654
 15     0.5634       -0.6162       -0.5407        0.6571*      -0.5703        0.4055        1.0000       -0.1391
 16    -0.1133       -0.3109       -0.1240        0.0344       -0.3055       -0.1654       -0.1391        1.0000
 17     0.0225        0.4429        0.1861       -0.1376        0.4327        0.1435        0.0536       -0.9792**
 18     0.1951       -0.2924        0.0491        0.0867       -0.3047       -0.4000       -0.0202        0.8174**
 19     0.1529       -0.1368        0.1745       -0.1425       -0.1579       -0.7570*      -0.2984        0.5773
 20    -0.2285        0.3460        0.1761       -0.2143        0.3365        0.1975       -0.1395       -0.4004
 21    -0.4691        0.3031        0.2797       -0.3211        0.2794        0.1003       -0.5371        0.3293
 22     0.2601       -0.3633       -0.1248        0.2524       -0.3586       -0.1679        0.1148        0.2475
 23    -0.2094        0.3396        0.1620       -0.2039        0.3315        0.1991       -0.1112       -0.4283
 24     0.4626       -0.2001        0.0798        0.2839       -0.2122       -0.3250        0.1472       -0.3142

          COL.          COL.          COL.          COL.          COL.          COL.          COL.          COL.
          17            18            19            20            21            22            23            24
ROW     NV-Total      NV-Latency     NV-30        NV-Total      NV-Total      NV-Pause      NV-Words      NV-Total
        Circles                      Words         Words         Time          Mean         Per Min       Variance

  1     0.4596       -0.2522       -0.1917        0.0096       -0.2150        0.0073        0.0219        0.0083
  2     0.6183       -0.6207       -0.5839        0.3145       -0.0820       -0.2431        0.3294        0.1666
  3    -0.0718       -0.0728        0.1336       -0.0563       -0.4509        0.0375       -0.0330        0.3407
  4     0.0191        0.0228        0.4843        0.0687       -0.3810       -0.0807        0.0904        0.1229
  5     0.3085       -0.3672        0.0030        0.1772       -0.4853       -0.1544        0.2092        0.3386
  6    -0.6653*       0.4583        0.1065       -0.3850        0.2778        0.3843       -0.4122       -0.0516
  7     0.7139*      -0.5064       -0.2178        0.4191       -0.1259       -0.4154        0.4388        0.0007
  8    -0.0409       -0.1801        0.2190        0.4516        0.0204       -0.4735        0.4664       -0.2236
  9     0.0225        0.1951        0.1529       -0.2285       -0.4691        0.2601       -0.2094        0.4626
 10     0.4429       -0.2924       -0.1368        0.3460        0.3031       -0.3633        0.3396       -0.2001
 11     0.1861        0.0491        0.1745        0.1761        0.2797       -0.1248        0.1620        0.0798
 12    -0.1376        0.0867       -0.1425       -0.2143       -0.3211        0.2524       -0.2039        0.2839
 13     0.4327       -0.3047       -0.1579        0.3365        0.2794       -0.3586        0.3315       -0.2122
 14     0.1435       -0.4000       -0.7570*       0.1975        0.1003       -0.1679        0.1991       -0.3250
 15     0.0536       -0.0202       -0.2984       -0.1395       -0.5371        0.1148       -0.1112        0.1472
 16    -0.9792**      0.8174**      0.5773       -0.4004        0.3293        0.2475       -0.4283       -0.3142
 17     1.0000       -0.7785**     -0.5797        0.3600       -0.3143       -0.2297        0.3858        0.3226
 18    -0.7785**      1.0000        0.7176*      -0.6129        0.0599        0.4938       -0.6322*      -0.0472
 19    -0.5797        0.7176*       1.0000       -0.4372       -0.0795        0.3735       -0.4462        0.1394
 20     0.3600       -0.6129       -0.4372        1.0000        0.5706       -0.9701**      0.9990**     -0.6493*
 21    -0.3143        0.0599       -0.0795        0.5706        1.0000       -0.5957        0.5339       -0.8410**
 22    -0.2297        0.4938        0.3735       -0.9701**     -0.5957        1.0000       -0.9677**      0.7218*
 23     0.3858       -0.6322*      -0.4462        0.9990**      0.5339       -0.9677**      1.0000       -0.6259
 24     0.3226       -0.0472        0.1394       -0.6493*      -0.8410**      0.7218*      -0.6259        1.0000
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** p<.01   * p<.05

VITA

Patricia Leigh Beiland Morgan

Candidate for the Degree of

Doctor of Philosophy

Thesis: THE DIFFERENTIAL EFFECTS OF VISUAL BACKGROUND AND FATIGUE ON AUTOMATIZED TASK PERFORMANCE IN LEARNING DISABLED AND NORMAL CHILDREN

Major Field: Psychology

Biographical:

Personal Data: Born in Cushing, Oklahoma, November 22, 1931, the daughter of Mr. and Mrs. J. P. Beiland. Mother of one son, Cliff.

Education: Graduated from Cushing High School, Cushing, Oklahoma, in May, 1948; received Bachelor of Business Adminstration degree in Accounting from the University of Oklahoma, Norman, Oklahoma, in January, 1952; attended the University of Oklahoma in 1971 as unclassified in the Graduate College; received Master of Science in Psychology from Oklahoma State University in May, 1974; completed requirements for the Doctor of Philosophy degree at Oklahoma State University in July, 1976.

Professional Experience: Served as a graduate instruction assistant in the Department of Psychology, Oklahoma State University, 1973-1974; National Institute of Mental Health Fellow, 1974-1975; intern at the University of Arkansas Medical Center, Little Rock, Arkansas, 1975-1976.