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Learning & Productivity

Supporting Research

Research concerned with identifying the relationship(s) between academic achievement and individual learning style has provided consistent support for the following:

a) students do learn differently from each other;

b) student performance in different subject areas is related to how individuals do, in fact, learn;

c) when students are taught with approaches and resources that complement their unique learning styles, their achievement is significantly increased

(DeBello, 1985; Dunn, DellaValle, Dunn, Geisert, Sinatra, & Zenhausern, 1986; Dunn, Dunn, Primavera, Sinatra, & Virostko, 1987; Dunn, Krimsky, Murray and Quinn, 1985; Dunn, Cavanaugh, and Zenhausern, 1982; Giannitti, 1988; Hill, 1987; White, 1981; Hodges, 1985; Jarsonbeck, 1984; Kroon, 19 85; Lemmon, 1985; Lynch, 1981;, MacMurren, 1985; Martini, 1986; Miles, 1987; Murrain, 1983; Pizzo, 1981; Shea, 1983; and Spires, 1983).

In addition to the research documentation substantiating the positive effects that occur when students are taught in ways that are responsive to how they each learn, widespread practitioner corroboration has been published based on classroom or schoolwide experiences *(Ballinger & Ballinger, 1982; Carruthers & Young, 1980; Cavanaugh, 1981; Dunn, 1981; Fiske, 1981; Dunn & Griggs, 1987, 1989a, 1989b; Gardiner, 1983; Hodges, 1982, 1983; Jenkins, 1982, 1986; Lemmon, 1982, 1985; Pizzo, 1982; Vigna & Martin, 1982; and Wheeler, 1980).*

This document provides an overview of selected correlational and experimental studies concerned with the identification of students' learning style characteristics with the Learning Style Inventory (LSI).

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Achievement Gains Through Learning Styles Matching

A doctoral investigation conducted by Spires *(1983)* revealed that implementation of a learning styles program resulted in significant gains in reading and mathematics achievement on standardized achievement tests.

The Learning Style Inventory *(Dunn, Dunn, & Price, 1978)* was administered to students in grades 3 through 6, and the Learning Style Inventory Primary Version *(Perrin, 1982)* to grades K through 2. Analyses of the data indicated that teaching students through their individual learning styles resulted in significantly higher reading and mathematics achievement, particularly on those subtests requiring higher level cognitive abilities, such as reading concepts.

A study was conducted to (a) identify how the Dunn, Dunn and Price Learning Style Model had been implemented in seven diverse regions of the United States and (b) develop guidelines for providing instruction for students with learning styles not currently accommodated in conventional classrooms *(Klavas, Dunn, Griggs, Geisert, Gemake, & Zenhausern, 1994)*. Many practitioners had reported that such students often were classified as poor achievers, learning disabled, discipline problems, or dropouts; but that academic reversals had occurred when instruction was redesigned to respond to their particular learning-style preferences as revealed by Dunn, Dunn, & Price's *(1989)* LSI *(Andrews,1990; Brunner & Majewski, 1990; Elliot, 1991, Klavas, 1993, Perrin, 1990; Stone, 1992)*. Braio *(1995)* analyzed the effects of gradually implementing learning-style strategies on reading achievement and attitude toward instruction with 81 special education and 35 low-achieving general education-urban students in grades four, five, and six.

Pre-and post-tests concerned with structural analysis instructional units were administered in each of five phases, of two weeks each, to determine reading achievement gains. Significant gains in reading achievement for both groups were revealed when students were taught using gradually-increasing, learning style approaches that included responsiveness to students' varied Sound, Light, Temperature, Seating, Mobility, and Perceptual preferences. Removal of learning-style approaches evidenced decreased achievement. Statistical significance for attitude was achieved by the general education students, but not those in special education, perhaps because these students' classroom environment often reflects a relaxed traditional ambiance.

Marino, *1993* argues that students will accept and even learn from homework provided that its design takes into consideration students' learning styles and study skills. He describes an effort at an all-boys high school in Brooklyn, New York, to tailor class instruction and homework to results obtained from a Learning Styles Inventory.

Klavas, *1994* describes how a North Carolina elementary school altered teaching methods to suit varied learning styles of the students based on the results of a Learning Styles Inventory. She discusses changes made based on students' perceptual preferences, time of day preferences, environmental preferences, and sociological preferences. Discipline problems dropped dramatically and test scores rose precipitously.

This investigation *(Braio, 1995)* analyzed the effects of incremental implementation of learning-style strategies on reading achievement and attitude toward instruction via structural analysis with special education and low-achieving general education students in grades four, five and six. To identify individual preferences, the Learning-Styles Inventory *(Dunn, Dunn, & Price, 1990)* was administered to students who attended an urban intermediate school. Two categories were targeted: 81 special education students and 35 low-achieving general education students. Both categories were divided into two sub-groups: group one was incrementally matched according to learning-style preferences for sound, light, temperature, design, mobility, tactual, kinesthetic, auditory and visual elements; group two consisted of unmatched and/or no preferences. Instructional units were divided into five phases of two weeks each. Structural analysis units and varied learning-style preferences gradually were introduced during these instructional phases: (phase 1) compound words using traditional teaching methods; (phase 2) plurals accommodating for sound, light, temperature, design and/or mobility elements; (phase 3) prefixes accommodating for sound, light, temperature, design and/or mobility elements and/or tactual and kinesthetic modalities; (phase 4) suffixes accommodating for sound, light, temperature, design and/or mobility elements and/or tactual, kinesthetic, auditory and/or visual modalities; and (phase 5) contractions using traditional teaching methods. Pre- and post-tests were administered in each of the five phases to determine reading achievement gains. Significant gains in reading achievement for both special education and general education students were found when students were taught using incremental learning styles strategies. To determine attitudinal changes toward reading, the Semantic Differential Scale *(Pizzo, 1981)* was administered four times

throughout this study: before phase 1 (a baseline measure); after phase 1 (traditional teaching); before phase 5 (learning-styles intervention); and after phase 5 (with the return to traditional teaching and the removal of learning styles). Statistical significance for attitude was not achieved for the special education students. However, the general education students' attitudes toward reading became increasingly favourable after learning-style instruction and a decrement occurred after learning-style methods were removed. These data confirmed the importance of matching learning-styles preferences with complementary instructional strategies and environments.

Experimental studies *(Dunn, Griggs, Olson, & Beasly, 1995)* based on the Dunn, Dunn and Price Learning Style Model and conducted between 1980-1990 were identified to determine the value of teaching students through their learning-style preferences. Thirty six studies provided a database of 3,181 participants. Results were synthesized through meta-analysis and the standard normal curve suggests that students whose learning styles are accommodated would be expected to achieve 75% of a standard deviation higher than students who have not had their learning styles accommodated. This finding indicates that matching students' learning-style preferences with educational interventions compatible with those preferences is beneficial to their academic achievement.

Through the use of greater tactual, kinesthetic, and global methodology during reading instruction, the fifteen students enrolled in the program experienced an average increase of 73.33 percent in selfconcept, according to the Primary Self-Concept Inventory. These same students experienced an average gain of 7.25 months in reading achievement, as measured by the Iowa Test of Basic Skills, during five months of instruction *(Settle, 1989)*.

After a brief review of the literature on sound, a study by J. Pizzo *(1981)* is described involving learning style preferences of 64 6th graders. Results of exposure to either noise or sound revealed that Ss' who preferred quiet performed best in a quiet acoustic environment (AE). Ss' who preferred sound performed best in a noisy AE. Ss' in an environment that complemented their learning style preference also had statistically higher attitudinal scores than their mismatched peers, and a mismatched environment affected Ss' reading achievement and attitudes toward intellectual ability and other strengths.

A Summary of Learning Style Preferences at Various Grade Levels

An examination of the ways in which learning style characteristics appeared to change as students advanced from grade to grade was conducted by Price *(1980)*. It was revealed that selected environmental, emotional, sociological, and physical traits appeared to be stable over time, whereas others tended to parallel the growth curve. A total of 3,972 subjects in grades 3 through 12 completed the LSI during the 1979-1980 school year. Some of the statistically significant findings revealed were:

- The higher the grade level, the more Sound and Light were preferred.
- The higher the grade level, the less preference was indicated for Formal Design (wooden, plastic, or steel chairs when studying).
- Self Motivation decreased during grades 7 and 8, but then a gradual increase was evidenced in each of the grades thereafter.
- The higher the grade level, the less Teacher-Motivated students became.
- The higher the grade level, the less Motivated in general, students were. The biggest shift was between grades 7 and 8, with grade 11 having the highest peak for being Unmotivated.
- An overall decrease in the need for Structure was evidenced the higher the grade.
- Although the junior high school years are considered strong periods for Peer influence, there was a greater need to learn/study alone in grades 9, 10, 11, and 12 than during any other interval.
- The highest need to learn with Peers occurred in grades 6 through 8; the lowest need was in grade 12, followed by grade 9, with a slight increase in grades 10 and 11.
- The younger the student, the more tactual and kinesthetic he/she was. Those modalities were followed by the development of visual strengths and, beginning with grades 5 and 6, the development of auditory strengths.

Price *(1980)* revealed how learning-style changed as students moved from elementary school into adolescence and young adulthood. Others found that learning styles are also different by achievement level, gender, and age *(Dunn & Griggs, 1995)*. Thus general changes in style can be anticipated as students develop.

Classroom Discipline

A survey *(Campbell, 1990)* of teachers in an elementary school building and a literature review indicated that the causes of the lack of individualizing student learning were related to class size, poor leadership, teacher training, and poorly developed learning style instruments. A practicum was designed for classroom teachers to recognize differential learning styles and incorporate them into their repertoire of teaching. This practicum involved 31 sixth grade students and included five behavioural objectives: (1) improved study habits, attitudes, and behaviour; (2) employment of four distinct teaching methods; (3) administration of the Dunn, Dunn, and Price Learning Style Inventory self-reporting instrument to 27 elementary teachers; (4) in-service on learning styles for all elementary teachers; and (5) parental review of child's learning style inventory results. Outcomes of the practicum showed improved work habits in 27 students, improved classroom attitudes in 26 students, and improved classroom behaviour in 10 students. The students and their classroom teacher found the four group teaching methods that were introduced and demonstrated to them to be an excellent experience.

Cognitive Style

Go into any classroom, at any level, in any school, and select a textbook in any subject. Chances are excellent that the textbook is not presented compatibly with how more than half the students in that classroom learn best. How is that possible? A large majority of educators are analytic processors whereas many students at any level are global processors. Neither method is better than the other and both types can learn the same information; they just do it differently. Analytics respond best when ideas are presented sequentially with new information building upon past knowledge leading up to eventual understanding of entire concepts. Globals/ Holistics, on the other hand, need to "see the whole picture" first. They respond best when a teacher begins with a short story that explains why learning this information is important. Globals must be able to relate new information to what they already know. For a greater understanding of the differences between global and analytic processors, we turn to the research.

Kaley *(1977)* investigated field dependence versus field independence and how it affected sixth-grade readers. She found that of the good readers, half were analytic and half were global. Of the poor readers, 85% were global. She concluded that good readers were field independent (analytic) because they could see each letter, sound it out individually, and piece it together with others to form words.

Two years later, Trautman *(1979)* explored the relationship between selected instructional techniques and cognitive style. He used Contract Activity Packets (CAP' s) with junior-high school social studies classes. Half the objectives were written analytically and half were written globally. Each student completed all the objectives. Trautman's findings indicated that the groups matched with their processing styles achieved statistically higher gains on those objectives than on the objectives written in the unmatched style.

Further support for matching instructional techniques to cognitive style was provided by Tanenbaum *(1982)* who studied high school students enrolled in nutrition classes. Trautman's, Douglas', and Tanenbaum's students all produced significant gains when instructional techniques matched their cognitive styles.

At about the same time, Dunn, Cavanaugh, Eberle, and Zenhausern *(1982)* found that right/left brain dominance was linked with certain learning-style elements. Using a scale for brain dominance developed by Zenhausern, the researchers identified high school students as being either right-brain dominant or left-brain dominant. Their findings revealed that students who were strongly left-brain dominant needed quiet, bright light, formal design, were persistent, and required no intake while studying. Conversely, right-dominant students needed sound, preferred low lighting and informal seating, were not persistent, and often required intake while learning. The findings of Dunn, Cavanaugh, Eberle, and Zenhausern constituted a significant breakthrough in our understanding of the importance of cognitive processing. For the first time, specific conditions under which analytic and globals learn were identified.

One of the first correlational studies that revealed a relationship between IQ and cognitive processing was conducted by Cody *(1983)*. She examined the learning styles of highly gifted, average, and underachieving students. Among her findings were that: (a) of the students with an IQ of 145 or higher, 9 of 10 were global: (b) of the students with an IQ of 135 or higher, 8 of 10 were global: (c) of the students with an IQ of 125 or higher, 8 of 10 were analytic: and (d) analytics performed better than globals in school. Furthermore, Cody noted that the learning styles of gifted, average, and underachievers were very different from each other.

The most crucial point that teachers need to know is how to teach both analytically and globally. Analytics learn best when information is presented in a step-by-step sequence, whereas globals need to understand the whole concept first; they then focus on the details. To engage a global learner, a teacher should introduce a new lesson with a humorous story and use diagrams, illustrations, and pictures to represent key ideas. It is important to note that many globals prefer to work with peers rather than alone or with a teacher, and they often like to structure their own tasks. Globals appear to concentrate best with Sound, Soft or Low Lighting, an Informal seating arrangement, and some form of Intake. Also, they take frequent breaks while studying and often work on several tasks simultaneously. Analytics, on the other hand, prefer to work on one assignment at a time before proceeding to the next. They prefer a quiet, well illuminated environment and formal seating. Most analytics do not require Intake to concentrate *(Dunn, Cavanaugh, Eberle, & Zenhausern, 1982)*.

Many highly gifted students and most underachievers are global. The difference between the two groups is that underachievers tend to become unmotivated and are essentially Tactile/Kinesthetic learners. Globals appear to concentrate best with Sound, Soft or Low Light. It would be wise to vary tasks to increase students' motivation and persistence and to encourage active, hands-on participation while learning.

It is interesting to note that the majority of elementary school-age children are global. However, as children develop and progress through the grades, many become increasingly analytic *(Dunn, Dunn, 1992, 1993; Dunn, Dunn, & Perrin, 1994)*.

Counselling

Griggs, Price, Kopal, and Swaine *(1984)* tested 165 sixth-grade, suburban students for their styles with the Learning Style Inventory *(Dunn, Dunn, and Price, 1978)*. The 19 who revealed either Low Motivation and a High Need for Structure or High Motivation and a Low Need for Structure were randomly assigned to one of three groups:

(1) High Structure & Counselling: Compatible: Low Motivation, High Structure (three students); Incompatible: High Motivation, Low Structure (two students);

(2) Low Structured Counselling: Compatible: High Motivation, Low Structure (four students); Incompatible: Low Motivation, High Structure (three students);

(3) Control Group: (seven students).

All groups met for eight sessions conducted weekly during a two-month period. The treatment objectives, to explore the world of work, were identical, but their strategies differed.

A one-way analysis of covariance was used to analyze the data. The independent variable had three levels: Compatible, Incompatible, and Control; the covariate was pre-test scores, and the dependent variable was post-test score on the Occupational List Recall Test (OLRT). The comparison of groups for the adjusted OLRT post-test score was significant ($p<.01$; $f=6.51$). Students in the Compatible group had an adjusted mean of 50.68; the Incompatible's was 45.56; and the Control's 38.26.

Students whose learning style preferences for Motivation and Structure were accommodated in the counselling groups achieved significantly higher Career Awareness scores than those whose styles were not matched.

Dunn, et al. *(1993)* compared the learning style characteristics of 687 Mexican-American and 70,000 Anglo-American elementary school children (Grades 4-6). Data suggest that it is crucial that counsellors and educators identify their students' learning styles and experiment with counselling and learning strategies that respond to individuals' strengths.

A comparison *(Dunn, et al. 1990)* of 300 African-American, Chinese-American, Greek-American, and Mexican-American 4th-6th graders' mean scores on the Group Embedded Figures Test (GEFT) indicated that all 4 groups were field dependent. Ss' also completed the Learning Style Inventory. Analysis revealed significant correlations between the elements of Responsibility/Conformity, Learning Alone vs Learning with Peers, Learning in the Evening vs Learning in the Morning, Parent-Figure Motivated, Self-Motivated, and Learning in Several Ways rather than through routines and patterns. Data suggest that children from different areas of the American subculture have different patterns of preferred learning strategies; alternative classroom environments, methods, and resources could contribute to an effective education for such students.

Cultural Comparisons

The purpose of the study by Jackson-Allen, 1994 was to identify and compare the learning style preferences of low-achieving and high-achieving young African-American males. Measures of perceptual preferences for 22 learning modalities were obtained from a sample of 50 ninth- and tenth grade

students. Half of the students were randomly selected from a pool identified as low-achievers, and the other half from a pool identified as high-achievers. The pools were identified based on grade averages in core academic courses. The Dunn, Dunn, and Price Learning Style Inventory was administered to each of the two groups. Independent t-test comparisons of mean raw scores on each of the learning modalities yielded only three significant differences between low and high achievers. High-achievers had stronger preferences for motivation and were more parent motivated than low-achievers. Low-achievers, however, had stronger preferences for learning experiences that involve opportunities for mobility. From the results of this study, one might conclude that young African-American males who are identified as either low- or high-achievers are more alike than they are different in their preferences for various learning modalities.

Dunn, et al. *(1993)* examined learning style characteristics of Mexican-American students (n=687) in grades 4 through 6 and compared results to those from 70,000 Anglo-American children. Compared to Anglo Americans, Mexican-American students preferred formal seating designs and were significantly more peer oriented. Sex differences also were found.

Ewing *(1993)* compared learning style preferences among gifted African-American (n=54), Mexican-American (n=61), and American-born Chinese (n=40) middle grade students attending Chicago, Illinois, public schools. Significant ethnic, gender, and grade differences were found. All three groups preferred studying in the afternoon and bright light and did not prefer noise, structure, and authority figures.

Tseng *(1993)* investigated the differences in learning styles among Chinese American, Anglo American and Hispanic American students in elementary third and fourth grades. Ninety students were randomly selected to complete the Learning Style Inventory by Dunn, Dunn and Price. There are some differences among the three ethnic groups. Discussion emphasized how the cultures influence the learning styles and how teachers and parents can apply the results of this research.

The primary focus of this study *(Sanders, 1993)* was to determine if student learning styles, as measured by the Learning Style Inventory, would influence achievement in mathematics and reading of students using an Integrated Learning System (ILS). The secondary purpose was to investigate the effects of an ILS upon achievement and the interaction of learning styles and demographic attributes which include gender, economic status, and ethnicity. Subjects for this study were fifth grade students from a Central Texas school district. Descriptive statistics and statistical analyses expressing means, standard deviations, adjusted means, and statistical significance ($p<.05$) were used to compare achievement. Statistical data are resultants of the 1991- 92 norm-referenced assessment test for Texas. The following results were gleaned from this study. (1) In examining the sixty-two comparisons of adjusted means from the mathematics and reading parts of this study, the control and experimental groups had near equal results. (2) The sixty-two comparisons for statistical significance in this study indicated that only two groups from the reading part of the study, the control groups for auditory learners, who did not qualify for the federal government's free or reduced lunch program and European American, auditory learners, achieved statistical significance. (3) In six of the seven comparison groups which performed the best with an ILS as a supplement to traditional instruction, haptic learners were involved. All four of the comparison groups which performed the best with an ILS as a supplement to traditional mathematics instruction were haptic groups. Two of the three comparison groups which performed the best with an ILS as a supplement to traditional reading instruction were Hispanic groups. (4) In three of the five comparison groups which performed the best with traditional mathematical instruction, visual learners were involved. In the other two comparisons which performed the best with traditional mathematical instruction, Hispanic learners were involved. In four of the comparison groups which performed the best with traditional reading instruction, auditory learners were involved.

Lo *(1994)* investigated the learning style differences among gifted, regular classroom, and resource room/remedial program students in grades 3 to 6 in Taiwan, and their relations to gender and grade. A total of 660 students from six elementary schools in Taipei were administered the Chinese Learning Style Inventory *(Dunn, Dunn, & Price, 1989)*. Four hundred students (120 gifted, 160 regular classroom, and 120 remedial program Students), with equal number of female and male students in each grade, were selected from a total of 592 students who had valid LSI data and met the IQ criteria. Both descriptive and inferential statistical analysis were used in this study. The number and frequency of students' learning style preference on the 22 elements of the LSI were used to determine if Chinese students have learning style preference(s). Then a three-way analysis of variance (Group x Gender x Grade), Tukey's post hoc comparisons, and a

stepwise discriminant analysis were used to examine group, gender, and grade differences on learning styles. The findings indicated significant main effects of group difference on 11 LSI elements, significant main effects of gender difference on 5 LSI elements, and significant main effects of grade difference on 14 LSI elements. In addition, interactions were also found on 8 LSI elements. The discriminant analysis revealed that 9 LSI elements significantly discriminated among the three groups, and overall, 61.25% of the subjects were classified in their groups with accuracy. In general, there are more learning style differences between remedial program students and gifted or regular classroom students than between gifted and regular classroom students; female students are more self-motivated, more persistent, and more responsible than male students; and the student's learning experiences may be more influential than genetics in determining the development of learning styles.

Hong et al. *(1995)* examined whether changes in children's learning styles can occur from cultural, social, and environmental changes within an ethnic group using Learning Style Inventory scores from a sample of 49 Korean-American 10-14 yr olds (20 boys and 29 girls) and 146 Korean 11-13 yr olds (78 boys and 68 girls). Similarities as well as differences in learning styles were found between the 2 nationalities and between boys and girls in both groups. Those learning styles on which differences were significant might have been influenced by the social and environmental differences found between Korea and the United States. The pattern of preferred learning styles for Korean-American subjects tended to be similar to that reported for students in the U.S., indicating that the Korean- American subjects had become acculturated and their learning styles became close to the learning style pattern of students in the U.S.

Hickson *(1994)* explored learning style differences in ethnic populations and ways to accommodate these differences to enhance student success. Thirty-six Asian, 47 Hispanic, 78 African-American, and 58 European American 4th-6th graders completed the Learning Styles Inventory. Results showed that 12 variables on that instrument reliably discriminated among the 4 ethnic groups. These variables were Design, Requires Intake, Late Morning, Noise Level, Kinesthetic, Responsible, Parent Figure Motivated, Authority Figures Present, Temperature, Afternoon, Auditory, and Visual. Recommendations were made for adapting the environment to accommodate students according to their preferred learning styles.

Ewing et al. *(1992)* examined whether significant group, gender, and grade differences existed in the preferred learning styles of gifted minority 6th-8th graders. Fifty four African-American (20 males, 34 females), 61 Mexican-American (26 males, 35 females), and 40 Chinese-American (25 males, 15 females) students completed the Learning Style Inventory. Significant gender differences were found in preferences for tactile, and intake modality. All 3 ethnic groups were responsible and motivated. African-American subjects preferred a visual modality and studying in the afternoon. Mexican-Americans preferred a kinesthetic modality. Chinese-Americans reported the strongest preference for the visual modality of the 3 groups.

The purpose of the study, Jacobs *(1987)* was to determine whether a difference existed in the learning style of Afro-American high, average, and low achievers and to compare the learning styles of Afro-American and Euro-American high, average, and low achievers.

The sample included 300 students from three middle schools in the south. The local school district uses the Achievement Series of the Comprehensive Assessment Program Test to sort students according to achievement levels. The Learning Style Inventory was administered to ascertain individual learning style characteristics. Chi-square was utilized to analyze the data. Analysis of the data revealed that there are differences in learning styles according to achievement level, sex, and race: (1) African-American high achievers had strong preferences for teacher motivation; African-American average achievers had strong preferences for auditory learning; African-American low achievers had a strong preference for persistence. (2) More African-American male high achievers preferred less structure than did female average and low achievers; more African-American male low achievers preferred authority figures present while learning than did female achievers. (3) More European-American high achievers preferred auditory learning, while European-American average achievers were teacher motivated and European-American low achievers were less persistent. (4) More European-American male high and average achievers preferred sound; European-American male low achievers were less persistent than European-American female achievers. European-American female high achievers were more teacher-motivated than their male counterparts. (5) More European-Americans displayed a strong preference for bright lights while learning compared to African-Americans. African-Americans were more teacher-motivated and European-Americans were less teacher-motivated. (6) More European-American high achievers had a strong preference

for auditory learning, while African-American high achievers expressed a strong preference for teacher motivation. African-American average achievers exhibited a strong preference for structure, while European-American average achievers expressed less preference for structure. African-American low achievers were more persistent than European-American low achievers. This study verifies that students prefer to learn in ways that are personally unique to each individual student.

Williams *(1989)* investigated learning style preferences of urban African-American middle school students. The preferred learning style of urban African-American middle school learning disabled (LD) and non-learning disabled (LD) students was studied. Also, the learning styles of urban African-American middle school LD and non-LD male and female students were described.

Methods and Procedures:
The sample used in the study was composed of 86 urban African-American middle school students. The subjects consisted of 43 learning disabled (LD) and 43 non-learning disabled (LD) students, from grades six, seven, and eight. The Learning Style Inventory (LSI) was the instrument used to measure learning style. The LSI was administered to subjects using the auditory tape method and LSI answer sheets. The answer sheets were collected from subjects and mailed to Price Systems, Inc., in Lawrence, Kansas, for computerized scoring and printed profile sheets for individual subjects' learning styles. Also, a profile sheet containing a group summary of the subjects' learning styles was given.

Findings:
The multivariate analysis of variance (MANOVA), was used to analyze the learning style of subjects in the study. Large percentages of subjects, as a group, did not show learning style preferences. In the LSI, however, statistically significant differences were found between the LD and non-LD subjects on the 'light' and 'intake' preferences. Statistically significant differences were evident between LD and non-LD male and female subjects on the 'noise', 'light', 'responsible' and 'tactile' LSI preferences.

Conclusions:
The findings contribute to the body of research regarding the learning style of black children. The learning styles of the African-American children are heterogeneous. Therefore, educational programs should be designed to meet each child's individual learning style needs. Educators should consider research concerning the learning style of African-American children, in order to effectively and successfully teach these children.

A three-way analysis of variance revealed significant differences among gifted African-American, Mexican-American and American-born Chinese students in preferences for noise, light, visual modality, studying in the afternoon, and persistence. Significant gender differences were found in preferences for tactile modality and intake. Significant grade differences were found in preferences for temperature and mobility. Discriminant function analysis revealed that the six preferences that significantly discriminated among the three ethnic groups were studying in the afternoon, visual modality, noise, light, intake, and persistence. Multiple regression analysis revealed that preference for temperature was significantly predicted by gender and grade. A jack knife-classification showed that the cases correctly classified into groups was 62.58%. Findings of the Yong *(1991)* study support and extend past research regarding the learning styles of gifted students. They render support for the provision of differentiated curricula for gifted minority students.

Emotional Elements and Achievement

Motivation varies with students' interests and successes, and the degree to which their teachers' styles match their own. Motivation changes class to class, teacher to teacher, and day to day. Persistence is an analytic quality. Analytic processors, more than global processors, "stay on task" while learning. Global processors often require "breaks" for intake, interaction, and focus changes. The older students become, the less Structure they need, although, under pressure (of exams or multiple study assignments), many college students require structure *(Napolitano, 1986; Sawyer, 1995)*.

Responsibility tends to correlate with Conformity whereas students with low Responsibility scores are usually non-conforming *(Dunn, White & Zenhausern, 1982)*. Some people experience three different stages of nonconformity—the "terrible twos", "adolescence", and "mid-life crisis". Although some students are either consistently conforming or consistently nonconforming, others respond uniquely to particular situations. We know how to work with nonconforming students *(Dunn & Griggs, 1995; Dunn, White, & Zenhausern, 1982)*.

A learning style inventory and keyboarding pre- and post-test administered *(Sormunen, 1993)* to 48 fourth graders showed persistence to be the only learning style factor related to achievement. Pre-test score was related to final achievement, indicating that natural kinesthetic ability may affect keyboarding speed.

Formal/Informal Preferences and Achievement

Nganwa *(1986)* identified the learning styles of 111 South African children in Grades 2-5, using the Learning Style Inventory. Fifty-five subjects indicating strong preferences for the design element were subsequently given a reading comprehension test in both formal and informal design. On both subtests, subjects achieved significantly higher scores when tested in their preferred environments than when tested in a mismatched environment. Findings suggest that children may underachieve if their performance is limited by being in a classroom dissonant with their preferred learning style.

Gifted/Non-Gifted Students

Cody *(1983)* compared the learning style characteristics and hemisphericity of 240 students in grades 5 through 12, divided into three ability groups based on their I.Q.: (a) average (100-119); (b) gifted (130-139); and (c) highly gifted (145 and above) . The Learning Style Inventory (LSI) *(Dunn, Dunn, and Price, 1980)* and Your Style of Thinking and Learning (Reynolds, Kaltsounis, and Torrance) indicated significant differences ($p < .01$ and $< .001$ respectively) among the groups. Average students preferred: studying in a warm, quiet environment; late in the day; and knowing exactly what was required (strong need for Structure). They were less Motivated than the other two groups and evidenced significantly more integrated and Left Hemisphere processing. Gifted students also preferred quiet, but studied better: in a moderate Temperature; in the Early Morning; and with less Structure. The gifted were more integrated and demonstrated a right processing style. Highly gifted students preferred: Sound (music) while studying; a Cool environment; Evening; and the least amount of Structure. They were the most Motivated, the most integrated, and the strongest Right processors. The gifted and highly gifted demonstrated significant preferences ($p<.001$) for right hemisphere and integrated processing. Left dominant students preferred a Formal Design, more Structure, less Intake, and were Visual and less Tactile/Kinesthetic than their right dominant counterparts. Right dominant students disliked Structure and were not Adult Motivated.

Yong et al. *(1992)* investigated whether group, gender, and grade differences existed in the learning styles of learning disabled (LD) and gifted (GF) students using the Learning Style Inventory by R. Dunn et al *(1987)*. The study involved 53 (28 male and 25 female) LD and 64 (29 male and 35 female) GF 10th-12th grade students. A 3-way analysis of variance (ANOVA) revealed group differences in preferences for light, design, and kinesthetic modalities, and in motivation, persistence, responsibility, and parent and teacher motivation. Gender and grade differences were found in preferences for mobility and afternoon learning, respectively. A stepwise discriminant analysis revealed 6 variables separating the 2 groups. Findings imply that incorporating the learning styles of both groups is important for individualizing educational programming.

The learning styles of 232 7th-12th graders with high GPA's in school in literature and 192 who had high scores on out of school accomplishments in literature were compared *(Hong, et al. 1993)*. Six of the 22 elements measured by the Learning Style Inventory distinguished between the 2 groups. The out-of-school gifted group preferred to work with peers and felt comfortable learning in a variety of different ways. They tended to be less visual and more auditory learners and expressed a greater preference to learn by experiential or hands-on activities than the in-school gifted group.

Three instructional strategies and 16 learning style elements significantly discriminated between 425 fourth-, fifth-, and sixth-grade gifted and non-gifted students from one suburban and one New York school district *(Ricca, 1983)*. The Learning Style Inventory of both Renzulli & Smith and Dunn, Dunn, & Price revealed identical patterns to those previously reported in at least seven other investigations *(Dunn, 1982)*.

The gifted students requested independent study and were significantly more Self-motivated, Persistent, Responsible, Teacher and Adult motivated, and wanted Tactile rather than Auditory instruction; they also strongly preferred Learning Alone rather than in a whole-class or peer situation. The general population preferred Learning With Peers by listening and reading, needed Variety and Mobility to maintain attention, and learned best with an Authority nearby. The gifted students required independence, self-direction, flexibility, and options as well as a minimum of Structure and lecture.

The purpose of the study Nations-Miller *(1993)* was to investigate and identify the learning styles of "at-risk" students, vocational students, and gifted students to determine whether the composite profiles that are identified for each group are parallel. The investigation focused upon tenth, eleventh, and twelfth grade students in a suburban Georgia school system. Learning style profiles were identified

for "at-risk" students, gifted students, and vocational students. The three groups were compared within groups and contrasted between groups to determine if the profiles were parallel. The data was gathered during the month of February 1992. The sample frame included students from the "at-risk" (Coordinated Academic Vocational Education Program), gifted, and vocational programs at an urban high school south of Atlanta. The groups were stratified by types of programs and then a random sample of one hundred from each group was selected. The subjects completed the Learning Styles Inventory by Dunn, Dunn, and Price to determine their learning style preferences. Twenty-two elements were assessed by the subjects regarding their learning style preferences. The results of the study were analyzed using profile analysis and a discriminant analysis. All follow-up procedures that were appropriate to profile analysis were administered. Mean scores and group correlation were also obtained. A total of twelve variables significantly entered the discriminant equation. This was used to determine how the groups differed from each other by elements. The "at-risk" group showed a preference for responsible, learning through the auditory, visual and tactile modes and had the least preference for noise and being parent motivated. The vocational group showed a preference for noise, light, learning in the late morning and mobility. The least preference of this group was for responsible and learning through auditory, tactile and kinesthetic modes. The gifted group had a preference for being motivated by parents and learning through the kinesthetic mode. The gifted group had the least preference for mobility, light and learning through the visual and tactile modes. Using these findings, curriculum and instructional strategies were suggested that could help teachers better meet the needs of each group. Selected techniques were suggested that promoted the curriculum development and instructional strategies that could encourage the "at-risk" student to stay in school. With this information educators could be one step closer to preparing all students for their roles in our ever-changing society.

Intake, Sound and Achievement

MacMurren *(1985)* identified the learning style preferences of 173 sixth-grade students from two suburban school districts in northern New Jersey. Forty students who scored either between 20-40 or 60-80 on the Learning Style Inventory were assigned randomly to treatment groups with either Intake or No Intake available. Thus, treatments were either complementary or dissonant from the subjects' preferences. A standardized reading achievement test and a semantic differential attitude scale were administered to both groups.

The results, using a two-way ANOVA, evidenced that those students in an environment complementary to their preferences for Intake scored significantly higher in achievement ($p<.001$) than those in one dissonant from their preference. Further, youngsters' attitudes were significantly higher ($p<.003$) when they were tested in matched, rather than mismatched, situations.

This study clearly demonstrated the importance of Intake in a testing situation. Providing Intake for those who needed it lead to significantly higher academic achievement and improved attitudes toward the testing situation.

The need for Sound and Intake while learning can be observed by second- or third-grade, and remains fairly consistent until about sixth-grade for many. At that time, the two preferences increase and adolescents tend to speak and play music louder and eat more. For many ninth- or tenth-graders, these two elements return to their previously "normal" level. Among other students, the need for Sound and Intake while learning remains strong well into adulthood. The need for Quiet while learning increases, and the need for Intake decreases among older adults. Needing Quiet and little or no Intake while learning tends to be an analytic-processing trait, whereas needing Sound and Intake while learning tends to be a global-processing trait *(Dunn, Cavanaugh, Eberle, & Zehausern, 1982)*.

Learning Disabilities

The purpose of the Wild *(1979)* study was to determine whether learning style differences existed between learning disabled (LD) and non-learning disabled (non-LD) male students at the junior high school level. The Learning Style Inventory *(Dunn, Dunn, & Price, 1978)* indicated the sample's environmental, emotional, sociological, and physical needs.

The sample consisted of 80 male students, ages 12, 13, and 14, enrolled in grades seven and eight of a junior high school. The sample was divided into two groups, the LD and the non-LD, with forty males in each. The non-LD sample was selected by simple random sampling. The LD sample included all those students actively participating in the learning disabilities program at the junior high level, grades seven and eight. The complete sample of 80 students was primarily Caucasian (96.25%) and was comprised of members of the lower-middle to lower socioeconomic class.

To eliminate a possible reading ability factor, the LSI questions were tape recorded by the researcher. Ten seconds were permitted between each question to allow for response time. The students circled either True (T) or False (F) on the Answer Sheet.

An SPSS version 712A-0 step-wise discriminant analysis was used to detect which of the LSI variables discriminated significantly between students classified as learning disabled and those classified as non-learning disabled, minimizing Wilk's Lambda Co efficient. Significant differences were evidenced on 4 of the 24 scales, with the significant levels ranging from p<.0001 to .05. The four areas were Persistent and non-Persistent, adult Motivated, prefers Learning with Adults, and prefers learning in Several Ways. The non-LD students were more Persistent and more adult Motivated than the LD students. However, the LD students preferred to learn with Adults and the non-LD students preferred learning in Several Ways (needing variety) while the LD students did not.

Another investigation of LD students included a total of 1,266 students enrolled in a rural elementary school district in northern California *(Price, 1982)*. Thirteen percent of those were of East India origin, and 44% of that group scored below the 50th percentile on the Comprehensive Test of Basic Skills – a measure of achievement. In addition, 48% of all the students in that district were from middle to lower-middle socioeconomic families.

Forty-one LD students participating in an LD program comprised the sample for this investigation. The sample consisted of all the male and female LD students in grades four, five, and six in that district and ranged in age from 9 to 12. An additional 41 non-LD students were selected randomly from grades four, five, and six from the same schools the LD students attended. The non-LD students revealed average performance on the Comprehensive Test of Basic Skills.

The students were administered the Learning Style Inventory *(Dunn, Dunn, and Price, 1978)*. The two groups of students were compared using a discriminant analysis from SPSS, release 8.0C-3, statistical procedures. The purpose was to identify which of the LSI variables significantly discriminated between students identified as having learning disabilities and those identified as not having learning disabilities. A total of six LSI variables significantly discriminated between the two groups. The LD students preferred to learn with Peers in a warm environment. The non-LD students preferred to learn Kinesthetically, and were more teacher Motivated, Responsible, and Persistent than their counterparts (F = 6.89, d.f. 6, 75, p<.0001 at step six) with 78% of the subjects classified correctly.

Research on the learning styles of students with purported disabilities provides educators with empirical knowledge concerning the mismatches that occur between how those students learn and our well-entrenched, but inadequate system of educating everybody identically. Yong and McIntyre *(1992)* suggested a "personalized" approach to aid these youngsters. Andrews *(1990, 1991)*, Brunner and Majewski *(1990)*, Stone *(1992)*, and the teachers and administrators in the Buffalo City Schools' Special Education Learning Styles Programs *(Quinn, 1993)* provide testimony to the effectiveness of teaching students through their individual leaning-style strengths. Increased awareness of students' individual styles results in their improved academic achievement. Dean *(1982)* and Yong and McIntrye *(1992)* predicted it; the practitioners in this issue who consented to share their experiences verified it. When students recognized that they could succeed academically, their self-esteem increased and their behaviour improved *(Brunner & Majewski, 1990; and Quinn, 1993)*.

Students with learning disabilities consistently require special attention and care from their teachers. However, research indicates that many officially-classified LD children have the potential to master the same subject as students who are gifted *(Yong and McIntyre, 1992)*. Research also indicates that the term "LD" should be used only to mean "learning different", because these students can master difficult information, but differently from the way it is taught in traditional schools *(Andrews, 1990, 1991; Brunner & Majewski, 1990; Klavas, 1993; Stone, 1992)*.

Another problem, according to Lux *(1987)* is that the perceived "handicap" of officially-classified LD students often obscures any special gifts and talents they may have. In effect, their academic weaknesses become the primary focus of learning style strengths, which require modifications of both the conventional classroom environment and its instruction. Thus, when Stone *(1992)* allowed his elementary LD students to learn: (a) with tactual resources such as Flip Chute, Electroboards, Pic-AHoles, Floor Games, and multi-art Task Cards; (b) while seated informally in illumination that matched their identified learning styles; and (c) either alone, with a classmate or two or with their teacher, they achieved significantly better than they had before.

Pederson *(1984)* compared the learning styles of students with learning disabilities, versus those acknowledged as "gifted", versus those who were neither learning disabled nor gifted

on the basis of the Learning Style Inventory *(Dunn, Dunn, & Price, 1984)*. Although some learning style-preferences were common to the three groups of students, 5 of the LSI's 22 learning-style elements discriminated significantly among the three groups. Those LD students required Intake, an Authority figure present, Mobility while learning, and being permitted to Learn Alone with appropriate resources. They were conforming but could not behave conventionally, perhaps because of their need for Intake, Mobility, and learning independently with an Authority Figure nearby. Lux *(1987)* also reported significant differences between the learning styles of LD and other students. Similarly, Dunn, Bauer, Gemake, Gregory, Primavera, & Signer *(1994)* found that both learning disabled and emotionally handicapped students needed more Structure, Tactile resources designed to be used independently and more Mobility than "non-handicapped" students.

The following year, Yong and McIntyre *(1992)* compared the learning styles of students with learning disabilities and those considered gifted. In contrast with their gifted counterparts, those LD student(s) preferred Formal seating, learning-by listening, and studying in the Late Morning. They were neither Early Morning preferents nor less Motivated.

Students with learning disabilities require instruction that responds to their unique traits. Although LD students' learning styles vary, when their teachers focus on how they prefer to learn rather than on their assumed inability and pacing limitation, those learners' achievement begins to reflect significantly improved learning curves *(Brunner & Majewski, 1990; Stone, 1992)*. Thus, teachers should identify their students' learning style and choose instructional strategies responsive to those styles before they plan instruction. That knowledge would help students to achieve as well as possible and avoid unnecessary failure *(Yong and McIntyre, 1992)*.

Hill *(1987)* investigated the effects of selected spelling teaching methods on spelling mastery of upper-elementary, learning disabled students. It also examined the value of assessing learning disabled students' modality preferences for diagnostic/ prescriptive purposes.

The study's significance is that it sought to (a) determine whether students classified as learning disabled can identify their preferred learning modes; (b) determine whether matching modes of instruction to students' modality preference(s) results in greater achievement; and (c) identify a systematic way of prescribing instruction for learning disabled students. The study analyzed data collected from 117 learning disabled upper-elementary students in a suburban school district. Each student took the Learning Styles Inventory *(Dunn, Dunn, & Price, 1985)* to determine modality preference(s). Additionally, each student was taught spelling words via four methods: (a) visual, (b) auditory, (c) tactual/ kinesthetic, and (d) multisensory. The data analyses utilize the Multivariate Analysis of Variance (MANOVA) procedures of SPSS-X. Significant interaction occurred between modality preference(s) of learning disabled students and spelling instructional mode. Highpreferenced auditory learners demonstrated significant gains in spelling mastery following the auditory instructional treatment for both the immediate recall (F =.001) and delayed recall (F =.001) tests; and High-preferenced visual learners demonstrated significant gains on the immediate recall test following the tactual/kinesthetic treatment (F =.019). Learning disabled students expressed a variety of modality references, but they were skewed in the following descending order: kinesthetic, tactual, auditory, and visual. Conclusions are (1) Learning disabled students can express reliable modality preferences; (2) Interaction occurs between modality preference and instructional method; (3) No single teaching method is consistently more effective for learning disabled students when modality preferences are not considered; and (4) Learning disabled students benefit from a diagnostic/prescriptive process that systematically considers both modality preferences and various instructional methods.

Learning Styles/Teaching Styles

Guinta *(1984)* investigated whether: (a) the 12 English, 10 Mathematics, 11 Science, and 10 other randomly selected teachers in an urban, co-educational, New York City, parochial secondary school taught in essentially similar ways or whether their instructional strategies tended to differ; (b) those instructors' teaching styles were congruent with their own learning styles; (c) any relationship existed between matched student and teacher pairs and academic achievement; and (d) mismatches between students' and teachers' styles contributed to teacher stress.

Instructors' learning styles were identified with the Productivity Environmental Preference Survey *(Dunn, Dunn, & Price, 1981)*; the 11th and 12th-grade students' styles were revealed through the Learning Style Inventory *(Dunn, Dunn, & Price, 1978)*. Instructors' teaching styles were obtained on a self-report questionnaire. Learner/instructor congruence was based on measured degree of match with respect to 21 learning style variables. Instructors' perceptions of students

as stressors were measured through a semantic differential. A one-way analysis of variance, the pearson correlation, and a stepwise multiple regression procedure were used.

The data revealed that those secondary teachers' instructional styles were essentially similar across different subjects. In addition, teachers did not teach the way they learned with two exceptions: (a) when teachers needed quiet while learning, they imposed a quiet environment on their students, and (b) when they were authority-oriented they tended to be authoritative.

Unlike the Cafferty *(1980)* study, this research evidenced no relationship between matched teacher/student styles and academic achievement. When teachers' and students' styles were mismatched however, significant teacher stress was evidenced on both motor behavioural indicators and negatively toned affect.

Wallace *(1995)* assessed how closely students' learning style preferences matched those of their teachers. A total of 450 sixth- and seventh-graders completed the Learning Style Inventory, and 128 teachers completed the Productivity Environmental Preference Survey, the adult version of the Learning Style Inventory. While the auditory modality was the teachers' most preferred learning style, students preferred the visual modality.

Maths Test Scores and Attitudes

Hodges *(1985)* identified the Design preferences of seventh and eighth grade remedial mathematics students in an urban ghetto. Using a repeated measures experimental design, she assigned adolescents who liked to study in their conventional wooden, steel, or plastic seats, and those who indicated they could concentrate more easily on the floor, on a rug, or in an easy chair, to both environments -- learning and being tested in the Formal and the Informal Design.

Students who were taught and tested in their preferred environment achieved significantly higher mean test scores ($p<.001$) and demonstrated statistically more positive attitudes ($p<.001$) than those in the mismatched conditions. In fact, the youngsters who preferred the Informal Design evidenced higher achievement when permitted to learn and take their test informally than the youngsters who preferred the traditional classroom and were taught and tested in it. Those findings suggest that: (a) junior high school math underachievers may not be matched with complementary instructional environments; (b) a testing situation can impact significantly upon adolescents' academic performance and attitudes; (c) low math achievers learn differently from each other and, consequently, should be matched with their learning style preferences; and (d) educators need to re-evaluate how remediation programs are implemented in both their instructional and testing approaches for selected secondary students.

Mathematics, Reading, and Time Preferences

The purpose of Virostko's *(1983)* investigation was to examine the relationships among class instructional schedules, learning style Time preferences, and grade level, and their effect on the mathematics and reading achievement test scores of third, fourth, fifth, and sixth graders. Dunn, Dunn, and Price's concept of learning style was employed as the theoretical framework. Their instrument, the Learning Style Inventory (LSI) *(1975, 1978, 1981)* was utilized to establish the profile of individual preferences.

This research: (a) substantiated which of the 286 subjects were either matched or mismatched for Time preference and instructional schedule during each of two consecutive years of study; and (b) assessed whether individually or interactively, the three independent variables (Time preference, class instructional schedules for each of two years, and grade level) significantly affected the two dependent variables (NCE achievement test scores in mathematics and reading).

Data were analyzed using three-way analysis of variance procedures with one repeated measure. For all data analyses procedures, hypotheses were tested at the .05 level of confidence.

The findings revealed that: (a) students whose Time preferences and class schedules were congruent, achieved significantly higher test scores; and (b) when Time preferences and class schedules were dissonant, lower scores were evidenced.

Thus, this investigation demonstrated that class instructional schedules coordinated with individual Time preferences were the most significant factors responsible for increasing achievement test scores in both mathematics and reading at the .001 level of confidence.

Musical Talent

Kreitner *(1981)* used learning style theory to explore the patterns of 8 boys and 21 girls in Grades 7 through 12 from a rural Pennsylvania town; the students had been rated as "especially talented" by the one choral Director and two band Directors (p. 28). The Swassing-Barbe Modality Index (SBMI) and the Dunn, Dunn, & Price Learning Style Inventory (LSI) were administered to determine: (a) their usefulness in identifying gifted musicians; (b) similarities between the two models; (c) whether characteristics existed among the gifted that might provide insights for the teaching of subjects other than music; and (d) how, if at all, the learning styles of talented musicians differed from those of the general population. It had been anticipated that subjects would be highly auditory. The SBMI revealed the auditory channel as being the weakest; more students were kinesthetic and visual (as indicated by a mean percentage of 32.81 and 30.90 respectively). Similarly, the LSI identified the greatest number of students as kinesthetic (62%; and 55% were tactile; and 52% were auditory). The data corroborated the findings of other studies that similarly revealed that gifted students prefer kinesthetic, rather than auditory, activities *(Wasson, 1980)*. In addition, the findings suggested that conventional tests of musical talent, which emphasize the auditory mode, may be focusing on a supplementary, rather than a major, sensory channel.

Several characteristics identified the musically gifted better than their modality strengths; those included: (a) extremely high motivational levels: (b) the desire for options rather than a great deal of Structure, and (c) the desire for Learning Alone rather than with others. High Motivation, the need for little Structure, and Learning Alone preferences were representative of many gifted students. Other findings, such as the need for food Intake (69%); the acceptability of Sound (62%), and the need for bright Light probably were more related to the learning styles of adolescents than to the uniqueness of the musically talented.

A strong parallel, or overlap, was revealed between the two learning style models. Both agree that it is better to build on a student's strengths than to endeavour to remediate weaknesses. Both examine auditory, visual, and kinesthetic inclinations. The LSI regards Perceptual strengths as channels of input and as only one of 22 different learning style elements; the SBMI emphasizes modalities as means for processing information and focuses on that characteristic exclusively.

This investigation substantially contributed toward increasing the understanding of varied learning style instruments and clarified further how different models can supplement and reinforce each other.

Falkner *(1994)* examined the relationships among the perceptual elements of learning style, music aptitude, and attitude toward music of third-grade students. The Learning Style Inventory *(Dunn, Dunn, & Price, 1989)* was used to assess individual students' learning styles. This study examined the perceptual elements of learning style: auditory, visual, tactile, and kinesthetic. Participants in the study were 195 third-grade students at Oxford, Mississippi, Elementary School for the 1993-94 academic year. The research design was causal-comparative. One-way ANOVA's were used to determine the significance of the frequency distribution of perceptual modality strengths, musical aptitude, and attitude toward music class. No significant differences were found in the distribution of modality strengths; however, significant differences were found in musical aptitude and attitude toward music class. Results of a two-way ANOVA comparing the mean scores of musical aptitude with perceptual modality strengths showed an interaction effect between the level of musical aptitude and perceptual modality strengths to be significant. Students scoring in musical aptitude were primarily visual and kinesthetic learners. Significant differences among the mean scores of musical aptitude as related to attitude toward music class were found. No significant differences were found among the levels of attitude toward music class and perceptual modality strengths. It was concluded that students scoring highest in musical aptitude are primarily kinesthetic and visual learners. Conceptual skills in music are better served in an active approach that engages all perceptual modalities in the music-making process. Positive attitudes toward school music are better served through an elementary music education program that connects with childrens' real world musical experiences while reflecting the multi-musical culture of the society in which the students live.

Physiological Elements and Achievement

Perceptually, the younger the children, the more Tactual and/or Kinesthetic they are. In elementary school, less than 12% are Auditory (able to remember three quarters of what they learn through lecture or discussion) and 40% are Visual (able to remember three quarters of what they learn through reading). The older children become, the more Visual and Auditory

they become. As a group, females are more Auditory than males; males are more Visual and remain more Tactile and Kinesthetic than females *(Dunn & Dunn, 1992, 1993; Dunn, Dunn, & Perrin, 1994)*.

Time-of-day energy levels change with age. Only 28% of elementary-school students have early morning energy highs. Most "come alive" after 10:00 in the morning and are most alert between 10:30 A.M. and 2:00 P.M.--during which time they are assigned a one-hour lunch period. At the middle school level, no more than 30% are early-morning preferents; and, by high school, the morning group has increased to 40%. However at that level, at least 13% are "night owls" and the majority learn best in the late morning and afternoon *(Dunn & Dunn, 1992;1993; Dunn, Dunn, & Perrin, 1994)*.

Reading and Sound

Pizzo *(1981)* administered the Learning Style Inventory *(Dunn, Dunn, & Price, 1979)* to 125 sixth grade students attending a middle school in Western Nassau County, New York, to diagnose their preferences for acoustic instructional environments. Thirty-two males and 32 females diagnosed as having either a preference for Quiet or a preference for Sound while learning, were assigned randomly and equally to one of two conditions, quiet and noise, for the experimental variable, acoustic environment. Thus, half the total sample was tested in an acoustic environment congruent with its diagnosed learning style preference for Sound, and half was tested in an acoustic environment incongruent with its learning style preference for Sound.

Two acoustic environments - 40 dBA + 1 S. D. (5dBa) – designated "quiet," and 75 dBA + 1 S. D. (5dBA) – designated "noise," were selected for this study based upon a review of the research and sound level measurements. The audio-recording tape cassette utilized in the noise experimental condition was produced from an audio-recording of classroom noise previously made while sixth grade students were engaged in a small-group instructional activity.

Subjects in both the quiet and noise conditions were administered the Comprehension subtest of the Gates-MacGinitie Reading Tests and a semantic differential to measure their attitudes in both congruent/incongruent conditions.

A post-test-only control group design was employed; subjects diagnosed as having preferences for Sound congruent/incongruent with each of the two experimental conditions served as the control group for each condition.

A three-way analysis of variance and t-tests were used to analyze the data. The findings of this study indicate that there was a significant interaction $p<.01$ between the acoustic environment and individual learning style preference as revealed by the LSI. Specifically, the mean reading composition and attitude scores of the sixth graders tested in an acoustic environment congruent with their diagnosed learning style were compared with those of their peers tested in an incongruent environment. There was a significant interaction $p<.05$ between learning style preference and sex. Males and females tested in acoustic environments congruent with their learning style preferences achieved significantly higher reading comprehension and attitude scores than their counterparts in incongruent acoustic environments. There was no significant interaction evidenced between acoustic environment and sex. Therefore, neither sex achieved significantly higher mean reading comprehension or attitude scores. There was no significant interaction among acoustic environment, learning style preference, and gender.

Reading and Light

Krimsky *(1982)* administered the Learning Style Inventory *(Dunn, Dunn, & Price, 1978)* to the total population of fourth-grade students in each of three elementary schools in one suburban New York district to determine each student's preference for either dimly or well illuminated environments when learning new or difficult material. The 32 students who evidenced a strong preference for one or the other lighting conditions comprised approximately 25% of the total fourth-grade population. Both those who preferred extremely bright Light and those who preferred extremely low Light when concentrating were randomly selected and assigned to one of two experimental groups. Experimental Group A was tested in a brightly illuminated instructional environment. Experimental Group B was tested in a dimly illuminated instructional environment.

Student performance was assessed through the scores obtained on the Gates-MacGinitie Test for Reading Speed and Accuracy. A statistical analysis was developed using two, two-way ANOVA's for: (a) the main effects of learning style preference for Light and the illuminated instructional environments; and (b) the interaction effect of learning style preference and the illuminated instructional environment.

The data revealed two significant findings. Scores on both

reading speed and accuracy consistently were significantly higher when the illuminated environment was congruent with each student's identified learning style preference for Light. In addition, no significant difference was evidenced in reading speed and accuracy scores between students with a learning style preference for either dim or bright light. Thus, a student's preference for either low or bright light was not crucial; what was critical for increased reading speed and accuracy scores was the complementary matching of each student's learning style preferences for illumination with a responsively lighted instructional environment.

Reading Comprehension and Design (Study Area)

All 410 ninth graders in a New York junior high school were tested for their preferences for either a formal or an informal instructional environment when concentrating *(Shea, 1983)*. The students revealing strong Design preferences on the Learning Style Inventory *(Dunn, Dunn, & Price, 1978)* were randomly assigned to either matched or mismatched designs. Experimental Group A was tested in a formal Design containing only wooden or steel furniture; experimental Group B was tested in an Informal Design comprised exclusively of upholstered chairs and couches, pillows, and carpeting. Performance was assessed through scores obtained on the Metropolitan Achievement Comprehension Test. A 2x2 ANOVA was used to determine if there was a main effect of Design preference and instructional environment and a significant interaction effect.

Data evidenced a significant interaction beyond the $p<.001$ level between learning style preference and environmental design. Specifically, the mean reading comprehension scores of the ninth graders tested in an environment congruent with their preferences for an informal Design were significantly higher than those of their peers tested in an incongruent setting. Interestingly, those who preferred a formal Design, performed almost as well in the informal environment – which initially caused the researcher to suspect that such students could accommodate more easily than those with an opposite preference. However, when the graphs and anecdotal notes made during the experiment were analyzed, students who had seated themselves on the floor with their backs rigidly against the wall were those who preferred a formal Design and intuitively had adapted the environment to their needs. Thus, when we advise students to "sit up straight" in their seats, we inadvertently may be imposing the wrong condition on those who prefer an informal Design. This study was later replicated by Hodges *(1985)* who had identical findings with seventh- and eighth-grade urban junior high school students.

Rural/Inner City Student Background

The population for a study by Carruthers and Young *(1979)* consisted of 50 eighth-grade students from rural and inner-city schools located in middle Georgia.

Twenty-five subjects from each of the populations were selected randomly and administered the Learning Style Inventory *(Dunn, Dunn, & Price, 1975)*. The instructions for completion of the instrument were explained and additional assistance in reading the statements was offered when difficulties were apparent.

The researchers employed a simple Analysis of Variance on the scores of the four periods of optimum learning time within each group. After determining levels of significance through the use of Duncan's New Multiple Range Test, a t-test for independent samples was employed to determine if significant differences had been revealed between the rural and inner-city students' responses.

The mean score for each of the four time periods (early morning, late morning, afternoon, and evening) was calculated for use in comparison with the others'. The validity of the results was verified through the use of an analysis of variance and Duncan's New Multiple Range Test within each group, followed by a t-test for independent samples between the groups.

The findings concluded that no significant differences had been evidenced in the time-of-day when optimum learning occurred between rural and inner-city schools. It did reveal that both groups of tested students preferred to learn in the afternoon. At the time the study was undertaken, no prior consideration had been given to the learning styles of the students. It was documented that those in the inner-city school whose learning Time preferences matched the time of day in which they had been scheduled for math classes caused fewer discipline problems than those who were mismatched. Twelve of the students that were matched correctly with their Time preference by chance, also had achieved academically with fewer motivational influences from their teacher. Carruthers and Young's early study pioneered the later experimental research conducted by Lynch *(1981)*, Virostko *(1983)*, and Freeley *(1984)*.

Science Achievement with Computer-Assisted Instruction

Martini *(1986)* analyzed the effects of both matching and mismatching auditory, visual, and tactile instructional methods on the science achievement and attitudes of seventh graders who had been classified according to their perceptual preferences. The experimental sample of 30 junior high school students was administered the Learning Style Inventory (LSI) *(Dunn, Dunn, & Price, 1984)* and the Wepman Auditory Discrimination Test. The Human Body-An Overview provided the science content. A semantic differential scale *(Pizzo, 1981)* assessed attitudes.

Auditory students achieved significantly higher scores (.001) with the cassette tapes than visual or tactile students did. Visual students achieved significantly higher scores (.001) with the printed materials than either the auditory or tactile students. Tactual students achieved significantly higher scores (.001) with CAI than the auditory or visual students, but all youngsters achieved significantly higher ($p<.001$) with CAI than with either of the other two methods.

Two important outcomes resulted in addition to the significantly higher achievement and attitude scores. Tactual students, who conventionally are the underachievers, evidenced higher test scores with CAI than either of the other two, normally higher achieving groups. Furthermore, comparisons of students' scores on the LSI and the WADT indicated that the students' preferences (as revealed on the former) were identical with their strengths (on the latter).

Social Studies

White *(1981)* conducted a study in which 161 upper middle class, seventh and eighth graders were tested with the Learning Style Inventory (LSI) *(Dunn, Dunn, & Price, 1978)* and the California Psychological Inventory (CPI). Forty students who scored in the upper third, and 40 who scored in the lower third, of the LSI subscales of Persistence and Responsibility were randomly assigned to either a self-directed or a teacher-directed class. A Contract Activity Package was used as the instructional treatment.

Students classified as highly Persistent and Responsible in both groups achieved significantly higher than those with low Persistent and Responsible scores, although they did evidence slightly better gains in the self-directed, rather than the teacher-directed classes. Another finding was a positive correlation between the LSI subscales of Persistent and Responsible and the CPI subscale of achievement via conformity (Ac). Students identified as being Persistent and Responsible also were identified as manifesting a more conforming personality as measured by the CPI.

It is likely that teachers' perceptions of Responsibility and Persistence are based on students' ability or willingness to behave in way(s) in which they are directed, rather than on the students' ability to make appropriate, value-based decisions from among competing alternatives. Furthermore, because less Persistent and less Responsible students are not as conforming, it may be necessary to provide them with positive alternatives to enable them to succeed academically. It was suggested that educators should consider whether the achievement of nonconforming students might be increased if they were provided choices and alternatives when learning *(White, Dunn, & Zenhausern, 1982)*. As one outcome, the director of a successful New York City alternative school, Madison Prep, which instructs essentially delinquent junior high school students, reported significantly increased reading and mathematics achievement, reduced numbers of discipline problems, and improved attitudes when structured choices were made available to its nonconforming population *(K. Dunn, 1981)*.

Sociological Elements and Achievement

Most young children are Adult Motivated; they want to please their parents and teachers. Around third grade, many become Peer Motivated, when it is more important for them to have peer rather than adult approval. Two decades ago, studies revealed that children rarely became Peer Motivated before seventh or eighth grade *(Dunn & Dunn, 1972)*. Today, they become Peer Motivated early and remain that way longer.

Average achievers usually change from being Peer Motivated and become Self-Motivated by ninth- or tenth-grade or shortly thereafter. Although gifted children enter school wanting to please the adults in their lives, by first or second grade, most become Self -Motivated, Learning-Alone preferents, and rarely go through a "peer" stage. Underachievers remain Peer Motivated longer than either gifted or "average" achievers. We have not found more than 28% of any group to be Peer Motivated and, within that category, Peer Motivated youngsters learn better with just one classmate than in a small group *(Dunn & Dunn, 1992, 1993; Dunn, Dunn, & Perrin, 1994)*.

Within the 28% of students who are Teacher Motivated, some want a collegial teacher whereas others prefer an authoritative teacher. Finally, in three different studies, at-risk-students required a collegial adult but had been required to learn with an authoritative adult *(Gadwa & Griggs, 1985 & Johnson, 1984)*.

Wallace, *1990* examined the achievement of elementary school students when their strong preferences for learning alone or learning with peers had been identified and they were allowed to choose whether to learn alone or with peers in each of five lessons. The 114 subjects, of whom 34 were later selected for this study, were the students of five social studies teachers who volunteered to take a course on learning styles. The Learning Style Inventory *(Dunn, Dunn, & Price, 1989)* was administered to each student to ascertain whether he/she had a strong preference for learning alone or with peers. The 34 students selected for the study on the basis of their having a strong preference were introduced to a small group learning method and taught five lessons with the option of working alone or with peers each time. The students were tested after each lesson. The results yielded by ANCOVA revealed that the students who were identified as strongly preferring to learn alone achieved significantly higher mean lesson-test scores than students identified as strongly preferring to learn with peers. Students identified as strongly preferring to learn alone did not achieve significantly higher when they opted to learn alone; students identified as strongly preferring to learn with peers did not achieve significantly higher when they opted to learn with peers.

One hundred and twenty-eight fifth and sixth graders in an inner-city, elementary school in New York City were administered the Dunn, Dunn, and Price Learning Style Inventory *(1984)*. Forty who had indicated sociological preferences for either Learning Alone (n=22) or Learning with Peers (n=18) were assigned randomly to two instructional groups. Students then were taught career awareness and decision-making concepts in conditions that were both congruent and incongruent with their diagnosed preferences *(Miles, 1987)*.

Data revealed that the matching of sociological preferences with complementary grouping patterns increased career awareness achievement ($p<.01$) and career-decision-making ($p<.01$) significantly. Additionally, students' attitude scores were statistically higher when they were taught career awareness ($p<.01$) and career-decision making concepts ($p<.05$) in patterns that accommodated their preferences. Other significant differences demonstrated that students matched with their preferences for Learning Alone scored statistically higher ($p<.05$) than those individuals preferring to learn with their peers. Data evidenced however, that with the exception of career awareness achievement, neither group achieved better than the other; what was crucial was the matching of individual students' preferences for either Learning Alone or with Peers and the instructional grouping pattern assigned. Furthermore, a test/retest administration of the LSI demonstrated that the subjects' sociological preferences for either Learning Alone (.79) or with Peers (.80) remained consistent throughout this investigation *(Miles, 1987)*.

Time of Day Preferences and Achievement

One of the first correlational studies that revealed relationships between academic achievement and preferences for learning at a given time during the day was conducted by Clara Amelia Murray *(1980)*. While comparing the learning styles of seventh-and eighth-grade, low-achievers in a public middle school, she discovered that many of the female low achievers preferred learning in the evening, whereas male counterparts were afternoon preferents. Those initial data suggested a need to further examine the relationships between biologically-based time preferences and school achievement.

Within the next five years, at least nine separate investigations examined the learning styles of various multicultural groups *(Dunn & Griggs, 1990)*. Among the findings were that (a) Asian college students preferred early-morning learning significantly more than caucasians *(Lam-Phoon, 1986)*; (b) Mexican-Americans shared an early-morning preference with Asians but disliked afternoon learning *(Dunn, Gemake, Jalai, Zenhausern, & Quinn, 1990; Sims, 1988)*; and (c) later in the day was preferred by Caucasian, African-American, and Greek elementary students *(Dunn, et al. 1990)*. Later studies of gifted and talented adolescents in Brazil, Canada, Egypt, Guatemala, Israel, Korea, the Philippines, and the United States revealed that less than 10 percent were morning preferents; most preferred learning in the late morning and afternoon, and some were evening preferents *(Milgram, Dunn & Price, 1993)*.

As a result of a correlational study, Gadwa and Griggs *(1985)* reported that high-school dropouts in the state of Washington were self-, peer- and collegial/teacher-motivated, needed a great deal of variety when learning, and preferred evening as their optimal time for learning; they had difficulty

learning in the morning.

As an outcome, Lynch *(1981)* analyzed the relationship between time-of-day preferences and the English achievement of chronically truant eleventh-and twelfth-graders. He found that students achieved significantly higher test scores, and were absent significantly fewer times when their English course periods matched their preferred time. And, having had extensive experience with low auditory/low visual learners, Barbara Gardiner *(1986)* experimented with Multisensory Instructional Packages (MIP) with fourth-grade underachievers at specific times of the day. Significantly higher social-studies test scores resulted with MIP versus traditional instruction and during afternoon, rather than morning teaching.

Nine hundred and sixty sophomores and juniors were tested with the Learning Style Inventory *(Dunn, Dunn, & Price, 1978)* to identify their individual learning style characteristics *(Lynch, 1981)*. The attendance records of the entire group were reviewed to identify those who qualified as either initial or chronic truants by criteria established for this study. Based on data elicited from the New York State Attendance Register and students' records maintained by the Dean of Students, 136 comprised the total population for this investigation.

Lynch categorized all subjects with regard to: (a) degree of truancy (initial or chronic); (b) whether or not they were assigned to the same or a different English teacher for the two consecutive years of the study; and (c) their learning style Time of Day preferences. The Campbell and Stanley *(1963)* Design #4 was selected because it provided for a pre-test, post-test, control group design, and comprehensively considered the permutations of the groupings possible in a three-way analysis of variance design.

Each condition provided for its own control because of the matched versus mismatched comparisons. Thus, the traditional control group design from Campbell and Stanley was strengthened.

The design of this investigation incorporated two dependent variables (English course grade-point average and the number of days of partial or full truancy) and three independent variables (degree of truancy, English teacher assignment for the two consecutive years of the study, and the learning style Time preferences of the participating students).

Data were analyzed and the hypotheses tested using Three-Way Analysis of Variance procedures with Tukey post hoc comparisons. The Pearson Product-Moment Correlation also was utilized to determine the relationship between academic achievement and attendance. Although substantiated hypotheses exceeded previously established standards, the $p<.05$ level of confidence was accepted for statistical significance.

Findings indicated that: (a) the matching of individuals' schedules on the basis of learning style preferences affected attendance more significantly than the matching of teachers; (b) mismatched, rather than matched, teacher assignments significantly reduced truancy among chronic truants; and (c) a correlation did exist between academic achievement and number of days of partial or full truancy.

Summarily, the greatest single influence on the reduction of truancy among chronic truants was the matching of the students' learning style Time preferences with their English course period schedules. The study further demonstrated a significant reduction in the mean number of days of partial or full truancy when the single element (the Time of Day for English class schedule or teacher assignment) of the chronic truants' educational environment was changed. These findings caused Lynch *(1981)* to recommend that schools adjust students' academic schedules to respond to their learning style Time of Day preferences.

Most researchers experimented with underachievers, but Susan Smith *(1987)* examined the effects of learning-style time preferences on average-to-high-achieving high school students on matched and mismatched mathematics course schedules. When matched, even achieving students' scores evidenced a trend toward significantly higher achievement (.10). Time preferences apparently affect underachievers more than average students. Either that, or those to whom time-of-day is crucial, become underachievers because they cannot flex sufficiently during the wrong academic time schedule for them.

Building on the foundation established by previous researchers, Virostko *(1983)* monitored the reading and mathematics achievement of 296 elementary students over a two-year period. Students' schedules were designed to offer one subject at their preferred time of day and the other at their nonpreferred time. At the end of the first year, children achieved statistically higher scores ($p<.001$) in the subject that matched, rather than mismatched, their time preference on the New York State PEPS Tests. During the second year of that study, when each student's schedule was reversed, 98 percent of the students achieved statistically higher scores in the

opposite subject (p<.001). More recently, Missouri and Cramp *(1990)* replicated Virostko's research with a smaller group and revealed essentially similar findings.

In 1985, Lemmon administered the Iowa Basic Skills Tests in the morning and in the afternoon, and scheduled elementary school students so that they took their tests at their best time of day. She also allowed the youngsters to sit where they chose - either in their chairs or on the carpeted floor. Students made significant gains over each of their previous two year's scores on those same standardized tests in both reading and mathematics. In North Carolina, Andrews *(1990)* identified the time preferences of his underachieving elementary population and found that: 55 were "morning birds"; 70 were "night owls"; 41 were late-morning preferents; 100 were virtually non-functional in the morning but "came alive" in the afternoon. Thus, the majority should have been taught basic required subjects in the afternoon and/or late morning; night children should have been taught how to study at home in the evening. Andrews reversed the reading schedules for his students who, in 1986, had achieved only at the 30th percentile in reading and math on the California Achievement Tests. In one year, his school moved to the 40th percentile, by the second year the scores were between the 74th and 78th percentile, and the third year, they had risen to the 83rd percentile. These were the same children, but their reading and mathematics standardized achievement test scores had been negatively affected by mismatching their time preferences and their instructional schedules and other elements of their learning styles. Because of the extreme gains evidenced by this school on standardized tests, Andrews has secured State Department of Instruction approval to test pupils in a learning-responsive environment. Stone, Principal, Fred L. Wilson Elementary School, Kannapolis, North Carolina, had essentially similar experiences with his underachieving population *(1992)*.

Because of the many successes experienced by previously underachieving high-school students in Texas *(Harp & Orsak, 1990; Orsak, 1990)* when they were taught in accordance with their learning style strengths, Dotson, a curriculum coordinator for the Jacksonville Public schools, petitioned the State Educational Department to permit students to be taught in a timed responsive environment. That, too, led to statistically increased achievement for students tested at their best time of day *(Dunn, 1995)*.

Differences do exist among the times during which humans are able to learn new and difficult academic material; those differences are based upon biologically-imposed circadian rhythms. Underachievers appear to be late-morning, afternoon- or evening preferents - who learn well at those times of the day *(Andrews, 1990-91; Gadwa & Griggs, 1985; Harp & Orsak, 1990; Orsak, 1990)*. Talented students in art, dance, drama, music, and sports often are afternoon and evening preferents who actually achieve statistically higher test scores when permitted to learn and take tests at their best time of day *(Milgram, Dunn, & Price, 1993)*.

The mean of the NCE scores for the reading students matching the instructional time for reading was significantly higher at the .05 level than the reading students mismatched with the instructional time *(Cramp, 1990)*. The mathematics students who matched also scored significantly higher at the .05 level than the mismatched group of mathematics students. The study supports the belief that matching instructional time blocks to students' time preferences will increase achievement.

Vocational Education/Industrial Arts

Using 2,088 eleventh- and twelfth-graders who represented a cross section of students in Ohio, Tappenden *(1983)* scrutinized the learning style differences between vocational and non-vocational education boys and girls and the relationships among rural, urban, and suburban students of African-American and Caucasian backrounds. The Learning Style Inventory *(Dunn, Dunn, & Price, 1979)* data subjected to a multivariate analysis of variance revealed significant differences between: (a) vocational and non-vocational students (p<.0001); (b) 11th and 12th graders' learning styles (p<.0282); (c) rural and suburban students (p<.0164); (d) rural and urban students (p<.0002); (e) locations and grade level (p<.0001); (f) programs and location s (p<.0001); (g) males and females (p<.0001); and (h) Afro-Americans and Caucasians (p<.0001). In addition, interactions were evidenced among: (a) program, grade, and location; (b) program, grade, location, and Motivation; (c) program, grade, location, and Learning Alone; (d) program, grade, location, and being Tactile and/or Kinesthetic; and (f) program, grade, location, and the need for Intake. Fourteen of the 24 LSI *(1977)* variables significantly discriminated between males and females at p<.05. Eleven of the 14 significant variables had univariate p values significance at p<.0001.

Kroon *(1985)* identified the perceptual strengths of 78 ninth- and tenth-grade, industrial arts students with the Learning Style inventory *(Dunn, Dunn, & Price, 1984)*. Six lessons,

two auditory, two visual, and two tactual, were presented to every student, but in varying sequences. Achievement tests administered after each lesson revealed that lessons matched to each student's perceptual preferences resulted in statistically higher test scores ($p<.01$). In addition, when new information was introduced through individuals' strongest perceptual preferences (closest to 80 on the LSI), and then reinforced through secondary or tertiary preferences, achievement was significantly increased further ($p<.05$). A secondary finding revealed significant differences between the learning styles of industrial arts and non-industrial arts high school students, corroborating Tappenden's 1983 data. Specifically, the former were less self and Teacher Motivated, less Kinesthetic, and more Tactual than their counterparts.

Word-Pair Recognition and Mobility

Della Valle's *(1984)* initial screening of 417 New York seventh-graders with the Learning Style Inventory *(Dunn, Dunn, & Price, 1978)* resulted in identification of 217 with a preference for Mobility and 89 with a preference for passivity. Twenty students at each end of the Mobility continuum were selected to participate in this research. Word-pair recognition tasks were developed for use in both the passive and mobile environments, and all students were taught and tested in both conditions using a 2X2X2 way ANOVA with repeated measures to analyze the data.

The resultant data verified that: (a) students with either preference performed equally as well when matched, corroborating that both Mobility and passivity are strengths when they are responded to positively; (b) no differences were evidenced between the scores of students in the two extremely different environments, substantiating that no single environment that permits movement or one that requires students to sit still generates higher achievement than the other; and (c) significant differences were found when students' environments were congruent with their learning style Mobility preferences. Specifically, although actively and passively preferenced students performed equally well in the passive environment, those with a preference for Mobility obtained the highest scores of all groups when they were taught in the condition that permitted them Mobility while learning. Those findings suggest that such students may never have performed to their maximum potential in conventional classes. Conversely, those who preferred a passive environment scored poorly when required to engage actively in instruction while learning. When students were placed into settings congruent with their diagnosed learning style preferences for Mobility, their achievement scores increased significantly ($p<.001$). Those data verify that each school should provide at least two different classroom environments if both types of students are to achieve as well as they are able.

Word Recognition and Temperature

Murrain *(1983)*, then a New York junior high school principal, examined the temperature preferences of 268 seventh-grade students by administering the Learning Style Inventory *(Dunn, Dunn, & Price, 1978)*. The 38 subjects with preferences for cool, and the 76 with preferences for warm environments were assigned randomly and equally to experimental groups. All subjects were tested twice; once in an instructional setting which was congruent with their Temperature preference and once in an environment which was incongruent with their preference.

The warm classroom was maintained at a temperature of 80 degrees Farenheit; the cool room was 60 degrees Farenheit. A 2X2 Analysis of Variance compared the word recognition scores achieved by students in each environment.

Students preferring a warm environment evidenced higher scores in the warm room than in the cool one; students with a preference for cool temperatures scored better in the 60 degrees Farenheit room. Means followed anticipated trends.

Overall, higher scores were obtained in an environment congruent with students' diagnosed thermal preferences. The results were particularly profound in view of the only marginal preferences indicated by the learning style profiles of subjects in this investigation. These data clearly indicated that even a marginal preference, and not necessarily an extreme preference, can exert sufficient strength to be used as a predictor of academic achievement. The findings of this investigation and a review of the literature indicated that administrators should include thermal preferences as a criterion in facilities utilization, scheduling of major examinations, and planning the instructional environment.