This dissertation entitled

A CORRELATIONAL ANALYSIS OF UNDERGRADUATE ATHLETIC TRAINING STUDENTS’ AND FACULTY EDUCATORS’ MIND STYLES AND PREFERENCES OF TEACHING METHODS

by

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Educational reforms currently underway in athletic training have focused on improving the quality of educational programs through new pedagogical paradigms. Assessment of students’ individual learning styles can provide athletic training educators with an opportunity to develop a more personalized approach to instruction by facilitating students to learn through their own style. Matching or guided mismatch of student and educator learning styles could provide the best environment for cognitive growth. Therefore, the purpose of this study was to establish a valid, but efficient, assessment of undergraduate athletic training students’ and educators’ learning styles.

The Gregorc Style Delineator (GSD) was chosen to assess learning style differences. This instrument focuses on two-types of cognitive abilities in adult learners:
perception and ordering. Each cognitive ability is a bipolar continuum. The continua are combined using a quaternary design to create four mediation channels: concrete sequential (CS), abstract sequential (AS), abstract random (AR), and concrete random (CR). Two hundred (M = 68; F = 132) undergraduate athletic training students and 43 (M = 22; F = 21) program directors volunteered to participate. Principle components factor analysis with varimax rotation revealed reasonable construct validity. Internal consistency of the four channels yielded alpha coefficients of .53 to .68.

Frequency analysis of the responses yielded 44.4% (n = 89) of students and 58.1% (n = 25) of program directors preferring the CS channel. The research design was MANOVA utilizing the CS, AS, AR, and CR channels as the dependent measures. The independent variables were gender, education level, and academic role. Data analysis revealed a significant main effect for gender ($F_{4,194} = 3.13, p<.05$) and academic role ($F_{4,239} = 4.49, p<.01$), but not for education level ($p = .310$). These main effects reflected mild associations with the dependent variables, partial $\eta^2 = .061$ and .070 respectively. These findings suggest that females prefer learning styles that employ multiple methods of
expression to reach course outcomes. Additionally, educators were more likely than students to prefer learning styles that were concrete and structured. The application for educators is to use learning styles as an additional pedagogical tool in the facilitation of cognitive growth.

Approved: Ralph Martin

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In route to any worthwhile destination, there are often many sacrifices that have to be made. My dissertation process has been one of those destinations. I would like to dedicate the following brief narrative to those individuals that have encouraged, mentored, and sustained me during the last eleven months.

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CHAPTER ONE: INTRODUCTION

Background of the Study

History of Athletic Training Education

The last three decades have seen the largest contributions to the educational reform that athletic training education has undergone. During the 1970’s, much of the curriculum reform of the 1980’s was stimulated through the development of learning objectives and an effort to move toward a specialized body of knowledge (Delforge and Behnke, 1999). However, it was not until 1980 that a student could choose athletic training as an academic major.

The first effort to move into a competency-based athletic training education program was developed during the 1981-82 school year by the National Athletic Trainers’ Association (NATA) Professional Education Committee. The culmination of this effort resulted in the 1983 release of the Guidelines for Development and Implementation of NATA Approved Undergraduate Athletic Training Education Programs that became known simply as The Guidelines (Delforge and Behnke, 1999). The Guidelines was a document that contained standards and operating codes for the development of undergraduate athletic training as an academic major. A
subsection of this document became known as the
Competencies in Athletic Training (Delforge and Behnke, 1999). The Competencies in Athletic Training were based on
“performance domains” taken from the first role delineation
study conducted by the NATA Board of Certification in 1982
(Delforge and Behnke, 1999).

In the 1990s, the NATA sought outside accreditation
and academic recognition. As a result, the NATA joined
forces with the Commission on Accreditation of Allied
Health Education Programs (CAAHEP) in 1994 after the
previous accrediting agency (Commission on Allied Health
Education and Accreditation [CAHEA]) disbanded (Delforge
and Behnke, 1999). CAAHEP is an independent agency that
accredits allied health education programs. Further, the
Joint Review Committee on Educational Programs in Athletic
Training (JRC-AT) was formed in 1990. The committee’s
mission was to work with CAAHEP and various other sports
medicine organizations to formally review entry-level
programs for accreditation (Delforge and Behnke, 1999;
Hunt, 1998). The committee’s first task was to establish a
set of guidelines to govern the review process. These
guidelines became known in 1991 as Essentials and
Guidelines for an Accredited Educational Program for the
Athletic Trainer (Delforge and Behnke, 1999). The intent was to standardize educational programs and provide consistency with a common body of knowledge. A companion document, titled Competencies in Athletic Training, was retained in the Essentials (Delforge and Behnke, 1999).

With the completion of The Essentials and the Competencies in Athletic Training, the foundation for a competency-based curriculum had been established. Students entering into a CAAHEP-approved, entry-level athletic training program would have to complete the requirements set forth in both the aforementioned documents. These accomplishments attempted to improve accountability of the profession by providing outcomes (i.e., competencies) that students must attain by graduation.

Issues in Athletic Training Education

The curriculum model for athletic training education is based on educational competencies. Competency-based education is intended to be both prescriptive and descriptive (National Athletic Trainers’ Association Education Council [NATA-EC], 2002). The educational competencies are divided into cognitive, psychomotor, and affective domains. Collectively, these competencies are prescriptive in that they describe the content that must be
taught in a CAAHEP-accredited entry-level athletic training program. The competencies are rarely viewed as a descriptive document that could guide students to the destination of qualified allied healthcare professional. There are approximately 1,230 individual competencies and proficiencies. Because of the large number of each, the competencies and proficiencies are often employed in a checklist manner. The problem is that this checklist method is often extremely time consuming to create on the front end and quite cumbersome to perform (NATA-EC, 2002). Despite the inherent problems with this method, the checklist approach is still looked upon by program directors as an efficient method of assessment (D. Fuller, personal communication, December 3, 2002). Many individuals and programs embrace this method probably because of its passive nature. However, it is not the most effective model to approach qualitative educational outcomes in athletic training didactic and clinical education (NATA-EC, 2002).

The athletic training curriculum model has gone through a major educational reform throughout the past decade. The 1990s saw outside accreditation of athletic training education programs, one route to certification, and the restructuring of the Competencies in Athletic
Training (Hunt, 1998). All of these events show the change over time in both the didactic and clinical components of athletic training education. In the 1990’s, this reform focused on the process of curriculum building and its inherent structure. In the decade of 2000-2010, reform is still ongoing. The current decade has seen more attention on improving academic and instructional quality. The Competencies continue to be reformed. However, beyond the NATA-EC’s mission to improve the educational outcomes of the athletic trainer, there is little known about how athletic training students learn.

Issues in Learning Styles Literature

Learning style is an umbrella term similar to the term sports medicine. The term sports medicine incorporates all medical and allied health professions that work with athletes and the physically active. Likewise, “learning styles” is a term that covers all the literature corresponding to individual differences among all the domains of learning. Learning style is often referred to in the literature, although incorrectly, as cognitive style. Cognitive style deals with only mental processes, whereas learning styles incorporates cognitive, as well as, psychological, physiological, and social aspects of
learning. Therefore, the two terms should not be used interchangeably.

This study will use the term Mind Style, trademark by Anthony F. Gregorc, PhD, to refer to the channels through which the mind expresses itself (Gregorc, 1982a). The term Mind Style would fall under the umbrella of learning styles, more specifically under cognitive style. Mind Styles and cognitive styles differ and cannot be used interchangeably. Cognitive style deals only with mental processes that can be learned, whereas Mind Styles deal with innate predispositions or proclivities that emerge from within the learner (Claxton and Murrel, 1987).

**Issues in Athletic Training Learning Styles**

A thorough review of literature revealed four studies that have investigated undergraduate athletic training student learning style (Draper, 1989; Harrelson, Leaver-Dunn, & Wright, 1998; Cocker, 2000; Brower, Stemmans, Ingersoll, & Langley, 2001). Two of the four studies used the same measurement instrument: Kolb’s LSI (Cocker, 2000; Brower et al., 2001). All four of the studies implemented non-experimental procedures (i.e., ex post facto designs) looking at relationships between existing characteristics of students compared to variables like gender and education.
level (Harrelson et al., 1998), admission success (Brower et al., 2001), certification exam performance (Draper, 1989), and consistency between classroom and clinic performance (Cocker, 2000).

Issues in Athletic Training Instruction

The classroom of today is a very different environment than it was even a decade ago. The widespread use of computers has infiltrated academics resulting in smart classrooms. With such easy access, athletic training educators are frequently incorporating the computer as an instructional tool. A thorough review of the literature (i.e., MEDLINE, ERIC, and PSYCHINFO) including journal publications, abstracts, and dissertations revealed nine studies that investigated the use of instructional methods in athletic training education (Fincher & Wright, 1996; Speitel & Buxton, 1995; Holgen, Buxton, & Speitel, 1995; Gould, Ransone, Conry, & Chan, 1995; Deere & Wright, 1995; Chen & Buxton, 1995; Buxton, Speitel & Holgen, 1995; Bruce, 1993).

All of the aforementioned studies looked at computer-assisted instruction (CAI) methods of teaching. The same literature review revealed no additional scholarship that addressed alternative instructional methods (e.g. lecture,
projects, group discussion, etc.). Although four of the aforementioned studies investigated CAI and the effects on learning (Holgen, Buxton & Speitel, 1995; Deere & Wright, 1995; Chen, Buxton & Holgen, 1995; Buxton, Speitel & Holgen, 1995), the literature is deficient regarding scholarship focused on bridging the gap between instructional methods and learning style. Therefore, the primary reason to perform this study is to fill the literature gap and investigate the relationship between learning style and preferred teaching method.

Statement of the Problem

The problem of the study was to investigate the Mind Styles of undergraduate athletic training education students and program directors as referenced by the Gregorc Style Delineator™ Research Edition (GSD). The proposition is that we may be better able to understand the educational process through any significant relationships that may be present. The problem was specifically approached through the following research questions:

RQ1: Are the Mind Styles of undergraduate athletic training education students and program directors proportionately distributed as determined by the GSD?
RQ2: Is there a difference between male and female undergraduate athletic training students’ Mind Styles as determined by the GSD?

RQ3: Is there a difference between undergraduate athletic training students’ Mind Styles and their education level?

RQ4: Are the Mind Styles of undergraduate athletic training students different from program directors’ Mind Style preferences?

RQ5: Is there a difference in preferred teaching method between undergraduate athletic training students and athletic training program directors?

RQ6: Are athletic training education students’ and program directors’ Mind Styles related to preferred teaching method?

Null Hypotheses

$H_{01}$: There will be an equal proportion of undergraduate athletic training students for each Mind Style and an equal proportion of program directors for each Mind Style.

$H_{02}$: There will be no difference between male and female undergraduate athletic training students’ Mind Styles.
H₀₃: There will be no difference in undergraduate athletic training students’ Mind Styles and their education level.

H₀₄: There will be no difference between undergraduate athletic training students’ Mind Styles and program directors’ Mind Styles.

H₀₅: There will be no difference between undergraduate athletic training students’ and program directors’ preferred teaching methods.

H₀₆: There will be no relationship between Mind Styles and preferred teaching method for athletic training education students and program directors.

Significance of Study

Both students and educators enter into the learning environment with a particular mental alignment. Generally, the educator is perceived as the classroom facilitator. Therefore, the educator becomes a significant factor in helping students learn. When student and educator mental alignments are congruent, the environment becomes quite suitable for learning. Conversely, mismatched teaching and learning styles can often result in a poor learning environment (Keefe, 1979; Messick, 1984; Claxton & Murrell, 1987). The goal is for the educator to realize his or her
teaching style and guard against over-teaching in that particular style (Friedman & Alley, 1984).

Another goal for the educator is to identify the learning styles of students and help them learn through their own style preferences (Friedman & Alley, 1984).

Wilbert McKeachie (1980) states:

The effectiveness of student learning depends to some extent upon the strategy used by the student. Students often fail to choose the strategy that they can use most effectively and also fail to match their strategy to the learning task. (p. 89)

However, students will eventually become too comfortable at learning within their preferred style. It then becomes imperative to encourage students to diversify styles (Strother, 1982). This “style flex” would enable cognitive growth by letting students that learn in one style to be carefully guided by the educator in learning styles that are not strengths for the student.

Learning style is an over arching term that encompasses all scholarship related to recognizing individual learning differences (Butler, 1987). Specifically, this investigation focuses on the aspect of learning style known as Mind Style. Assessing Mind Styles
would provide athletic training educators with an opportunity to develop a more personalized approach to instruction. In only a few minutes of the educator’s time, a dominant Mind Style could be identified for each student. This Mind Style assessment matched with appropriate instructional methods (e.g., lecture, simulation, computer-assisted instruction, or style differentiated instruction [SDI] etc.) could serve students by greatly enhancing academic achievement and serve faculty by evaluating curriculum content, objectives, and stylistic demands (Butler, 1987). As stated by Harrelson, Leaver-Dunn, and Wright (1998), “An understanding of student learning preferences would allow athletic training educators to strengthen the quality of teaching as the content and process of athletic training education are standardized” (p.50). Educators can have a powerful effect on the minds of students when they can offer multiple ways to reach course outcomes.

Delimitations of the Study

This study was delimited by the following factors:

1. Sample 1 = a national, simple random sample of approximately 10 entry-level athletic training education programs (i.e., ~10 programs = ~200
undergraduate athletic training education students).
Sample 2 = a national, simple random sample of 100 university/college educators (i.e., program directors).


3. The use of the Preferred Teaching Methods Inventory to assess students’ and program directors’ preferred mode of learning information in the didactic setting.

4. The administration of the data collection instruments at the beginning of the Fall 2002 quarter. Specifically, the instrument was administered within the first week of the quarter or semester before academic obligations overwhelmed either sample group.

Limitations of the Study

This study was limited by the following factors:

1. The results of the study are only generalizable to undergraduate athletic training education students and faculty educators who are from CAAHEP programs.

2. Genetic predisposition toward specific types of instructional methods (e.g., simulation versus
structured lecture) may confound the results obtained regarding preferred teaching method.

3. The students may orient their answers according to a specific course or topic. The students’ attitudes toward that subject matter that is to be taught may confound the results of preferred teaching method.

4. By leaving the definition of each instructional method to the subject, differences may arise simply due to different definitions and experiences had with each instructional method.

5. To obtain optimal results, the preferred method of administering the GSD is oral dissemination of the instructions (A. Gregorc, personal conversation, April 8, 2002). This research study incorporated a mailed survey with written instructions for the GSD supplied in the cover letter. This format, according to Gregorc, could influence the accuracy of the results.

6. The self-selection process of choosing a profession may influence the results from this study. For example, students and faculty may have been attracted to the profession because of the dominant style perceived necessary to excel in athletic training.
7. Incorrect scores or missing data could be obtained if individuals fail to follow the ranking directions or if individuals guess at the meaning of any of the words.

8. Due to the unbalanced design between undergraduate students and program directors, careful generalizations must be made about any statistically significant findings.

9. The degree to which respondents answer in an honest manner will affect the results.

Definition of Terms

For consistency of interpretation and understanding, the following terms are defined:

1. Learning Style- It is a larger umbrella term that includes “…characteristic cognitive, affective, and physiological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment” (Keefe, 1979, p.4).

2. Cognitive Style- a subsequent type of learning style that is formally defined as “people’s characteristic and typically preferred modes of processing information” (Sternberg & Grigorenko, 1997, p. 700).
3. *Mediation Ability*—theory that states, “the human mind has channels through which it receives and expresses information most efficiently and effectively. The power, capacity, and dexterity to utilize these channels are collectively termed mediation abilities” (Gregorc, 1982a, p. 5).

4. *Mind Style*—trademark term by Anthony F. Gregorc that refers to the “outward appearance of an individual’s mediation abilities” (Gregorc, 1982a, p. 5).

5. *Perception*—defined by Gregorc (1982a) as “means through which you grasp information. These emerge as two qualities: Abstractness and Concreteness” (p. 5).

6. *Ordering*—defined by Gregorc (1982a) as “the ways in which you authoritatively arrange, systematize, reference, and dispose of information. These emerge as two qualities: Sequence and Randomness” (p. 5).

7. *Gregorc Style Delineator*™ *Research Edition*—an instrument that measures learning style preference by “combination of perceptual and judgmental orientations to form four possible learning styles: concrete sequential (CS), abstract sequential (AS), abstract random (AR), and concrete random (CR)” (Hendrichson, Berlocher, and Herbert, 1987, p. 176).
8. **Style**—"The outward appearance of the mind and psyche. At base, style is what is used to make their presence known to the world" (Gregorc, 1982b, p. 18).

9. **Mental Qualities**—"Aggregate energy units used by the mind to perform its functions" (Gregorc, 1982b, p. 17).

10. **Concrete Sequential**—students that “have a propensity for deriving information through direct, hands-on experience...appreciate order and logical sequence in presentation of material” (Claxton & Murrell, 1987, p. 34).

11. **Concrete Random**—students that “approach learning with an experimental, trial-and-error attitude...likely to have flashes of insight and make intuitive leaps in structured situations” (Claxton & Murrell, 1987, p. 34).

12. **Abstract Sequential**—students that “have strong skills in working with written and verbal symbols...tend to use conceptual pictures as they learn” (Claxton & Murrell, 1987, p. 34).

13. **Abstract Random**—students that are “tuned to nuances of mood and atmosphere...associate the medium with the message and link a speaker’s manner of delivery and
personality to the content” (Claxton & Murrell, 1987, p. 34).

14. **Commission on Accreditation of Allied Health Education Programs (CAAHEP)** - a non-profit agency that accredits programs representing 18 allied health professions including athletic training education programs (CAAHEP, 2002).

15. **National Athletic Trainers’ Association (NATA)** - the national organization for certified athletic trainers. The organization’s goal is to “...advance the profession of athletic training through education and research in prevention, evaluation, management, and rehabilitation of injuries” (NATA, 2003).

16. **Teaching style** - “A pervasive way of approaching the learners that might be consistent with several methods of teaching” (Fisher & Fisher, 1979, p. 245).
CHAPTER TWO: REVIEW OF LITERATURE

Introduction to the Literature

This chapter reviews the literature relevant to learning styles. First, a brief review of the history of athletic training education is provided. Second, a review of the history of learning styles theory development, specifically in higher education, allied health and athletic training, is provided. Gregorc’s (1982a) Mind Styles Model and subsequent Mediation Ability Theory are also presented. Third, a review of scholarship involving instructional methods is provided. Fourth, a brief review of the scholarship concerning the variables utilized in the study is provided. The subsections of this chapter specifically follow the order of Introduction to the Literature, Critical Review of Relevant Literature, and Summary and Conclusion.

Athletic Training Education

In 1950, approximately 125 individuals met in Kansas City, Missouri, for the First National Training Clinic (Delforge and Behnke, 1999; Hunt, 1998). The professionals at that meeting voted to establish a national governing body. Subsequently, the National Athletic Trainers’ Association (NATA) was established at that meeting. The
1950’s were focused on organization and structuring of the professional organization. In 1955, the NATA Committee on Recognition was developed with the mission of professional advancement (Delforge and Behnke, 1999). The committee’s first endeavor was to develop a curriculum model that would adequately prepare athletic trainers to enter the workplace. This curriculum model was approved in 1959 (Delforge and Behnke, 1999).

Most of the 1960’s were void of major curriculum advancements. However, the first NATA-recognized athletic training education program was established in 1969. Also in 1969, the Professional Advancement Committee was formed. This committee had two subcommittees: the Subcommittee on Professional Education and the Subcommittee on Certification. The Subcommittee on Professional Education was the first organizational body that formally recognized undergraduate programs as meeting NATA curriculum standards (Delforge and Behnke, 1999). Thus, the process of curriculum evaluation and approval began. The programs became known as NATA-approved.

The 1970s saw a large increase in the number of NATA-approved programs. The 1970s also witnessed the formation of the Professional Education Committee. This committee was
charged with creating a list of objectives that described desirable learning outcomes for the athletic training student. As a result, the Guidelines for the athletic training major were created in 1983 (Delforge and Behnke, 1999). The 1983 Guidelines encompassed two components. One component dealt with subject matter requirements. The other component dealt with the educational objectives developed in the 1970s and became known as the Competencies in Athletic Training (Delforge and Behnke, 1999). This document was the initial effort to move toward a competency-based athletic training education model.

In 1990, the American Medical Association recognized athletic training as an allied health profession (Delforge and Behnke, 1999). Without this important step, athletic training would not have been able to seek accreditation by an outside agency. The Joint Review Committee on Education Programs in Athletic Training (JRC-AT) was also formed in 1990. This committee was established to review entry-level programs for accreditation. The committee’s first task was to develop a set of guidelines to govern the process of reviewing candidate programs. These guidelines became known as Essentials and Guidelines for an Accredited Educational Program for the Athletic Trainer. The JRC-AT works in
conjunction with the Commission on Accreditation of Allied Health Education Programs (CAAHEP) to review candidate programs. The Education Council was established in 1996 as “a clearinghouse for educational policy, development, and delivery” (Delforge & Behnke, 1999). All educational issues are now addressed through this governing body.

Critical Review of Relevant Literature

Historical Development of Learning Styles

The history of modern learning style research can be traced to differences that were formulated over 2,500 years ago by the ancient Hindus (Fizzel, 1984). These peoples believed there were four pathways to practice their religion known as yogas. These different pathways were developed based upon beliefs that people were both active/passive and emotional/thoughtful individuals. However, it wasn’t until the early 1900s that German psychologists started scientifically considering differences in individual cognitive processes (Guild & Garger, 1985).

In 1921, Carl Jung’s work on psychological types was published. He proposed a theory about personality styles in a book titled Psychological Types (1923). In Jung’s medical work with nervous patients, he discovered two psychological
types: Introversion and Extraversion (Jung, 1923). Jung’s work further discriminated that there are certain basic functions that exist and also prevail as psychological types. The basic functions that he discriminated were: thinking, feeling, sensation, and intuition types (Jung, 1923). Jung was quick to point out that each of the aforementioned psychological types can moreover be introverted or extraverted (Jung, 1923). Jung’s work was the first to develop the distinction of introvert and extrovert as well as the sensitive and intuitive type.

In the decades following Jung, other individuals also contributed their commentary on styles. Allport (1961) conducted seminal research on individual differences in personality and learning. Allport was the first to coin the term “learning style” to describe patterns individuals use to learn (Allport, 1961; see also Keefe, 1987). Lowenfield identified persons that experience the world through touch (haptic) and those that experience the world through seeing (visual) (Claxton & Murrell, 1987). Klein identified individual variations in memory processing termed levelers and sharpeners in 1951. Levelers merge similar ideas, experiences and, hence, memories together. Sharpeners separate experiences from one another within their memories.
(Gardner et al., 1959; Keefe, 1987). Grasha (1972) commented on three learning styles that emerged through in-depth interviews: 1. avoidance style, 2. competitive response style, and 3. dependent style. In his later work, Grasha discussed how the examination of differences in the consistency of student-clock-calibrators in Greenwich was the first opportunity that learning style differences were scrutinized under experimental rigor (1984).

In 1963, John B. Carroll conducted an experiment where teaching approaches and time were altered. The results showed that intelligence did not predict achievement well when other factors were held constant. One implication of this study is that with ample time and the correctly matched teaching method almost any student can learn or master material (Henson and Borthwick, 1984; Bloom, 1979). Benjamin Bloom furthered this effort with the concept of mastery learning (Bloom, 1979). Henson and Borthwick (1984) further add, “that individual learners have their own preferred learning style and that teachers have some responsibility for gearing up their style to ‘fit’ the preferred learning style of the learners” (p. 4). If teachers adapted instruction and time on task, the assertion is that the distribution of achievement scores
would become highly negatively skewed (i.e., many scores lumped at the high positive end of distribution).

Since the emphasis in the 1960s and 1970s, efforts on learning style research have waned. Evidence of this decline can be seen in the absence of a clear definition of learning style. European schools of research have focused more on the practical aspects of learning including classroom application of learning theory. North American schools have focused more on theoretical issues such as cognitive and psychomotor psychology (Hendricson, Berlocher, and Herbert, 1987).

Modern Learning Styles Theory

Modern research on learning styles really began in the 1950s and 1960s and was termed cognitive styles (Sternberg & Grigorenko, 1997). The research at this time especially focused on the relationship between cognition and personality. Several researchers felt a need to link personality with cognition in a single theory (Cattell, 1971; see also Eysenck, 1982; Messick 1984). Many of the learning style or cognitive style assessment tools available currently are a direct result of the work of this school of thought (e.g., Myers-Briggs Type Indicator). Sternberg and Grigorencko (1997) suggest that cognitive
styles have provided and can continue to provide a viable way of bridging the gap between cognition and personality.

Within the umbrella concept of theories about modern learning styles research, there are a growing number of learning styles. Whereas early researchers focused on single perceptual modes to explain learning and retention, modern theories have expanded to include cognitive, affective, and physiological influences on learning style. Keefe (1987) has noted that learning style research has even progressed into research on the brain including hemispheric differences, sequential versus simultaneous processing, and whole-brain education. Although researchers continue to develop brain-based research theory (Sylwester, 1995) while discovering its useful applications schools (Caine & Caine, 1997), the scholarship on brain-based research is still limited in terms of linking brain function to the appropriate diagnosis and use of instructional methods.

Curry (1987) conceived a theoretical framework for the various modern models and instruments to be examined. Formally referred to as the “onion model”, it encompasses 25 different modern theories and instruments and processes
them into four layers (Griggs et al., 1994). The layers of Curry’s model are as follows:

1. **personality models**—this is the core of the onion measuring personality traits like the Myers-Briggs Type Indicator (MBTI).

2. **information-processing models**—this is the next layer of the model measuring how individuals gather, use, and dispense information. Examples of instruments would include the Kolb Learning Style Inventory and Gregorc’s Style Delineator.

3. **social interaction models**—the next layer of the model measuring student interaction in the classroom environment. An example would be field-dependent versus field-independent learners (Witkin, 1977).

4. **multidimensional and instructional preference models**—the surface layer of the model focused on multiple factors of learning style (e.g. environmental, personality, social, physiologic, and information processing concerns). An example of this is the Dunn and Dunn model and subsequent Productivity Environmental Preference Survey (PEPS) instrument (Griggs, et al. 1994).
Curry’s work represents a fresh approach to learning styles school of scholarship. Curry (1987) further proposed that each layer of the “onion model” is a separate construct. Each of the several learning styles theories typically measures one of these four major constructs as defined by Curry. Likewise, several of the learning styles instruments typically use a bipolar continuum as the foundational theoretical construct. A representation of the “onion model” is presented in Figure 2.1.

Friedman and Alley (1984) have further developed a theory that suggests there are six principles that emerge from modern learning style literature. These principles are that:

1. Both teaching style and student learning style can be identified (Witkin, 1981; Dunn & Dunn, 1978; Gregorc & Ward, 1977).
   a. Teachers have styles by which they prefer to teach (Entwistle, 1981; Gregorc & Ward, 1977).
   b. Teachers are more likely to develop teaching strategies congruent with their learning styles when unaware of the learning styles literature (Barbe & Milone, 1980).
Figure 2.1. Curry’s “Onion Model” framework for modern learning style theories.
2. Teachers need to guard against over-teaching by their own preferred learning style.
3. Teachers are most helpful when they assist students in identifying and learning through their preferred style.
4. Students should have an opportunity to learn through their preferred style.
5. Students should be encouraged to diversify their learning style preferences.
6. Teachers should focus efforts on developing specific learning activities that reinforce a style.

Friedman and Alley (1984) also suggest that the literature on matching learning styles takes two forms: (a) learning styles matched with personality, and (b) learning styles matched with teaching methods. Since learning styles and teaching methods are the focus of this study only the latter will be discussed.

There are several studies that provide support for matching student styles with teaching method (Fizzell, 1984; Doyle & Rutherford, 1984; Hyman & Rosoff, 1984; Henson & Borthwick, 1984; Bloom, 1986; Bloom, 1979; Pascal, 1971; and James, 1962). These studies all find significant
increases in achievement when students were allowed to
learn in their preferred style. Friedman and Alley (1984)
postulated that these results could have occurred for
several reasons. Students may become more open to the
material being taught if there are choices on how the
material can be acquired. The authors further postulated
that lifting the barriers to learning through matching can
produce less anxiety about the learning approach (Friedman
and Alley, 1984).

Friedman and Alley (1984) summarize by noting that
educators need not accommodate learning styles on all
occasions for all students, but there are instances when an
educator can incorporate a teaching method based on
learning style that may more efficiently transmit
information to the student-learner.

Importance of Learning Styles Research. Learning
styles research is the first attempt to link two distinct
areas of psychology: cognition and personality (Sternberg &
Grigorenko, 1997). Many psychologists have attempted to
link the two areas in a single encompassing theory
(Cattell, 1971; Royce, 1973). Other psychologists have
tried to link personality with other aspects of cognition,
including intelligence (Baron, 1982; Saklofske & Zeidner,
1995; Sternberg & Ruzgis, 1994). The volume of research in this area provides some evidence of heuristic generativity and a need to link cognition with personality.

Learning styles research is stated as having important implications for educational theory and practice (Sternberg & Grigorenko, 1997). The major advantage for educational theorists is that the prediction of academic achievement could be improved by adding elements of learning styles as predictors.

Perhaps one of the single most important aspects of learning styles research is that of matching. Several researchers have found that matching student and teacher learning styles increases achievement (Hyman & Rosoff, 1984; Friedman & Alley, 1984; Claxton & Murrell, 1987; Keefe, 1987; Keefe, 1979). Specifically, Carroll (1963) designed an experiment with several treatment groups. All treatment groups received the same instructional material. Some groups were allotted strict time limits and some groups had no time limits. Additionally, several of the groups were exposed to different treatment methods. The results indicated that when suited with the right teaching method and ample time on task, all students achieved at the 95th percentile or better (Carroll, 1963).
In 1960, Bruner wrote a text titled *The Process of Education* in which he states “...any subject can be taught effectively in some intellectually honest form to any child” (p. 33). Many have misunderstood or thought Bruner to have recanted his position. On this subject, Bruner states:

I’ve certainly not recanted! But the statement has often been misunderstood. It is intended to bring attention to the many alternate ways in which concepts can be represented -- like the concept of infinity, for example, which is represented by the tale of the tortoise and the hare, which is understandable to any kid, in contrast to the Bourbaki "uncertainty" proof of the idea fashionable among some mathematicians. I used to talk about three modes of representation -- enactive, iconic, and symbolic, which is moderately useful. More latterly, I’ve tried to discuss the extent to which narrativizing affects the accessibility of ideas. (personal communication, February 21, 2003)

His statements emphasize the significance of the teachers’ role in presenting information. Perhaps no individual has
provided more evidence of the importance for individualized learning than Benjamin Bloom.

Bloom has conducted numerous experiments on student learning differences. His efforts have acknowledged that individual tutoring is the single best teaching method that produces the highest achievement and retention (Bloom, 1986). Bloom’s studies report that individual tutoring increased academic achievement to 98% regardless of intelligence (Bloom, 1986). Although not practical to implement, these findings assisted Bloom in developing his learning for mastery method. Learning for mastery is a teacher-paced and group-paced approach to learning that Bloom reports produces similar results to the impractical individualized learning (1986). If thought of in statistical terms, the normal distribution of scores for achievement would become highly negatively skewed. This contrasts the traditional belief that one-third of students are poor learners, one-third average learners, and one-third are excellent learners.

Limitations of Learning Style Research. The most significant limitation in this field of research is the lack of clear definition between terms such as: learning style, thinking style, Mind Style, and cognitive style.
There have been over 100 research studies on some version of cognitive style (Curry, 1999). There seems to be a different definition of learning or cognitive style for almost every theory that is developed. Inconsistency in defining the learning styles paradigm may raise more questions than can be answered by the research conducted within the paradigm (Hyman & Rosoff, 1984). Consensus on a definition will take time and will require further research to refine the theory in this field. Therefore, it becomes important for researchers to define the aspect of learning style they are referring to when using the term (Claxton & Murrell, 1987). For the purpose of this investigation, learning style is the larger, overarching term that encompasses all scholarship within this field. Therefore, cognitive style (i.e., methods of information processing) would be one subdivision of the larger learning style field.

To a lesser extent, the learning style research field has been plagued with poor research design (Curry, 1999). The majority of research conducted in the allied health literature has been correlational with only a few (n=5) studies implementing a true experimental design (Griggs et al., 1994). Because correlational designs only assess
possible relationships, it becomes difficult to make the strong causal statements regarding the effect of learning styles within this specific body of scholarship.

Another weakness in the field of learning styles research is a lack of evidence of validity and reliability of the psychometric measurement devices. According to Grasha (1984), many of these instruments “rely on rankings and ratings of things important to learners,” resulting in instruments that are “grounded more in attitudes than in behavior” (p. 50). It is then left to the participant-learners to define their frame-of-reference for answering the inventory. Curry (1990) further explains that the evidence of the effectiveness of learning styles is diminished by the following factors:

1. The overwhelming majority of published literature is from PhD dissertations that have not been replicated to ensure generalizability across disciplines.
2. Most inventories select comparison groups by using extreme scores causing concern for bias due to regression toward the mean.
3. The research designs rarely incorporate the use of covariates to remove the effects of confounding
variables (e.g., prior attitude toward instructional method).

4. The few experimental research designs have been reported as having inherent threats to validity such as the Hawthorne effect.

Curry (1990) also explains that it is rare to find reports of standard errors of measurement for the test scores for the various learning style inventories. This may be one reason for the weak to moderate validity and reliability of current psychometric measurement devices (Grasha, 1984).

Learning Styles in Allied Health Professions

Other allied health professions have dealt with the student learning issues, specifically those dealing with learning styles. The majority of the studies in allied health are from the nursing literature and are correlational in design. There were three studies found that implemented an experimental design. Billings and Cobb (1992) examined the effects of learning styles on achievement when students were exposed to interactive video. The results indicated that student achievement was positively correlated with learning styles corresponding to motivation and responsibility (Billings and Cobb, 1992). Buell and Buell (1987) examined the perceptual preferences
of undergraduate nursing students noting that the majority of students had preferences that influenced the satisfaction of training sessions. Leneham (1994) discovered that GPA and achievement scores increased when undergraduate nursing students were taught how to capitalize on their individual learning preferences.

Undergraduate occupational and physical therapy students have been found to prefer teacher-structured, concrete, and interpersonal learning experiences (Barris, Kielhofner, & Bauer, 1985). The same study also revealed that graduate students in the same disciplines shifted to more abstract experiences from their undergraduate counterparts (Barris, Kielhofner, & Bauer, 1985). Hendricson, Berlocher, and Herbert (1987) conducted a longitudinal examination of dental student learning styles. The results indicated that the majority of dental students are concrete sequential. The researchers also discovered that dental students were influenced by curriculum factors. The dental students tended to prefer more abstract styles when in the classroom setting and more concrete styles in the clinical phase of education (Hendricson, Berlocher, and Herbert, 1987).
Learning Styles in Athletic Training

Athletic training faculties have devoted considerable attention to defining the competencies and proficiencies, sequencing of courses, and methods of assessment. However, learning styles of athletic training students has received limited attention by faculty despite the current curriculum reform within the academic major. There have been four studies documented in the athletic training literature that have assessed learning styles of students (Draper, 1989; Harrelson, Leaver-Dunn, & Wright, 1998; Cocker, 2000; Brower et al., 2001). These studies represent the breadth of learning styles literature in the profession.

Draper (1989) performed the initial study and identified the learning styles preferred by athletic training students. The instrument used in this study was Babich and Randol’s Learning Style Inventory (LSI). The LSI measured three types of learning preferences: 1) personal, including auditory language, visual language, and kinesthetic learning; 2) social, including group or independent learning; and 3) examination, oral or written (as cited in Draper, 1989). The learning style information obtained was used to see if the National Athletic Trainers’
Association Board of Certification (NATABOC) exam was biased toward the different learning styles.

Draper (1989) found that 63% of athletic trainers were independent learners, 58% preferred written to oral exams, and 60% were kinesthetic “hands on” learners. The study found that individuals who preferred written exams scored significantly higher on the written portion of the certification exam than those individuals who preferred oral exams. They found that the reverse finding for those individuals preferring oral exams was not true. Draper (1989) also found that there was no relationship between NATABOC exam scores and any of the following independent variables: 1) personal learning style; 2) social learning style; 3) preference for oral examinations; 4) type of educational program (internship or curriculum); and 5) number of clinical hours. This study was a correlational design and was simply the first step to baseline the learning styles of athletic training students.

Harrelson, Leaver-Dunn, Wright (1998) assessed learning styles in a Committee on CAAHEP-accredited undergraduate athletic training education program. The authors investigated the impact of different demographic variables on learning styles. The demographic variables
investigated were gender and education levels of the athletic training education program. The authors chose the Productivity Environment Preference Scale (PEPS) as their instrument to measure learning style differences. According to the earlier "onion model", the PEPS would be considered a physiological measurement device.

Harrelson, Leaver-Dunn, and Wright (1998) found no substantial differences by gender or academic level and no significant preference for kinesthetic or tactile learning experiences. Their findings were perplexing when compared to the literature. Other closely related allied health care fields have studied the learning styles of their respective students. The results have all been remarkably similar in that most allied health care students are kinesthetic learners (Griggs et al., 1994; Hendricson, Berlocher, & Herbert, 1987). Harrelson, Leaver-Dunn, and Wright (1989) state that the difference may be due to the use of a different learning style inventory. The authors offer another alternative reason for the disparity. Their results suggest that student preferences vary according to the topic (Harrelson, Leaver-Dunn, and Wright, 1989). The assumption is that certain topics lend themselves to hands-on learning activities. For example, a class on evaluating
orthopedic athletic injuries may require students to use different style approaches compared to a class on athletic training administration.

The two remaining studies utilized the Kolb Learning Style Inventory (KLSI) (Cocker, 2000; Brower et al., 2001). Cocker (2000) examined the consistency of undergraduate athletic training students’ learning styles from the classroom setting to the clinical setting. The findings were that 58% of the students switched learning style according to setting (Cocker, 2000). The dominant learning styles for the classroom and clinical setting were assimilator (65%) and converger (42%) respectively (Cocker, 2000). Brower et al. (2001) used the Kolb LSI to examine whether a specific learning style among underclass undergraduate athletic training students led to successful admission into athletic training education programs. The results indicate that there was no preferred learning style difference between those students that were successfully admitted into the program and those students that were not successfully admitted (Brower et al., 2001).

**Gregorc Mind Styles Model**

The theoretical framework of this study is a learning style theory developed by Anthony F. Gregorc, PhD known as
the Mind Styles Model. The key tenet and base of this model is Mediation Ability Theory. Gregorc (1982e) explains the theory as, “…the mind has qualitative mental channels through which it receives and expresses data most efficiently and effectively.” (p. 31). This definition is the key element of the Mind Styles model. Gregorc defines the channels as qualitative because style is inherently different from ability and strategy. Abilities are quantitative and task-specific wherein having more ability is better than having less ability (Curry, 1999). Strategies are conscious decisions about the specific situation at hand (Curry, 1999). Style is a qualitative, valueless behavior that is unconsciously demonstrated across situations (Curry, 1999).

These mental channels are the means by which an individual shares information with his or her surroundings (Gregorc, 1982a). The theory was derived from the phenomenological study of adults’ various abilities to learn. Interviews, document analysis, and field notes were used to examine how the adult participants perceived their own learning styles. Through the analysis process, Gregorc discovered two main themes that emerged from the data:
perception and ordering. These are the two main cognitive abilities that the GSD is designed to reveal.

Each of the cognitive abilities is considered to be a bipolar continuum. Perception cognitive ability is primarily the way individuals grasp information (Gregorc, 1982a). Perception ranges from abstractness to concreteness. Concrete persons would prefer the physical senses to grasp learning material. Abstract persons would prefer to use their mind’s eye to grasp information.

Ordering cognitive ability is primarily the way individuals organize information (Gregorc, 1982a). Ordering ranges from sequence to randomness. Individuals who display the sequence quality like to organize information in a linear (i.e. straightforward) manner. Individuals who display the randomness quality prefer to organize material in a non-linear fashion (i.e., chunking).

A combination of the two bipolar cognitive abilities yields the four mediation abilities represented by the model (see Figure 2.2). The Mind Styles created are: concrete sequential (CS), abstract sequential (AS), abstract random (AR), and concrete random (CR). According
Figure 2.2. Gregorc Mind Style theoretical model including polar opposition. The dotted ellipses represent the Mind Style polar opposition subscales.
to Mediation Ability Theory, each mediation ability reveals the way an individual’s mind expresses, views, and reacts with information and surroundings (Gregorc, 1982c). The GSD instrument attempts to identify these abilities in individuals. The concrete sequential Mind Style describes individuals who prefer physical, hands-on tasks that are structured (e.g., repair technician) (Butler, 1987; Gregorc, 1982a, 1982b, 1982c, 1982d, 1982e). The abstract sequential Mind Style describes individuals who prefer reflective thinking tasks that provide an expression of intellect and rationality (e.g., academician) (Butler, 1987; Gregorc, 1982a, 1982b, 1982c, 1982d, 1982e). The abstract random Mind Style describes individuals who prefer non-physical tasks that allow emotional and interpretive expression (e.g., poetic writer) (Butler, 1987; Gregorc, 1982a, 1982b, 1982c, 1982d, 1982e). The concrete random Mind Style describes individuals who prefer investigative tasks that incorporate risk-taking or multiple options (e.g., cinematographer) (Butler, 1987; Gregorc, 1982a, 1982b, 1982c, 1982d, 1982e).

The Mind Styles Models relates well to the cognitive science literature. Cognitive science literature is often referred to as the “information-processing approach”
(Phillips & Soltis, 1998). Cognitive science researchers generally model human learning after the computer. The premise of this approach is that the brain has many interconnections known as “neural networks” (Phillips & Soltis, 1998). As data is acquired through experiences, each piece is “filed”. The resultant schema or cognitive structure is unique in each individual. Gregorc’s Mind Style Model seems to have a similar theoretical underpinning as the cognitive science approach in that it takes into account how individuals store, recall, and process information.

**Instructional Methods Research**

There are generally two important decisions that an educator must make when developing any form of instruction. Those two decisions are what to teach and, more importantly, how to teach. Intuitively, the what to teach involves discriminating between appropriate materials to include and materials not to include in the instruction. The how to teach, in a competency-based athletic training context, applies more to this study. The how to teach could involve discriminating between appropriate instructional tools or methods.

Athletic training education is primarily driven by a competency-based instructional approach. The *Guidelines and
Competencies give educators the what. However, there are no stipulations placed upon accredited undergraduate athletic training programs regarding the how these competencies should be taught.

The research on instructional methods in athletic training literature is limited to eight studies (Fincher & Wright, 1996; Speitel & Buxton, 1995; Holgen, Buxton, & Speitel, 1995; Gould, Ransone, Conry, & Chan, 1995; Deere & Wright, 1995; Chen & Buxton, 1995; Buxton, Speitel & Holgen, 1995; Bruce, 1993). All of the aforementioned studies are limited to variations of one teaching method: computer-assisted instruction (CAI). A single published journal article by Fincher and Wright (1996) explored the use of computer-based instruction (CBI) in athletic training education. The researchers reported that 55.8% (N=48) of program directors reported using CBI in their curricula. For those who reported that they did not use CBI, lack of funds (63.2%) was the main reason cited for non-incorporation. The program directors were also asked about the type of instructional method that they use to incorporate CBI into the curricula. There were 42 program directors (91.3%) that reported using CBI as a supplement to other forms of instruction. Seven program directors
(15.2%) used CBI as their primary method of instruction. A substantial number of program directors [16 (34.8%)] used CBI as an assessment or testing tool.

The remaining studies have investigated the effects of interactive software on achievement in athletic training education classrooms. Collectively, these studies have found that computer-based instructional methods can facilitate learning when the curriculum content remains consistent over time (Speitel & Buxton, 1995; Holgen, Buxton, & Speitel, 1995; Gould, Ransone, Conry, & Chan, 1995; Deere & Wright, 1995; Chen & Buxton, 1995; Buxton, Speitel & Holgen, 1995; Bruce, 1993).

**Literature on Variables**

**Gender Variation**

Some investigators have postulated that the cognitive development of females and males is similar although qualitatively different (Gilligan, 1982). Kolb (1976) sampled 1,439 male and female college students. Among the males sampled, 59% identified with abstract style and 41% with concrete style. Conversely, of the females sampled, 59% identified with concrete style and 41% with abstract style. Similar studies have indicated that females entering college preferred concrete types of learning experiences
(Mentkowski & Strait, 1983; Mentkowski, 1984). Titus, Bergandi, and Shryock (1990) utilized the Kolb LSI to investigate the learning styles of secondary school students. Their findings suggest that female learning styles were more concrete and homogenous than male high school students. Conventional wisdom regards females as more developmentally mature than males at the secondary school age. It becomes difficult to explain these researchers' findings in terms of departure from conventional wisdom. Perhaps there are developmental personality differences that account for these conventional differences. Logically, it seems that these researchers' findings suggest that males approach formal operations sooner than females.

Gender emerges as a significant variable dependent on the model of learning styles employed (O’Brien, 1990). In the information processing literature, Witkin’s model of field dependence has shown that males tend to be more field independent than females (Witkin, 1977). The interpretation of this finding would suggest that males would choose careers that involve analytical abilities while females would choose careers that call for social interaction. A longitudinal study conducted by Mentkowski and Strait
(1983) indicated that students move from reliance on concrete experience abilities to abstract conceptualization abilities during their college careers.

O’Brien (1990) utilized a MANOVA design to assess differences in gender, major, achievement, and education level for the mean scores of the four mediation channels. The analysis revealed gender as a significant variable. Although education level was non-significant, the variable was very close to the significance threshold. Univariate analysis were conducted and found that gender was significant for the AS, AR, and CR scales. Males scored higher on the AS scale, females scored higher on the AR scale, and males scored higher on the CR scale.

O’Brien (1994) also assessed learning style differences in the secondary school setting. The design utilized a MANOVA with mediation scores as the dependent variables and age, gender, education level as the independent variables. The findings suggest that females significantly preferred the Abstract Random Mind Style more than males. Conversely, males significantly preferred the Concrete Sequential Mind Style more than females (O’Brien, 1994).
The effects of gender on learning styles in the athletic training education literature have been researched to a much lesser extent. Of the four studies on learning styles in the athletic training education literature, only one study examined the effects of gender on student learning style. The study used the PEPS instrument (i.e., a measurement of physiological styles) and cannot be compared to the GSD instrument used in the current study. Therefore, the effects of gender and learning styles as determined by the GSD are unknown.

Education Level Variation

O’Brien (1994) investigated the relationship between the Mind Styles obtained by the GSD and the independent variables of GPA, gender, age, and grade level. All four independent variables were found to be significant. In terms of education level, this study found that high school freshmen students tend to prefer Mind Styles that are more concrete (CS and CR). However, as the students develop through their high school years, a shift occurs from more concrete styles to more abstract styles (AS and AR). Although this shift was not found to be statistically significant, it was close to significance and noteworthy to
mention because of its close alliance with Piagetian developmental learning.

Piaget believed that a child constructs its own knowledge as it progresses through different developmental stages that Piaget labeled as: (a) sensorimotor stage, (b) preoperational stage, c) concrete operations, and (d) formal operations (Phillips & Soltis, 1998). The premise of Piaget’s theory was that knowledge was linked to actions. So, as individuals accrue physical experiences, they are better able to conceptualize and transform ideas in the abstract realm. Therefore, it becomes intuitively apparent that undergraduate students may likewise shift from more concrete preferences to more abstract preferences between freshmen and senior years.

There have been no studies in the athletic training literature that have investigated the effects of education level on learning styles. Similar allied health professions have reported that underclassmen are generally more concrete with a shift toward styles that are more abstract as the student progresses through to graduation (Hendricson, Berlocher, & Herbert, 1987; Griggs et al., 1994).
Student/Faculty Variation

The research on variations in faculty and student learning styles is limited especially in the athletic training education literature. Reckinger (1980) investigated differences in personality between teachers and students. She determined that dominant personality types for teachers are almost always different than that of students noting that compromise between the two is necessary to avoid conflicts (Fizzell, 1984). Wakefield (1993) studied the differences between undergraduate education majors and secondary school teachers. The results appear to corroborate Gregorc’s Mind Style model in that secondary school teachers preferred more concrete styles (CS and CR) and more AS styles (i.e., academician) more often than undergraduate students. Another finding from this study that supports the model is that undergraduate students preferred the AR (i.e., emotional) Mind Style more than secondary school teachers.

Preferred Teaching Method Variation

There has been little research conducted on how preferred teaching method is related to a student’s learning style. In fact, there was only one study found that investigated such differences. Seidel (1999)
investigated whether the learning styles of 100 full-time college students related to their learning styles as determined by the GSD. This study found that students classified as Dual Sequential (CS and AS) learners preferred structured activities and independent lab experiments more than those individuals classified as Dual Random. Conversely, students classified as Dual Random learners preferred group discussion and group projects more than those learners classified as Dual Sequential.

Herbster, et al. (1987) reported findings from an investigation on student teachers that were consistent with Gregorc’s assertions about preferred style. Student teachers that were classified Concrete Sequential used teaching methods where students were asked to logically analyze. Student teachers classified as Abstract Random preferred the use of teaching methods where the teacher was a facilitator and methods were flexible to the students’ needs. Furthermore, student teachers that were classified as Concrete Random preferred the use of teaching methods that encouraged self-paced learning and self-evaluation (Herbster, et al., 1987).
Summary and Conclusions

Although the growth of learning styles theory within athletic training is somewhat underdeveloped, general education literature examining the effects of learning styles has come a long way from Jung’s 1923 development of psychological types. Learning styles research has been plagued with several design flaws and inconsistencies in defining the paradigm. Despite these flaws, the research generated from the fields of cognitive and educational psychology has demonstrated what intuitively makes sense. Individuals learn in different ways.

The present study attempts to address some of the gaps within the learning styles literature. Specifically, this study attempts to add to the existing literature by examining the effects of gender, education level, and faculty versus student differences. The effects of these variables need to be examined as gender demographics of the field shift toward a higher percentage of females. Further, the effects need to be examined as educators in athletic training education continue to reform the competency-based education system.
CHAPTER THREE: METHODOLOGY

Research Design

A correlational ex post facto research design was chosen for this study. This type of design is used when the researcher is unable to manipulate the variables and must examine their naturally occurring effects after-the-fact (Tuckman, 1999). The variables are then related to outcome or dependent measures. This type of research design only establishes relationships and not whether the independent and dependent variables are causally related.

According to Tuckman (1999), three rival interpretations of a correlational design are available: the independent measure caused the dependent measure; the dependent measure caused the independent measure; a third, unmeasured variable caused both to change. In most cases, either multiple variables or unique combinations of these three interpretations are probably at work. Correlational research designs are useful because they suggest possible causal links between variables (Tuckman, 1999). This study is the first to measure undergraduate athletic training student and program director Mind Styles using the Gregorc Style Delineator™ Research Edition (GSD). The logical next step of correlational research is to design a study.
employing the correlated variables as the treatment under experimental control.

*Operational Definition of Variables*

Gender is the first independent variable. *Gender* is defined as either male or female. Education level is the second independent variable. *Education Level* is defined as underclassmen (i.e., freshman and sophomore) and upperclassmen (i.e., junior and senior). Freshmen and sophomores were combined because it was believed that they would have similar experiences in the program so far. Likewise, juniors and seniors were combined because it was believed that they would have shared similar experiences in the program. Academic role is the third independent variable. *Academic Role* is defined as undergraduate athletic training student or athletic training program director. Preferred teaching method is the fourth independent variable. *Preferred Teaching Method* is defined as: structured lecture, group discussion, group project, short lecture with question and answer session, individual project, self-guided learning, writing assignment, and computer-assisted instruction. Personal experience and support of instructional methods literature has shown these
methods to be popular in the allied health setting (Seidel, 1999).

There are four dependent variables (i.e., Mind Styles) measured in this study: concrete sequential, abstract sequential, abstract random, and concrete random. Concrete sequential Mind Style was defined as an individual who prefers physical, hands-on tasks that are structured (e.g., repair technician) (Butler, 1987; Gregorc, 1982a, 1982b, 1982c, 1982d, 1982e). Abstract sequential Mind Style was defined as an individual who likes reflective thinking tasks that provide an expression of intellect and rationality (e.g., academician) (Butler, 1987; Gregorc, 1982a, 1982b, 1982c, 1982d, 1982e). Abstract random Mind Style was defined as an individual who likes non-physical tasks that allow emotional and interpretive expression (e.g., poetic writer) (Butler, 1987; Gregorc, 1982a, 1982b, 1982c, 1982d, 1982e). Concrete random Mind Style was defined as an individual who likes investigative tasks that incorporate risk-taking or multiple options (e.g., cinematographer) (Butler, 1987; Gregorc, 1982a, 1982b, 1982c, 1982d, 1982e).
Identification of the Population

The theoretical target population consisted of all undergraduate athletic training students and all university/college program directors with a teaching role in the athletic training education curriculum. Undergraduate athletic training students were chosen because of their important link in the educative process. The undergraduate athletic training students play the role of learner in this educator-learner relationship. University/college program directors were chosen to explain any relationship between educator Mind Styles and learner Mind Styles.

The theoretical target population is often not practically accessible. Sometimes there are severe problems involved in collecting responses from individuals in the target population. One example would be attempting to survey all certified athletic trainers (ATCs) when not all ATCs are NATA members. According to Kalton (1983), the advantage of starting with the theoretical population is that the exclusions are explicitly defined and the magnitude and consequences of those exclusions can be addressed. Therefore, only members of the NATA that fit the aforementioned categories from CAAHEP-accredited entry-
level undergraduate programs were chosen as the actual target population.

**Sampling Plan**

**Sampling Frame and Procedures**

To avoid the weakness of subjectivity, this study incorporated an equal probability selection method (epsem). Probability sampling requires a sampling frame from which all samples can be selected (Kalton, 1983). A comprehensive list of all accredited status entry-level athletic training programs was obtained through CAAHEP’s website (CAAHEP, 2002). This list represented the sampling frame. A cluster sample of approximately 10 programs was needed to achieve the necessary sample size of 200 undergraduate athletic training students. According to Kalton (1983), “The justification for cluster sampling is the economy it creates for sampling and data collection” (p. 29). Kalton (1983) also reports that if clusters are selected in an epsem method, then the units within the clusters are likewise selected by an epsem method.

The epsem method is a “take all” approach to cluster sampling where program directors were contacted to have their program participate in the study. If the program directors accepted, all students, including the program
director, were participants in the study. Entry-level programs were then added through this epsem method until the sample size reached 200 students (Sample 1). A simple random sample (i.e., epsem method) of 100 program directors was also taken to obtain Sample 2.

**a priori Estimation of Sample Size**

Type I error, alpha ($\alpha$), is the probability of rejecting the null when it is true. It is an established convention in the social sciences to set the chance of making a Type I error at $.05$ (Stevens, 1996). Type II error, beta ($\beta$), is the probability of accepting the null hypothesis when it is false. Power is the probability of making a correct decision to accept or reject the null hypothesis. Therefore, the sample size needed in any study is primarily related to three factors: alpha level, effect size, and power.

For this study, alpha was set a priori at $\alpha = .05$ level. According to Stevens (1996), the effect sizes of MANOVA are reported as partial eta squared ($\eta^2$) and range from small ($.25$), medium ($.64$), large (1), and very large (2.25). Previous research has not revealed any concrete evidence of the effect size that gender and education level have on Mind Style or preferred teaching method. Since the
effect of these variables has not yet been established, I chose to proceed in an exploratory fashion utilizing Stevens’ medium (.64) effect size for MANOVA. In social science research, it is also a well-known standard to set alpha (α) and beta (β) at a 1:4 ratio. Therefore, alpha (α) was set at .05 and beta (β) was set at .2. Being that power equals 1 - beta (β), power was set at .8 respectively. With all three constants set a priori, sample size was then determined. With alpha at .05, effect size at .64, and power at .8, consultation with Stevens’ (1996) tables suggested that approximately 50 subjects per cell were needed with 4 dependent variables. Therefore, Sample 1 consisted of an epsem sample of 200 undergraduate athletic training students and Sample 2 consisted of an epsem sample of 50 program directors.

Instrumentation
Selection and Development of Instrument

The GSD was chosen by the researcher to examine the Mind Styles of the athletic training education program directors and undergraduate students. This instrument is self-scoring and focuses on two types of cognitive abilities in adult learners: perception (i.e., means of grasping information) and ordering (i.e., means of
arranging information). Each cognitive ability has a bipolar continuum associated with it. The bipolar dimension of the perception ability ranges from abstractness to concreteness (Gregorc, 1982a; see also Butler, 1987). The bipolar dimension of the ordering ability ranges from sequential to random (Gregorc, 1982a; see also Butler, 1987). Gregorc employs a quarternary design that combines the perception and ordering qualities to form four mediation channels: concrete sequential (CS), abstract sequential (AS), abstract random (AR), and concrete random (CR) (Gregorc, 1982b). The GSD instrument is a fixed sum format. The instrument requires each participant to rank order ten columns of four words (Appendix A). A summed rank score of >27 results in a dominant Mind Style. It is possible to score >27 in more than one Mind Style.

Validity Issues

Gregorc (1982d) reported construct validity of the GSD through three methods. The first method was interviews with over 100 individuals that took the GSD. The results were that nearly all individuals found the descriptive words accurate (Gregorc, 1982d). The second method Gregorc reported was predictive validity measured by correlation between GSD scores and attribute scores. There were 110
adults who took the GSD on two occasions and rated attributes that make up the GSD. Correlations between GSD scores and ratings of attributes were .68 and .70 for the CS scale; .68 and .76 for the AS scale; .61 and .60 for the AR scale; and .55 and .68 for the CR scale respectively (Gregorc, 1982d). The third validity method reported by Gregorc was responses to the descriptions resulting from the GSD. There were 123 subjects who were asked to rate resulting descriptions of themselves on a Likert type scale anchored with 1 (Strongly Disagree) and 5 (Strongly Agree). The results were that 29% of the sample Strongly Agreed with their respective description, 57% Agreed, 14% were Unsure, and there were no responses of disagreement at any level (Gregorc, 1982d).

In additional research that incorporated factor analysis, several researchers have investigated the construct validity of this instrument (O’Brien, 1990; Joniak & Isaksen, 1988; see also Bokoros, Goldstein, & Sweeney, 1992; Harasym, et al., 1996; Drummond & Stoddard, 1992). O’Brien (1990) assessed the construct validity of the GSD through confirmatory factor analysis using a LISREL 7 technique. The study was designed to investigate the underlying theoretical model of the instrument. The results
found by O’Brien (1990) suggest that the four separate scales meet minimal requirements for factor definition. O’Brien (1990) further indicated that the scale may have some practical utility, but “only three of the four could be considered defensible measurement models” (p. 636). Applying the Chi-Square statistic, only the CS, AS, and CR measurement models fit the data. The AR scale reported high error terms, low squared multiple correlations, and an unacceptable coefficient of determination and chi-square statistic.

Harasym, Leong, Juschka, Luchier, and Lorscheider (1996) assessed the GSD utilizing a principal component factor analysis with varimax rotation of the scores. Harasym et al. (1996) found the psychometric qualities of the GSD to have questionable validity. The factor analysis revealed only the bipolar mediation channel of ordering ability. The factor analysis further revealed that the bipolar scale of perception (concrete versus abstract) to nullify each other (Harasym, et al., 1996). The design of the current study will also incorporate a principal component analysis (PCA) of the GSD. Agreement or disagreement of the PCA analysis performed in this study
with previous research findings is discussed in the pilot study section.

Reliability Issues

Gregorc (1982d) has reported two measures of reliability for the GSD. The first method reported was internal consistency as measured by Cronbach’s alpha. Gregorc (1982d) reported standardized alphas as .92 for the CS scale; .89 for the AS scale; .92 for the AR scale; and .91 for the CR scale. The second method reported was test-retest correlation coefficients. Gregorc (1982d) reported correlation coefficients between first and second test administrations as .85 for the CS scale; .87 for the AS scale; .88 for the AR scale; and .87 for the CR scale.

O’Brien (1990) conducted a study with 263 undergraduate students as the sample. The findings of this study contradicted the results reported by Gregorc. The reliability analysis conducted by O’Brien (1990) yielded alpha coefficients of .64 for the CS scale, .51 for the AS scale, .61 for the AR scale and .63 for the CR scale. Although substantially lower than the results reported by Gregorc, the results were still within an acceptable range.

Joniak and Isaksen (1988) conducted a study with two samples (n = 109 and n = 135) of undergraduate students
enrolled in a sophomore level creative problem-solving class. The reliability analysis conducted by Joniak and Isaksen yielded Cronbach’s alphas on the CS, AR, and CR subscales that ranged from .55 to .66 for samples one and two. However, in both samples, the alphas for the AS subscale were .23 and .25. The GSD was combined with another instrument totaling 245 items to answer. The authors postulated that the discrepancy may have been manifested due to participant fatigue (Joniak and Isaksen, 1988). The design of the current study will also incorporate an analysis of internal consistency of the GSD. The internal consistency analysis will be performed utilizing Cronbach’s alpha on data from the pilot study in an effort to help support the internal consistency of this psychometric measurement tool.

**Pilot study**

A convenience sample (n = 69) of undergraduate students enrolled in a health-related academic major at Ohio University, Athens, Ohio, volunteered to participate in the pilot study. Each participant received an instrument packet that was intended to be identical to the packet used in the study. One additional qualitative piece was added to the instrument packet. This addition asked open-ended
questions regarding the clarity, additions or deletions, and about topics that were not addressed. This section was added to obtain participant feedback and correct any errors in wording or procedures before official mailing. The means and standard deviations for the four Mind Style subscales are given in Table 3.1.

**Factor Analysis Results.** A principal components factor analysis at the item level with varimax rotation of the responses to the 40 items was performed. Items that loaded at .30 or above were retained as defining a factor. The results of the factor analysis are presented in Table 3.2. Gregorc (1982b) theorized that two bipolar scales (CS versus AR and CR versus AS) should be present.

To determine the number of factors to retain, parallel analysis was performed. Parallel analysis uses simulation to model the average scree obtained over 1000 iterations. The free parallel analysis software provided by authors Kaufman and Dunlop (2000) produces 95th percentile eigenvalues. To retain a factor, compare the real sample eigenvalue of Factor 1 with the eigenvalue of the simulated data. If the real sample value is larger than the averaged simulation value, then that factor is to be retained. This
Table 3.1

Means and Standard Deviations for the Four Mind Style Subscales of the GSD Pilot Study

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Sequential</td>
<td>27.70</td>
<td>5.35</td>
</tr>
<tr>
<td>Abstract Sequential</td>
<td>23.49</td>
<td>4.48</td>
</tr>
<tr>
<td>Abstract Random</td>
<td>24.84</td>
<td>5.03</td>
</tr>
<tr>
<td>Concrete Random</td>
<td>23.97</td>
<td>5.38</td>
</tr>
</tbody>
</table>

Note. n = 69
Table 3.2

Factor Loadings at the Item Level for the Four Mind Styles of the GSD Pilot

<table>
<thead>
<tr>
<th>Factor and variable</th>
<th>Factor loading</th>
<th>% of variance</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Component One</strong></td>
<td></td>
<td>20.89</td>
<td>20.89</td>
</tr>
<tr>
<td>Item 6-AS</td>
<td>.746</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 7-CS</td>
<td>.723</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 6-AR</td>
<td>-.632</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 1-CR</td>
<td>-.632</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 5-CR</td>
<td>-.575</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 4-CS</td>
<td>.554</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 1-CS</td>
<td>.523</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 5-AR</td>
<td>.516</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 8-CS</td>
<td>.476</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Component Two</strong></td>
<td></td>
<td>14.03</td>
<td>34.92</td>
</tr>
<tr>
<td>Item 8-CR</td>
<td>-.800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 5-CS</td>
<td>.685</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 2-CS</td>
<td>.668</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 3-AS</td>
<td>.668</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 6-CS</td>
<td>.580</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 2-CR</td>
<td>-.551</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3.2 (con’t)

Factor Loadings at the Item Level for the Four Mind Styles of the GSD Pilot

<table>
<thead>
<tr>
<th>Factor and variable</th>
<th>Factor loading</th>
<th>% of variance</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 5-AS</td>
<td>-.404</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 9-CR</td>
<td>-.390</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 3-CS</td>
<td>-.373</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.09</td>
<td>42.01</td>
</tr>
<tr>
<td>Component Three</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 7-AS</td>
<td>.683</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 2-AS</td>
<td>.678</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 1-AR</td>
<td>-.646</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 7-AR</td>
<td>-.626</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 10-AR</td>
<td>-.575</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 1-AS</td>
<td>.518</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 8-AR</td>
<td>.418</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 6-CR</td>
<td>.308</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Component Four</td>
<td></td>
<td>6.32</td>
<td>48.33</td>
</tr>
<tr>
<td>Item 10-CS</td>
<td>.582</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 9-AS</td>
<td>.549</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 10-CR</td>
<td>-.533</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 7-CR</td>
<td>-.530</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 4-AR</td>
<td>-.469</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3.2 (con’t)

Factor Loadings at the Item Level for the Four Mind Styles of the GSD Pilot

<table>
<thead>
<tr>
<th>Factor and variable</th>
<th>Factor loading</th>
<th>% of variance</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 10-AS</td>
<td>.451</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 4-AS</td>
<td>.355</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 8-AS</td>
<td>.340</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Component Five</td>
<td>4.35</td>
<td>52.68</td>
<td></td>
</tr>
<tr>
<td>Item 9-AR</td>
<td>-.658</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 9-CS</td>
<td>.543</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 3-AR</td>
<td>-.543</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 2-AR</td>
<td>-.512</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 3-CR</td>
<td>.512</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 4-CR</td>
<td>.507</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
procedure is then followed on the remaining factors until no more factors can be retained.

Five factors were retained in this analysis that cumulatively accounted for 52.68% of the variance. Additionally, intercorrelations between the four Mind Styles were calculated to assess the theoretical construct of bipolar opposition. The results are presented in Table 3.3. The results should indicate CS and AR as opposites and AS and CR as opposites. The analysis provides only weak support for the bipolar constructs. A factor analysis at the construct level was conducted to verify the two mediation abilities. The results of that analysis are presented in Table 3.4. Only two factors were retained for interpretation. Both factors appear to be measuring the Mind Style ability of perception (i.e. concreteness to abstractness).

Harasym, et al. (1996) reported the results of their principal component analysis as yielding two bipolar scales that were unlike those claimed by Gregorc (1982d). Harasym, et al. (1996) concluded that there was a bipolar scale of CS versus CR (Factor 1) and AS versus AR (Factor 2). The results of the current factor analysis appear to have a
Table 3.3

Pearson Intercorrelation Matrix of the Four Mind Style
Subscales of the GSD Pilot Study

<table>
<thead>
<tr>
<th>Delineator Subscale</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Concrete Sequential</td>
<td></td>
<td>-.024</td>
<td>-.349*</td>
<td>-.721*</td>
</tr>
<tr>
<td>2. Abstract Sequential</td>
<td></td>
<td></td>
<td>-.709*</td>
<td>-.198</td>
</tr>
<tr>
<td>3. Abstract Random</td>
<td></td>
<td></td>
<td></td>
<td>.010</td>
</tr>
<tr>
<td>4. Concrete Random</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. n = 69.
*p < .05 (2-tailed).
Table 3.4

*Factor Loadings for the Four Mind Style Subscales of the GSD Pilot*

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor Loading</th>
<th>Communality</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUM_CR</td>
<td>-.937</td>
<td>.88</td>
</tr>
<tr>
<td>SUM_CS</td>
<td>.885</td>
<td>.83</td>
</tr>
<tr>
<td>SUM_AR</td>
<td>-.921</td>
<td>.86</td>
</tr>
<tr>
<td>SUM_AS</td>
<td>.859</td>
<td>.77</td>
</tr>
<tr>
<td>Eigenvalues</td>
<td>2.13</td>
<td>1.20</td>
</tr>
<tr>
<td>% of variance</td>
<td>53.36</td>
<td>29.91</td>
</tr>
</tbody>
</table>
high level of indeterminacy that is unable to corroborate the previous findings of Harasym, et al. (1996). The pilot sample (n = 69) was relatively small which may have affected the ability to interpret the results of the factor analysis. Several sources report that sample size should be between 200-300 subjects or approximately 5 subjects per variable for good or interpretable factor analysis (Tabachnick & Fidell, 2001; Stevens, 1996).

**Internal Consistency Results.** Internal consistency for the pilot sample was measured utilizing Cronbach’s coefficient alpha. Reliability analysis yielded alpha coefficients of .65 for the CS scale, .58 for the AS scale, .53 for the AR scale, and .68 for the CR scale (see Appendix B). Item analysis revealed that both the CS and CR scales functioned well with no negatively correlated items. Further item analysis on the two remaining subscales revealed that the AR scale had two potentially fatal items (item 5C, r = -.26 and item 8C, r = -.10) and the AS scale had one potentially flawed item (item 5B, r = -.10). All three items were carefully monitored during the actual study noting whether the larger study sample caused these items to function better.
Statistical Results. A preliminary MANOVA was run on gender and the dependent variables to assess the functionality of the statistical procedure with a fixed sum format. This statistical procedure was tested to determine how SPSS would deal with any singularity issues. It was found that SPSS throws out any redundant information from the fixed sum format. The results of the MANOVA are presented in Table 3.5.

Data Collection Procedures

This research investigation and all of the associated materials were granted exempt status by the Ohio University Institutional Review Board (see Appendix C). Informed consent was achieved through both cover letter (see Appendix D) and through the instruments’ instructions (see Appendix E). Consent to participate was considered inherent upon completion of the instrument.

The program director from each epsem selected entry-level athletic training program was contacted via e-mail to ask for his/her participation, to provide a brief description of the study and time requirements, and to inquire as to the number of students in the program (see Appendix F). Programs continued to be added in an epsem process until the required sample number was met. An
Table 3.5

**MANOVA Table Results for the GSD Pilot**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>$\eta^2$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Multivariate</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>3</td>
<td>2.61</td>
<td>.108</td>
<td>.058</td>
</tr>
<tr>
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<tr>
<td><strong>Between Subjects</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS</td>
<td>1</td>
<td>3.86</td>
<td>.054</td>
<td>.054</td>
</tr>
<tr>
<td>AS</td>
<td>1</td>
<td>0.47</td>
<td>.007</td>
<td>.496</td>
</tr>
<tr>
<td>AR</td>
<td>1</td>
<td>0.75</td>
<td>.011</td>
<td>.389</td>
</tr>
<tr>
<td>CR</td>
<td>1</td>
<td>4.92</td>
<td>.068</td>
<td>.030*</td>
</tr>
</tbody>
</table>

* $p < .05$.

**Note.** Wilks’ lambda was utilized to determine any significant multivariate differences.
additional two programs were added to prevent non-response and non-participation bias. The major incentives for program directors to participate in this study were the brief time requirements of participation and the ease of administration within the first week of class. A tailored feedback of the data for each school also served as an incentive for CAAHEP self-study purposes.

After confirmation of willingness to participate, a packet was mailed to each program director with the specified number of instruments. The program director was asked to read aloud the cover letter provided. The instruments were distributed with a 10-minute time limit for completion. The program directors collected the instruments and mail them back to the researcher via the self-addressed, postage paid envelope provided. There was a follow-up e-mail at two and four weeks in an attempt to increase return rate.

Data Analysis Procedures

This section provides a general description of the analyses. Specifically, this section provides a detailed description of the statistical procedure performed for each research question and subsequent null hypothesis. In order to describe the sample’s Mind Styles, descriptive
statistics (e.g. mean and standard deviation) for each Mind Style were calculated using the Statistical Package for Social Sciences (SPSS, Inc., Chicago, IL., v. 11).

The independent variables of interest included athletic training student gender (male and female), education level (underclassmen and upperclassmen), educational role (program director and undergraduate student), and instructional method (structured lecture, group discussion, group project, short lecture with question and answer session, individual project, self-guided learning, writing assignment, and computer-assisted instruction). The summed scores on each of the four scales within the GSD served as the dependent variables. In general, multivariate analysis of variance (MANOVA) was utilized to assess any potential relationships between the independent variables and Mind Styles. All differences were measured at the p < .05 level of significance. A concise representation of the analyses is shown in Table 3.6.

Analysis of Research Question One

To determine if the Mind Styles of undergraduate athletic training education students and program directors are proportionately preferred as determined by the GSD, a Chi-Square Goodness of Fit test was performed utilizing the
categorical variable of dominant style. Dominant style is determined from the summed rank score for each Mind Style quadrant. A summed score of 27 or greater indicates a “pointy head” or dominance in the respective quadrant. It is possible to be dominant in more than one quadrant. Those subjects are referred to as dual dominant. To determine dominance, the rank scores were recoded into a new categorical variable based on the highest summed score. A Chi-Square ($\chi^2$) Goodness of Fit test statistic was calculated for the Mind Styles of the students and the program directors.

Analysis of Research Questions Two and Three

To create the most parsimonious model, research questions two and three were combined into one statistical analysis. An approach like this also controls for Type I error (alpha). A two-way MANOVA was used to assess significant main effects. Selected student characteristics (gender and education level) were treated as categorical independent variables and mean scores on the four Mind Style scales (CS, CR, AR, AS) were treated as dependent variables. The Wilks’ lambda statistic was utilized for testing overall main effect differences among the multiple dependent variables. This analysis used only Sample 1 (UG
students). Education level was collapsed to underclassmen (i.e., freshman and sophomores) and upperclassmen (i.e., juniors and seniors). The justification is that underclassmen are more similar in course work, prerequisites, and experience prior to acceptance into the major. Likewise, upperclassmen (i.e. juniors and seniors) are more similar because each are taking classes in the major curriculum and share similar field experiences in athletic training. Significant multivariate main effects will be followed with univariate analyses.

Analysis of Research Question Four

To determine differences in the Mind Style preferences of undergraduate athletic training students from university/college program director Mind Style preferences, an additional one-way MANOVA was performed to assess any significant main effects. Academic role (faculty and student) was treated as the single independent variable and mean scores on the four Mind Style scales (CS, CR, AR, AS) were treated as dependent variables. Wilks’ lambda was again utilized for overall main effect testing. This analysis used Sample 1 (UG students) plus Sample 2 (educators) in an unbalanced design. Due to an unbalanced design, any generalizations from Sample 2 needed to be made...
with caution. Significant multivariate main effects were followed with univariate analyses.

Analysis of Research Question Five

To determine differences in preferred teaching methods between students and educators, a mixed model, 2 X 8 factorial ANOVA with repeated measures was performed. Academic role served as the between subjects variable and teaching method served as the within subjects repeated measure. Ratings on each teaching method style served as the dependent variable for this analysis. Post hoc analysis consisted of univariate F-tests to determine whether undergraduate students or program directors significantly differed on a particular preferred teaching method. This analysis used Sample 1 (UG students) plus Sample 2 (educators). Due to the unbalanced design, any generalizations from Sample 2 needed to be made with caution.

Analysis of Research Question Six

To determine differences between Mind Styles and preferred teaching methods for undergraduate students and program directors, two, mixed model, 4 X 8 factorial ANOVAs with repeated measures were performed. Mind Styles served as the between subjects variable and teaching method served
as the within subjects repeated measure. Ratings on each teaching method style served as the dependent variable for this analysis. Post hoc analysis consisted of univariate F-tests to determine whether undergraduate students and program directors Mind Styles significantly differed on a particular preferred teaching method. This analysis used Sample 1 (UG students) plus Sample 2 (educators). Due to the unbalanced design, any generalizations from Sample 2 needed to be made with caution.

Statistical Assumptions of MANOVA

Three statistical assumptions had to be met to use MANOVA. The first assumption was independence of observation. According to Stevens (1996), violation of this assumption is very serious. MANOVA is not robust to the violation of this assumption. This assumption requires that each observation be derived from the independent action of the subject. In other words, there should be no collaborating amongst subjects or working in pairs. Therefore, the mean or sum of each individual’s score should not be influenced by another subject’s action.

The second assumption of MANOVA was that the observations on the dependent variable(s) are normally distributed. This assumption is less stringent and MANOVA
is robust to its violation. Stevens (1996) states “deviation from multivariate normality has only a small effect on Type I error” (p. 243). This assumption requires that each of the individual variables must be normally distributed to follow a multivariate normal distribution.

The third assumption of MANOVA was homogeneity of the covariance matrices. Although this is a restrictive assumption to meet in the social sciences, Stevens (1996) states that MANOVA is conditionally robust to violations of this assumption. The major point here is to strive to attain equal or nearly equal group numbers. This assumption requires that the elements in the matrices, their diagonals, and their non-diagonals must all be equal for the matrices to be equal.

The GSD is a fixed sum format. Therefore, if any three of the four dependents are known, the fourth can be perfectly predicted without error. Typically, one of the four dependents would be dropped to achieve the most parsimonious model. However, there is no multicollinearity assumption with MANOVA. All subsequent MANOVA analyses were run including all four dependent variables. The justification for not dropping a variable would be losing the ability to speak about the Mind Style that was dropped
from the analysis. The importance lies in being able to speak about any differences between all four variables.

Summary

This chapter explained the method and procedures for the design used in the study. The design and variables were presented first. The sampling plan and estimation of sample size were then presented. The instrument and pilot study results were then presented. The last sections included an explanation of the data collection procedures, individual explanations for analysis of the research questions, and explanations of the assumptions for MANOVA.
### Table 3.6

**Summary of Statistical Analyses by Research Question**

<table>
<thead>
<tr>
<th>Research question</th>
<th>Independent variable(s)</th>
<th>Dependent variable(s)</th>
<th>Statistical test</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>Recoded Mind Style summed scores</td>
<td>Frequencies - scores &gt;27</td>
<td>One Sample Chi-Square statistic</td>
</tr>
<tr>
<td>Two and Three</td>
<td>Gender; 2 levels - male - female Education level; 2 levels - underclassmen - upperclassmen</td>
<td>4 Mind Styles - CS - AS - AR - CR</td>
<td>Two-way MANOVA; Wilks’ lambda; F statistic; partial eta²</td>
</tr>
<tr>
<td>Four</td>
<td>Role; 2 levels - student - educator</td>
<td>4 Mind Styles - CS - AS - AR - CR</td>
<td>One-way MANOVA; Wilks’ lambda; F statistic; partial eta²</td>
</tr>
<tr>
<td>Five</td>
<td>Role; 2 levels - student - educator Teaching method; 8 levels - structured lecture - group discussion - group project - short lecture with Q&amp;A - individual project - self-guided learning - writing assignment - CAI</td>
<td>Preference ratings; 5 point Likert scale</td>
<td>2X8 factorial ANOVA with repeated measures; univariate ANOVA follow-up</td>
</tr>
</tbody>
</table>
### Table 3.6 (con’t)

**Summary of Statistical Analyses by Research Question**

<table>
<thead>
<tr>
<th>Research question</th>
<th>Independent variable(s)</th>
<th>Dependent variable(s)</th>
<th>Statistical test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Six</td>
<td>Recoded Mind Styles; 4 levels</td>
<td>Preference ratings; 5 point Likert scale</td>
<td>4X8 factorial ANOVA with repeated measures; univariate ANOVA follow-up</td>
</tr>
<tr>
<td></td>
<td>CS</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AS</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AR</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teaching method; 8 levels</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>structured lecture</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>group discussion</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>group project</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>short lecture with Q&amp;A</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>individual project</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>self-guided learning</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>writing assignment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CAI</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER FOUR: RESULTS

The purpose of this chapter is to present the results from the study. Included in this chapter are the data collection procedures, response rates, results of the data entry and screening process, the demographic results, the validity results, the reliability results, and the results of the analyses for each research question and hypothesis. The latter section will be subdivided into sections according to the specific research question and null hypothesis.

Data Collection Procedures

The researcher electronically contacted each CAAHEP-accredited athletic training program director that was cluster-sampled to determine the number of undergraduate students in that program. The exact number of instruments (plus five for errors) was mailed to the program director to distribute on the first day of class. The mailing included a pre-addressed, postage-paid envelope in an effort to increase the return rate. Each program director was given two weeks to complete the task. A single, follow-up e-mail was sent at the beginning of the third week. Each survey was coded and entered into the Statistical Package
for Social Sciences upon return (SPSS, Inc., Chicago, IL., v. 11.0).

Response Rates

There were a total of eight CAAHEP-accredited athletic training programs that were cluster sampled to achieve the undergraduate return of 201 completed instruments. The total number mailed was eight with a 100% response rate. Additionally, 100 program directors from CAAHEP-accredited programs were randomly sampled. The return rate achieved with a single follow-up was 43% (n = 43).

Data Entry and Screening Results

Prior to data analysis, gender, education level, and the four composite mediation channel scores for Mind Styles were examined through various SPSS programs for accuracy of data entry, missing values, and fit between their distributions and the assumptions of multivariate analysis. A review of the frequencies yielded that there were no missing values found for any case on the variables used in the analyses. There were two cases that had values that were out of the expected range. Those cases were reviewed for input errors and the out-of-range information was corrected. Inspection of within-group scatterplots was used to check for pairwise linearity and found to be
satisfactory. Examination of box plots and z-scores revealed no univariate outliers. Multivariate outliers were assessed using Mahalanobis distance. The test for multivariate outliers requires using the $\chi^2$ distribution with degrees of freedom equal to the number of dependent variables and testing at the $p < .001$ level (Tabachnick and Fidell, 2001). This test identified one case as a multivariate outlier, $\chi^2(4, n = 244) = 242.02, p < .001$. Because this case was an extreme multivariate outlier, it was deleted from subsequent descriptive and inferential analyses. Therefore, there were 243 (student $n = 200$; faculty $n = 43$) cases that were retained in the study.

**MANOVA Assumption Results**

There are primarily three assumptions that must be met when using MANOVA: (a) independence of observation, (b) multivariate normal distributions in each group, and (c) homogeneity of the covariance matrices.

**Independence of Observation Assumption**

This assumption is usually satisfied by using a random sample (Stevens, 2001). This study randomly selected and distributed the instrument to selected institutions. The program directors were instructed to administer the instrument in a classroom setting and that students were
work independently while completing the instrument. Although some dependency will exist due to responses coming from the same institution, it is reasonable to assume that the independence of observation assumption is tenable.

**Multivariate Normality Assumption**

Multivariate normality can be assessed in a myriad of methods. According to Stevens (2001), the best method to assess multivariate normality is to use skewness and kurtosis coefficients as well as the Shapiro-Wilks' statistic. I chose to use graphical tests as my main method of assessment and coupled those with the non-graphical tests. Histograms, normal probability plots, and detrended normal probability plots were all found to be satisfactory. Likewise, skewness coefficients, kurtosis coefficients, and the Shapiro-Wilks' statistic for each group across the dependent variables reaffirmed the multivariate normality assumption to be tenable.

**Homogeneity of Covariance Matrices Assumption**

The Box test is used to test the homogeneity of covariance matrices assumption and it is very sensitive to non-normality (Stevens, 2001). The instrument used in this study is a fixed sum scale. All four of the scores sum to a composite score of 100. Therefore, knowing three scores,
the fourth can be perfectly predicted. It is generally wise to omit the redundant information. As addressed in the previous chapter, the redundant variable was kept in the statistical analyses for practical issues. It has been confirmed by Harris (2001) that SPSS automatically deletes one of the redundant variables so that it can perform the MANOVA analysis. However, SPSS does not compute the Box test when all four variables are included due to a singularity issue. Therefore, the Box test was run on the analysis using only three of the dependent variables. Box’s M statistic tests the null that the covariance matrices are equal across groups. The Box’s M analysis failed-to-reject \( p = .325 \) the null hypothesis of equal matrices. Therefore, the homogeneity of covariance matrices assumption was found to be tenable.

Validity Results

Principal component factor extraction with varimax rotation was performed on the 40 items from the GSD for a sample of 243 undergraduate students and program directors. Using the parallel rule described in the previous chapter, nine factors were retained in this analysis that cumulatively accounted for 52.84% of the variance. This factor structure at the item level resulted in a high level
of indeterminancy on the latent variables. Additionally, another factor analysis was performed at the construct level. Two factors were retained for interpretation. This analysis provided support for the theoretical model at the construct level (see Appendix G). Concrete sequential and abstract random Mind Styles loaded highly and in a bipolar fashion on factor one. Abstract random and abstract sequential Mind Styles loaded highly and in a bipolar fashion on factor two. Further, an intercorrelation matrix (see Table 4.1) between the four Mind Styles was produced to further assess the theoretical construct of bipolar opposition. Therefore, concrete sequential and abstract random scores should be polar opposites. Likewise, concrete random and abstract sequential scores should be polar opposites. Graphical matrix results are presented in Figure 4.1. These results indicate moderate support for concrete sequential-abstract random opposition ($r = -0.473$) and concrete random-abstract sequential opposition ($r = -0.595$).

Reliability Results

Internal consistency of the four mediation channel subscales was measured utilizing Cronbach’s coefficient alpha. Reliability analysis yielded alpha coefficients of .62 for the CS scale, .52 for the AS scale, .56 for the AR
Table 4.1

Pearson Intercorrelation Matrix for the Four Mind Style Preference Subscales

<table>
<thead>
<tr>
<th>Subscale</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Concrete Sequential</td>
<td>--</td>
<td>.122</td>
<td>-.473*</td>
<td>-.654*</td>
</tr>
<tr>
<td>2. Abstract Sequential</td>
<td>--</td>
<td>--</td>
<td>-.595*</td>
<td>-.392*</td>
</tr>
<tr>
<td>3. Abstract Random</td>
<td>--</td>
<td>--</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>4. Concrete Random</td>
<td>--</td>
<td>--</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Intercorrelations are representative of entire sample (n = 243)
*p < .01 level (2-tailed).
Figure 4.1. Intercorrelation matrix graph of the four Mind Styles learning classifications.
Comparisons between pilot and actual study reliability including a breakdown of reliability results for academic role are provided in Appendix I. Item analysis revealed that both the CS and CR scales functioned similarly to the pilot data with no negatively correlated items. In the pilot, the AR scale had two potentially fatal items that were moderately negatively correlated. Item analysis on the AR subscale from the actual study data revealed no negatively correlated items. The pilot AS scale data also had one potentially flawed item (item 5B, \( r = -.10 \)). The actual study data revealed that this item was still flawed (item 5B, \( r = -.04 \)), but to a much lesser extent.

Demographics Results

Undergraduate Students

There were 200 undergraduate athletic training students that were retained for analysis in this study. Overall, males accounted for 34% \( (n = 68) \) of the undergraduate responses and females accounted for the remaining 66% \( (n = 132) \) of the sample. The mean age of undergraduate respondents was 20.12 \( (SD = 2.02) \) with a range from 18 to 32 years of age. The mean GPA for underclassmen \( (M = 3.27) \) closely approximated the mean GPA
of upperclassmen (M = 3.28). A frequency analysis of male and female students is provided in Appendix J.

Program Directors

There were 43 program directors that were retained for analysis in this study. Overall, males accounted for 51.2% (n = 22) of the program director responses and females accounted for the remaining 48.8% (n = 21) of the sample. The mean age of program director respondents was 40.05 (SD = 9.30) with a range from 26 to 63 years of age. A complete breakdown of undergraduate student and program director descriptive statistics for education level by age and GPA is provided in Table 4.2.

Learning Style Demographics

The percent dominance within each Mind Style category regardless of academic role was examined. The concrete sequential Mind Style recorded the highest percentage (63.4%) of preferred dominance. Figure 4.2 provides a visual representation of the percentage of individuals dominant for each Mind Style. The percent dominance between underclassmen, upperclassmen, and program directors for each preferred Mind Style are provided in Figure 4.3.
<table>
<thead>
<tr>
<th>Variables</th>
<th>Education level</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>N</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underclassmen</td>
<td>102</td>
<td>18.85</td>
<td>.813</td>
<td>102</td>
<td>3.27</td>
<td>.428</td>
<td></td>
</tr>
<tr>
<td>Freshmen</td>
<td>58</td>
<td>18.48</td>
<td>.755</td>
<td>58</td>
<td>3.30</td>
<td>.411</td>
<td></td>
</tr>
<tr>
<td>Sophomore</td>
<td>44</td>
<td>19.34</td>
<td>.608</td>
<td>44</td>
<td>3.24</td>
<td>.452</td>
<td></td>
</tr>
<tr>
<td>Upperclassmen</td>
<td>98</td>
<td>21.44</td>
<td>2.07</td>
<td>98</td>
<td>3.28</td>
<td>.397</td>
<td></td>
</tr>
<tr>
<td>Junior</td>
<td>43</td>
<td>20.49</td>
<td>.910</td>
<td>43</td>
<td>3.21</td>
<td>.420</td>
<td></td>
</tr>
<tr>
<td>Senior</td>
<td>55</td>
<td>22.18</td>
<td>2.40</td>
<td>55</td>
<td>3.33</td>
<td>.373</td>
<td></td>
</tr>
<tr>
<td>Program</td>
<td>43</td>
<td>40.05</td>
<td>9.29</td>
<td>43</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Directors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 4.2. Overall (Sample 1 + Sample 2) comparison of percent dominant versus non-dominant for each Mind Style.

Note. Dominant percentages will not sum as some individuals were dually dominant.
Figure 4.3. Education Level by Mind Style type comparison of percent dominance. Note. Dominant percentages will not sum as some individuals were dually dominant.
Learning Styles by Academic Role and Education Level

Of the four Mind Styles, underclassmen reported the highest preferred mean score ($M = 27.53$) for the concrete sequential Mind Style. Upperclassmen reported an even higher preferred mean score ($M = 28.21$) for the concrete sequential Mind Style. However, program directors reported the highest preferred mean score ($M = 30.02$) also for the concrete sequential Mind Style. Comparing each Mind Style across education level and academic role, underclassmen recorded a 48% preference for concrete sequential, upperclassmen recorded a 40.8% preference for concrete sequential, and program directors recorded a 58.1% preference for the concrete sequential Mind Style (see Figures 4.4, 4.5, and 4.6). A complete breakdown of the descriptive statistics is provided in Table 4.3.

Learning Styles by Gender

Males preferred the concrete sequential Mind Style 55.6% (n = 50) to other Mind Styles. Males did not record any additional notable preferences for Mind Styles. Females also primarily preferred the concrete sequential Mind Style, 41.8% (n = 64). Notably, females also preferred the abstract random Mind Style 30.1% (n = 46) of the time (see Table 4.4).
Figure 4.4. Percentage dominance of each Mind Style by gender for Underclassmen (n = 102). All percentages are calculated from the total number of Underclassmen.
Figure 4.5. Percentage dominance of each Mind Style by gender for Upperclassmen (n = 98). All percentages are calculated from the total number of Upperclassmen.
Figure 4.6. Percentage dominance of each Mind Style by gender for Program Directors (n = 43). All percentages are calculated from the total number of Program Directors.
Table 4.3  

Means and Standard Deviations of Mind Styles by Education Level and Academic Role  

<table>
<thead>
<tr>
<th></th>
<th>Concrete Sequential</th>
<th>Abstract Sequential</th>
<th>Abstract Random</th>
<th>Concrete Random</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Underclassmen&lt;sup&gt;a&lt;/sup&gt;</td>
<td>27.53</td>
<td>5.27</td>
<td>23.11</td>
<td>3.51</td>
</tr>
<tr>
<td>Freshmen</td>
<td>27.38</td>
<td>5.38</td>
<td>22.95</td>
<td>3.90</td>
</tr>
<tr>
<td>Sophomore</td>
<td>27.73</td>
<td>5.19</td>
<td>23.32</td>
<td>2.95</td>
</tr>
<tr>
<td>Upperclassmen&lt;sup&gt;b&lt;/sup&gt;</td>
<td>28.21</td>
<td>4.55</td>
<td>23.48</td>
<td>4.55</td>
</tr>
<tr>
<td>Junior</td>
<td>28.14</td>
<td>3.99</td>
<td>23.56</td>
<td>4.62</td>
</tr>
<tr>
<td>Senior</td>
<td>28.27</td>
<td>4.93</td>
<td>23.42</td>
<td>4.54</td>
</tr>
<tr>
<td>Program</td>
<td>30.02</td>
<td>5.36</td>
<td>23.79</td>
<td>5.17</td>
</tr>
<tr>
<td>Directors&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>n = 102.  <sup>b</sup>n = 98.  <sup>c</sup>n = 43.
Table 4.4

Means and Standard Deviations of Mind Styles by Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Concrete</th>
<th>Abstract</th>
<th>Abstract</th>
<th>Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sequential</td>
<td>Sequential</td>
<td>Random</td>
<td>Random</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>M</th>
<th>SD</th>
<th>M</th>
<th>SD</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>29.04</td>
<td>4.95</td>
<td>24.66</td>
<td>4.23</td>
<td>23.02</td>
<td>5.08</td>
<td>23.28</td>
<td>5.06</td>
</tr>
<tr>
<td>Female</td>
<td>27.78</td>
<td>5.09</td>
<td>22.63</td>
<td>4.11</td>
<td>25.95</td>
<td>4.51</td>
<td>23.65</td>
<td>4.95</td>
</tr>
</tbody>
</table>

^a n = 90. ^b n = 153.
Hypothesis Testing

The purpose of the study was to examine undergraduate athletic training students’ and university/college program directors’ Mind Styles and teaching preferences. Specifically, the study addressed gender and education level differences. The main statistical method employed was a 2 X 2 MANOVA. The following section is organized so that each of the study’s hypotheses is identified followed by the statistical analysis, the decision to reject or fail to reject, and any necessary post hoc analyses.

Proportion of Undergraduate and Faculty Mind Styles: \( H_{01} \)

The purpose of this hypothesis was to determine if there were equal proportions of undergraduate athletic training students and programs directors for each Mind Style. The null hypothesis stated that there would be an equal proportion across Mind Styles for the academic roles. A single Chi-Square Goodness of Fit test was conducted for both undergraduate students and program directors for the Mind Styles categorical variable. Utilizing the Chi-Square criterion, it was determined that program directors and undergraduate students did not proportionately prefer the four different Mind Styles, \( \chi^2(3, N = 43) = 28.72, p < .001 \) and \( \chi^2(3, N = 200) = 51.48, p < .001 \) respectively (see Table
Therefore, the decision was to reject the null for hypothesis one.

**Gender and Education Level Differences of Student Mind Styles: H$_{02}$ and H$_{03}$**

The purpose of hypothesis two was to determine if there was a difference between genders for undergraduate athletic training student Mind Styles. The purpose of hypothesis three determined if there were differences within education levels. The two hypotheses were combined for the sake of parsimony. The null hypothesis stated that there would be no difference between genders and no difference between education levels. A 2 X 2 between subjects MANOVA was performed on four dependent variables: (a) concrete sequential, (b) abstract sequential, (c) abstract random, and (d) concrete random.

Utilizing the Wilks' lambda criterion, the linear combination of dependent variables was affected by gender, Wilks' lambda = .94, $F(4,194) = 3.129$, $p < .05$, but not by education level ($p = .310$) or their interaction ($p = .108$). The result reflected a mild association between gender and the combined dependent variables, partial $\eta^2 = .061$. Therefore, the decision was to reject the null for hypothesis two and fail to reject for hypothesis three.
Table 4.5

*Observed Frequencies and Expected Frequencies for Chi-Square Analysis of \( H_{01} \)*

<table>
<thead>
<tr>
<th>Mind Style</th>
<th>Faculty ((n = 43))</th>
<th>Student ((n = 200))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Expected</td>
<td>Observed</td>
</tr>
<tr>
<td>Concrete sequential</td>
<td>10.8</td>
<td>25</td>
</tr>
<tr>
<td>Abstract sequential</td>
<td>10.8</td>
<td>4</td>
</tr>
<tr>
<td>Abstract random</td>
<td>10.8</td>
<td>3</td>
</tr>
<tr>
<td>Concrete random</td>
<td>10.8</td>
<td>11</td>
</tr>
</tbody>
</table>
Univariate analyses were conducted for the main effect of gender on each of the dependent variables. Gender affected both the abstract sequential, \( F(1,198) = 5.21, p < .05, \) and abstract random Mind Styles, \( F(1,198) = 9.50, p < .01, \) but not the concrete sequential \( (p = .225) \) or concrete random \( (p = .813) \) Mind Styles. The strength of association for both significant results were mild, partial \( \eta^2 = .031 \) and .054 respectively. As indicated in Table 4.6, male undergraduate athletic training students were more likely \( (M = 24.19) \) to prefer the abstract sequential Mind Style than female students \( (M = 22.83) \). Conversely, male undergraduate athletic training students were less likely \( (M = 24.01) \) to prefer the abstract random Mind Style than female students \( (M = 26.11) \).

**Faculty and Student Differences on Mind Styles: \( H_{04} \)**

The purpose of this hypothesis was to determine if there were differences between athletic training program directors’ and undergraduate students’ preferred Mind Styles. The null hypothesis stated that there was no difference between faculty and students’ preferred Mind Styles. A one-
Table 4.6

Cell Means, Standard Deviations, and Sample Size Values for Gender and Education Level Differences

<table>
<thead>
<tr>
<th>Mind Style</th>
<th>Gender</th>
<th>Education Level</th>
<th>N</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>Male</td>
<td>Underclassmen</td>
<td>38</td>
<td>28.36</td>
<td>4.58</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Upperclassmen</td>
<td>31</td>
<td>28.52</td>
<td>5.30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>68</td>
<td>28.46</td>
<td>4.91</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>Underclassmen</td>
<td>65</td>
<td>27.03</td>
<td>5.58</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Upperclassmen</td>
<td>67</td>
<td>28.07</td>
<td>4.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>132</td>
<td>27.56</td>
<td>4.93</td>
</tr>
<tr>
<td>Abstract</td>
<td>Male</td>
<td>Underclassmen</td>
<td>38</td>
<td>23.58</td>
<td>3.70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Upperclassmen</td>
<td>31</td>
<td>25.06</td>
<td>4.63</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>68</td>
<td>24.19</td>
<td>4.18</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>Underclassmen</td>
<td>65</td>
<td>22.91</td>
<td>3.43</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Upperclassmen</td>
<td>67</td>
<td>22.75</td>
<td>4.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>132</td>
<td>22.83</td>
<td>3.91</td>
</tr>
</tbody>
</table>
Table 4.6 (con’t)

Cell Means, Standard Deviations, and Sample Size Values for Gender and Education Level Differences

<table>
<thead>
<tr>
<th>Mind Style</th>
<th>Gender</th>
<th>Education Level</th>
<th>N</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>Male</td>
<td>Underclassmen</td>
<td>38</td>
<td>25.05</td>
<td>3.95</td>
</tr>
<tr>
<td>random</td>
<td></td>
<td>Upperclassmen</td>
<td>31</td>
<td>22.68</td>
<td>5.34</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>68</td>
<td>24.01</td>
<td>4.77</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td>Underclassmen</td>
<td>65</td>
<td>26.09</td>
<td>4.34</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Upperclassmen</td>
<td>67</td>
<td>26.12</td>
<td>4.54</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>132</td>
<td>26.11</td>
<td>4.42</td>
</tr>
<tr>
<td>Concrete</td>
<td>Male</td>
<td>Underclassmen</td>
<td>38</td>
<td>23.08</td>
<td>4.97</td>
</tr>
<tr>
<td>random</td>
<td></td>
<td>Upperclassmen</td>
<td>31</td>
<td>23.74</td>
<td>5.23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>68</td>
<td>23.34</td>
<td>5.09</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td>Underclassmen</td>
<td>65</td>
<td>23.97</td>
<td>4.66</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Upperclassmen</td>
<td>67</td>
<td>23.06</td>
<td>4.58</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>132</td>
<td>23.51</td>
<td>4.62</td>
</tr>
</tbody>
</table>
way MANOVA utilizing academic role as the independent variable was performed on four dependent variables: (a) concrete sequential, (b) abstract sequential, (c) abstract random, and (d) concrete random.

Utilizing the Wilks’ lambda criterion, the linear combination of dependent variables was affected by academic role, Wilks’ lambda = .930, $F(4, 239) = 4.486, p < .01$. The result reflected a mild association between academic role and the combined dependent variables, partial $\eta^2 = .070$. Therefore, the decision was to reject the null for hypothesis four. The source table for this analysis is located in Appendix L.

Univariate analyses were conducted for the main effect of academic role on each of the dependent variables. Academic role affected both the concrete sequential, $F(1, 241) = 6.57, p < .05$, and abstract random Mind Styles, $F(1, 241) = 13.82, p < .001$, but not the abstract sequential ($p = .486$) or concrete random ($p = .685$) Mind Styles. The strength of association for both significant results were mild, partial $\eta^2 = .027$ and .054 respectively. As indicated in Table 4.7, undergraduate athletic training students were less likely ($M = 27.86$) to prefer the concrete sequential Mind Style than program directors ($M = 30.02$). Conversely,
Table 4.7

Cell Means, Standard Deviations, and Sample Size Values for Academic Role Differences

<table>
<thead>
<tr>
<th>Mind Style</th>
<th>Academic Role</th>
<th>N</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>Program Director</td>
<td>43</td>
<td>30.02</td>
<td>5.36</td>
</tr>
<tr>
<td>sequential</td>
<td>Student</td>
<td>200</td>
<td>27.86</td>
<td>4.93</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>243</td>
<td>28.24</td>
<td>5.06</td>
</tr>
<tr>
<td>Abstract</td>
<td>Program Director</td>
<td>43</td>
<td>23.79</td>
<td>5.17</td>
</tr>
<tr>
<td>sequential</td>
<td>Student</td>
<td>200</td>
<td>23.29</td>
<td>4.05</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>243</td>
<td>23.38</td>
<td>4.26</td>
</tr>
<tr>
<td>Abstract</td>
<td>Program Director</td>
<td>43</td>
<td>22.40</td>
<td>5.49</td>
</tr>
<tr>
<td>random</td>
<td>Student</td>
<td>200</td>
<td>25.40</td>
<td>4.64</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>243</td>
<td>24.86</td>
<td>4.93</td>
</tr>
<tr>
<td>Concrete</td>
<td>Program Director</td>
<td>43</td>
<td>23.79</td>
<td>5.90</td>
</tr>
<tr>
<td>random</td>
<td>Student</td>
<td>200</td>
<td>23.45</td>
<td>4.78</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>243</td>
<td>23.51</td>
<td>4.98</td>
</tr>
</tbody>
</table>
undergraduate athletic training students were more likely ($M = 25.40$) to prefer the abstract random Mind Style than program directors ($M = 22.40$).

**Faculty and Student Differences on Teaching Preferences: $H_{05}$**

The purpose of this hypothesis was to determine if there were differences between athletic training program directors and undergraduate students on ratings of preferred teaching methods. The null hypothesis stated that there was no difference between faculty and students preferred teaching methods. Ratings on the resultant teaching methods served as the dependent variables for a 2 X 8 (Academic Role X Teaching Method) ANOVA with repeated measures. Teaching methods were the within-subjects measure and academic role was the between subjects measure.

Utilizing the Wilks' lambda criterion, the linear combination of dependent variables was affected by academic role, Wilks' lambda = .956, $F(7, 235) = 2.31, p < .05$. The result reflected a mild association between academic role and the combined dependent variables, partial $\eta^2 = .024$. Therefore, the decision was to reject the null for hypothesis five. The source table for this analysis is located in Appendix M.
Univariate analyses were conducted for the significant interaction between academic role and preferred teaching methods. Academic role affected teaching method five, $F(1, 241) = 10.34, p < .001$, teaching method six, $F(1, 241) = 17.59, p < .001$, teaching method seven, $F(1, 241) = 13.53, p < .001$, and teaching method eight, $F(1, 241) = 5.39, p < .05$, but not teaching method one ($p = .265$), teaching method two ($p = .455$), teaching method three ($p = .449$), or teaching method four ($p = .169$). The strength of association for all significant results were all mild, partial $\eta^2 = .041, .068, .053, \text{ and } .022$ respectively. As indicated in Table 4.8, the mean response of undergraduate athletic training students suggests they were less likely to prefer teaching methods five through eight (i.e., individual project, self-guided learning, writing assignment, and computer-assisted instruction respectively) than athletic training program directors. A visual representation of these differences is also presented in Figure 4.7.

Mind Style Differences on Teaching Preferences: $H_{06}$

The purpose of this hypothesis was to determine if there were differences between the four Mind Styles on ratings of preferred teaching methods for undergraduate athletic
Table 4.8

Cell Means, Standard Deviations, and Sample Size Values for Academic Role Differences on Preferred Teaching Methods

<table>
<thead>
<tr>
<th>Teaching Method</th>
<th>Faculty</th>
<th></th>
<th></th>
<th>Students</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>M</td>
<td>SD</td>
<td>N</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>1. Structured lecture</td>
<td>43</td>
<td>3.74</td>
<td>.76</td>
<td>200</td>
<td>3.60</td>
<td>.77</td>
</tr>
<tr>
<td>2. Group discussion</td>
<td>43</td>
<td>3.86</td>
<td>.52</td>
<td>200</td>
<td>3.77</td>
<td>.80</td>
</tr>
<tr>
<td>3. Group project</td>
<td>43</td>
<td>3.49</td>
<td>.67</td>
<td>200</td>
<td>3.38</td>
<td>.88</td>
</tr>
<tr>
<td>4. Short lecture Q &amp; A</td>
<td>43</td>
<td>3.98</td>
<td>.67</td>
<td>200</td>
<td>3.81</td>
<td>.76</td>
</tr>
<tr>
<td>5. Individual project*</td>
<td>43</td>
<td>3.84</td>
<td>.57</td>
<td>200</td>
<td>3.40</td>
<td>.84</td>
</tr>
<tr>
<td>6. Self-guided*</td>
<td>43</td>
<td>3.42</td>
<td>.70</td>
<td>200</td>
<td>2.81</td>
<td>.89</td>
</tr>
<tr>
<td>7. Writing Assignment*</td>
<td>43</td>
<td>3.49</td>
<td>.74</td>
<td>200</td>
<td>2.98</td>
<td>.83</td>
</tr>
<tr>
<td>8. Computer-assisted**</td>
<td>43</td>
<td>3.44</td>
<td>.70</td>
<td>200</td>
<td>3.14</td>
<td>.77</td>
</tr>
</tbody>
</table>

*p<.001. **p<.05.
Figure 4.7. The interaction of program directors and undergraduate students for preferred teaching methods.
training students and program directors separately. The null hypothesis stated that there was no difference between the four Mind Styles on preferred teaching methods. Ratings on the resultant teaching methods served as the dependent variables for a 4 X 8 (Mind Style X Teaching Method) ANOVA with repeated measures. Teaching methods were the within-subjects measure and Mind Styles were the between subjects measure.

Utilizing the Wilks’ lambda criterion, the linear combination of dependent variables was not affected by the four Mind Styles for undergraduate students, \( p = .736 \) or for program directors, \( p = .565 \). Therefore, the decision was to fail to reject both nulls for hypothesis six. The source table for this analysis is located in Appendix N.

**Alternative Findings**

*Effects of Gender as a Covariate*

The previous section revealed that there was a main effect for gender (Hypothesis Two) on the linear combination of Mind Style dependent variables. Additionally, the purpose of analysis four was to determine if there were differences between academic roles (i.e., undergraduate students and program directors). After careful consideration, it was noted that the ratio of males
to females in the undergraduate sample was approximately 1 to 2 respectively. The distribution of males to females in the program director sample was approximately 50/50. Therefore, with different gender distributions and a significant gender effect on Mind Styles for undergraduate students, it became apparent that perhaps the differences found between undergraduate students and program directors may be caused by gender differences and not the academic role differences. Therefore, the analysis was run again including gender as a covariate to remove its effects on the variation of the linear combination of dependent variables.

The purpose of the hypothesis became to determine if there were still differences between academic roles after the affect of gender was removed. The null hypothesis stated that there was no difference between faculty and student preferred Mind Styles. A one-way MANCOVA utilizing academic role as the independent variable and gender as the covariate was performed on four dependent variables: (a) concrete sequential, (b) abstract sequential, (c) abstract random, and (d) concrete random.

Utilizing the Wilks’ lambda criterion, the linear combination of dependent variables was affected by the
covariate gender, Wilks’ lambda = .92, $F(3, 238) = 6.667$, $p < .001$. The result reflected a mild association between gender and the combined dependent variables, partial $\eta^2 = .078$. Even though gender was a significant covariate, it did not change the significant result of academic role on the four Mind Styles, Wilks’ lambda = .94, $F(3, 238) = 4.906$, $p < .01$. The $p$ value changed from significant at the .001 level to significant at the .01 level. The effect size changed very little from partial $\eta^2 = .069$ to .058 respectively. Therefore, the decision to reject the null for hypothesis four was unchanged by adding gender as a covariate.

Another approach to control for the effects of gender is to block the variable. To do this, two separate gender on Mind Style analyses were run by splitting the file on gender. Utilizing the Wilks’ lambda criterion and blocking males, the linear combination of dependent variables was not affected by female academic role ($p = .074$). Conversely, utilizing the Wilks’ lambda criterion and blocking females, the linear combination of dependent variables was affected by male academic role, Wilks’ lambda = .87, $F(3, 86) = 4.125$, $p < .01$. The result reflected a moderate association between gender and the combined
dependent variables, partial $\eta^2 = .126$. Therefore, the
decision to reject the null for hypothesis four while
blocking females but not for blocking males.

**MANOVA Analyses as Repeated Measures**

**Gender and Education Level Differences: $H_{02}$ and $H_{03}$**

The purpose of hypothesis two and three was to
determine if there were differences between gender or
education level for undergraduate athletic training student
Mind Styles using the repeated measures design. The two
hypotheses were combined for the sake of parsimony. The
null hypothesis stated that there would be no difference
between genders and no difference between education levels.
A mixed model between-within, 2 X 2 X 4 repeated measures
ANOVA was performed. Gender and education level served as
the between measures. The four within measures were the
Mind Styles: (a) concrete sequential, (b) abstract
sequential, (c) abstract random, and (d) concrete random.

Utilizing the Wilks’ lambda criterion, the linear
combination of dependent variables was affected by gender
as noted by the Mind Style-gender interaction, Wilks’
lambda = .95, $F(3,194) = 3.625$, $p < .05$, but not by the
interaction of Mind Style and education level ($p = .359$).
The result reflected a mild association between gender and
Therefore, the decision to reject the null for hypothesis two and fail to reject for hypothesis three was unchanged by the repeated measures design. The significant and non-significant interactions of Mind Style with gender and education level respectively are presented in Figures 4.8 and 4.9.

**Academic Role Differences: \textit{H}_{04}**

The purpose of this analysis was to determine if there were differences between athletic training program directors and undergraduate students’ preferred Mind Styles using a repeated measures design. The null hypothesis stated that there was no difference between faculty and students’ preferred Mind Styles. A one-way, mixed model repeated measures ANOVA utilizing academic role as the between subjects measure was performed. The within subjects measure was the four Mind Styles scores: a) concrete sequential, (b) abstract sequential, (c) abstract random, and (d) concrete random.

Utilizing the Wilks’ lambda criterion, the linear combination of dependent variables was affected by academic role as noted by the Mind Style-academic role interaction, Wilks’ lambda = .931, \( F(3, 239) = 5.905, p < .001 \). The
Figure 4.8. The interaction of Males and Females for Mind Style scores under the repeated measure design.
Figure 4.9. The interaction of Underclassmen and Upperclassmen for Mind Style scores under the repeated measure design.
result reflected a mild association between academic role and the combined within subjects measures, partial $\eta^2 = .069$. Therefore, the decision to reject the null for hypothesis four was unchanged using the repeated measures design. The significant interaction of Mind Style with academic role is presented in Figures 4.10.

Summary

This chapter presented the basic demographics, results of construct validity, results of internal consistency, and descriptive statistics for the major hypotheses. The results of the six research questions and hypotheses were also presented and are reviewed in the following list:

1. Faculty and students did not proportionately prefer the four Mind Styles. The concrete sequential learning style is most preferred by faculty and students.

2. Gender affected Mind Style preferences for undergraduate students. Specifically, males preferred the abstract sequential Mind style more than females while females preferred the abstract random Mind Style more than males.

3. Education level had no affect on Mind Style preferences for undergraduate students.
Figure 4.10. The interaction of Program Directors and Undergraduate Students for Mind Style Scores under the repeated measure design.
4. Faculty and students significantly differed in their Mind Style preferences. Program directors were more likely to prefer concrete sequential Mind Styles than undergraduate students. Also, undergraduate students were more likely to prefer abstract random Mind Styles than program directors.

5. Undergraduate students were less likely to prefer teaching methods five (individual project), six (self-guided), seven (writing assignment), and eight (computer-assisted) when compared to program directors.

6. The categorical Mind Style preferences of undergraduate students and program directors did not affect teaching method preferences.

The null hypothesis decisions were tested for accuracy by calculating post-hoc power utilizing GPOWER (Faul & Erdfelder, 1992). The percent estimations of making a Type II error were then calculated by subtracting the obtained power value in GPOWER from the constant 1. The results of the post-hoc power analyses and percent estimations of Type II errors are presented in Appendix O.
CHAPTER FIVE: DISCUSSION, CONCLUSIONS, SUMMARY, AND RECOMMENDATIONS

This chapter contains summaries, discussions, and conclusions of the study. First, a summary of each hypothesis is presented. Second, the results of each hypothesis are discussed and are followed by any conclusions drawn from the analysis. Finally, recommendations for application and future research conclude this chapter.

Summary of the Study

This section contains a brief review of the research questions and methodology of this study including discussion of sampling procedures, instrumentation, and data analysis.

This study was primarily designed to fill the literature gap on learning styles in athletic training scholarship. The majority of studies conducted in athletic training literature investigate learning styles in a descriptive manner or in a predictive manner. This study centers on the concept of Mind Style, which is a member of the information-processing family of the learning style construct. Further, this study is the first attempt at relating learning styles to existing characteristics
(gender, education level, and faculty versus student) and preferred instructional methods. Mind Style differences respective of preferred teaching methods were the primary focus of this study.

There were six null hypotheses that were used to examine the Mind Style scores with the independent variables. The first null hypothesis investigated the distribution of Mind Style scores for both program directors and undergraduate students.

The second and third hypotheses were combined for the sake of parsimony. This combination of hypotheses was designed to examine the relationship of gender and education level to undergraduate student Mind Style scores. These two variables have not been clearly related within the athletic training literature.

The fourth hypothesis was designed to examine differences in preferred learning style between program directors and undergraduate students. This question had not been asked prior to this study. It was presumed that any differences that were found may provide additional evidence for matching student and educator learning styles.

The fifth hypothesis was employed to investigate differences in preferred teaching methods for undergraduate
students and program directors. In athletic training literature, this area had not been examined. This is an important relationship to establish to provide additional support for matching learning styles.

The sixth hypothesis examined students’ and program directors’ categorical Mind Style differences on preferred teaching methods. This was an important hypothesis because it determined if users of certain Mind Styles prefer certain teaching methods. Again, this would provide additional support for the matching argument.

Sample 1 consisted of 8 cluster-sampled, CAAHEP-accredited, entry-level athletic training programs. The total number of participants after reviewing assumptions and outliers was 200 undergraduate students. Sample 2 was a simple random sample of 100 athletic training program directors. Of the 100 program directors sampled, 43 (43%) returned usable instruments. Undergraduate students were combined into two classes. Freshmen and sophomores were combined to form underclassmen. Juniors and seniors were combined to form upperclassmen.

Participants completed the Gregorc Style Delineator (GSD), the Preferred Teaching Method Inventory (PTMI), and a short section of demographic questions. The GSD is a
learning style instrument that was developed by Gregorc (1982a). This instrument measures learning styles on two bipolar continuums of perception and ordering. Combining the two continua in a quarternary design yields four scores for each Mind Style: concrete sequential (CS), abstract sequential (AS), abstract random (AR), and concrete random (CR). Each of these measures provides insight into the individual’s preferred learning style.

The PTMI is an instructional method instrument that was developed by Seidel (1999) and modified with permission by Gould (2003) to fit popular teaching practices within athletic training education. This instrument measures the degree to which an individual feels that each teaching method affects his or her learning. The instrument uses a five point Likert scale anchored by 1 (poorest learning) and 5 (best learning).

The first hypothesis was analyzed using a single Chi-Square Goodness of Fit test for program directors and undergraduate students. Hypotheses two and three were analyzed using a 2 factor (male and female) X 2 factor (underclassmen and upperclassmen) MANOVA with four dependent variables (CS, AS, AR, and CR scores). The fourth hypothesis was analyzed using a one-way MANOVA with
academic role (student and educator) as the independent variable and the four Mind Style scores as the dependent variables. The fifth hypothesis was analyzed using a 2 factor (student and educator) X 8 factor (structured lecture, group discussion, group project, short lecture with questions and answer session, individual project, self-guided learning, writing assignment, computer-assisted instruction) ANOVA with repeated measures. Academic role is the between factor and instructional method is the within factor. The sixth hypothesis was analyzed using a 4 factor (CS, AS, AR, and CR) X 8 factor (preferred teaching methods) ANOVA with repeated measures. The four Mind Styles are the between factors and instructional method is the within factor.

Summary of Quantitative Findings

Mind Style Proportions of Faculty and Undergraduates: \( H_{01} \)

This hypothesis attempted to determine if the observed distribution of Mind Style scores for undergraduate students and program directors differed significantly from the expected distribution of scores. The null hypothesis stated that there would be no difference between observed and expected frequency distributions for the Mind Style scores.
Results and Conclusions. The decision was to reject the null hypothesis for both undergraduate students and program directors. It appears that both faculty and students proportionately preferred the concrete sequential Mind Style over the remaining three Mind Styles more than expected. It is also noteworthy to mention that both students and program directors proportionately preferred the abstract sequential Mind Style less than expected compared to the remaining three Mind Styles.

Gregorc (1982d) speculates about the probable distribution of the four Mind Styles in the general population suggesting that for any sample the most common Mind Style is CS followed by AS, AR, and CR respectively. The results of this study among the sample of faculty indicate that 25 (58.1%) were CS, 4 (9.3%) were AS, 3 (7%) were AR, and 11 (25.6%) were CR. Among the sample of undergraduate students, 89 (44.5%) were CS, 21 (10.5%) were AS, 54 (27%) were AR, and 36 (18%) were CR. Except for the CS Mind Style, the remaining distribution of the scores is in almost direct contradiction with the suggested distribution that Gregorc (1982d) provides. Several researchers have also produced evidence that the proposed distribution of Mind Style scores suggested by Gregorc may
be incorrect (O’Brien, 1994; Seidel, 1999; Wakefield, 1993).

The results of this analysis appear to disagree with Gregorc’s assertions and may take on several interpretations. Perhaps the model of score distributions proposed by Gregorc is inaccurate. Although Gregorc’s assertion is based on several years of research and data collection, the end result is that his model of distribution may not fit the general population. Conversely, perhaps the discipline of athletic training is too specific or unique of a population for the model to apply. Several researchers have noted that the selection of a profession may be the byproduct an individual’s unique learning style (Hendrichson, Berlocher, & Herbert, 1987; Seidel, 1999). In other words, students tend to gravitate to professions that require specific attributes of a learning style that are most prevalent within their learning style makeup.

There are several observations of the results of this analysis that have implications for athletic training educators. The first observation is that the most preferred Mind Style for learning information within the context of athletic training for both undergraduate students and
program directors is concrete sequential. Concrete sequential individuals prefer factual and concrete information presented in a structured environment. These data-based findings suggest that athletic training educators need to be sensitive to the concrete sequential Mind Style in order to provide a satisfactory learning environment. Direct application of this finding may include designing curriculum that is highly organized and utilizes a task-oriented, hands-on approach that allows for physical movement. Specific teaching strategies that would promote this type of environment would include simulations and group breakout sessions to practice clinical techniques.

The second observation is that program directors and students appear to have a main preferential Mind Style that coincides with one another: concrete sequential. Superficially, this finding suggests that students and program directors are matched in their dominant preferred learning style. However, this study did not distinguish between a program director’s preferred mode of learning and the actual method with which the individual teaches to ensure congruency. A concrete sequential teacher does not necessarily ensure that the individual teaches in a concrete manner. Future research could discriminate between
teachers’ preferred learning styles and actual teaching styles.

**Student Mind Style Differences for Education Level and Gender: H_{02} and H_{03}**

The combination of these two hypotheses attempted to determine if there was a difference between genders or education level for undergraduate Mind Style scores. The null hypothesis stated that there would be no difference between the linear combination of Mind Style scores for either independent variable or their interaction.

**Results and Conclusions.** The decision was to reject the null hypothesis for gender, but not for education level. Univariate analyses indicated that gender affected the abstract sequential and abstract random Mind styles, but not the concrete sequential and concrete random Mind Styles. Males tended to prefer AS styles more than females while females tended to prefer AR styles more than males.

The Gregorc Mind Style Model was developed to detect certain characteristic differences. Although Gregorc makes no assertions regarding gender differences, the abstract sequential style is described as analytical, serious, and logical while the abstract random style is described as perceptive, emotional, and impulsive (Hendricson,
Berlocher, & Herbert, 1987). From a developmental perspective, it intuitively would seem that males would prefer AS styles more than females and that females would prefer AR qualities more than males.

Several other researchers have postulated that the learning style development of males and females is different (Seidel, 1999; Orr, Park, Thompson, & Thompson, 1999; O’Brien, 1994, Gilligan, 1982; Kolb, 1976). The results of the current study provide further evidence that gender, in fact, has an effect on the AS and AR Mind Styles. O’Brien (1990; 1994) strengthens this argument citing results that males exhibit stronger AS preferences than females and that females exhibit stronger AR preferences than males. Kolb (1976) noted that 59% of males identified with an abstract style and 59% of females identified with a concrete style. Similar studies support the notion that females prefer concrete types of learning experiences (Mentkowski & Strait, 1983; Mentkowski, 1984; Titus, Bergandi, & Shryock, 1990). Witkin (1977) findings suggest that males would choose careers that involve analytical abilities while females would choose careers that call for social interaction.
The effects of gender on learning styles as determined by the GSD within athletic training education are largely unknown. Of the four studies on learning styles in the athletic training education literature, only one study examined the effects of gender on student learning style. The study used the PEPS instrument (i.e., a measurement of physiological styles) and cannot be compared to the GSD instrument used in the current study. This is the first attempt to provide evidence that gender affects an individual’s learning style.

This study found a demographic ratio of 2:1 for females and males respectively. This is a trend that is consistent with the 2002 NATA Membership Statistics. Currently, the latest gender split is in favor of males at 52% (NATA, 2001). However, the profession of athletic training is experiencing an influx of female students and the gender split will soon be in favor of females. As more female students enter the profession, educators (both male and female) could apply this type of learning style information by designing curriculum and selecting teaching methods that are sensitive to the AR learning characteristics of female students. Specific examples could include choosing instructional methods, such as self-guided
techniques and group formats (discussions and projects), that capitalize on the intuitive and social strengths of the abstract random Mind Style.

Faculty and Student Differences for Mind Styles: $H_{04}$

This hypothesis attempted to determine if there was a difference between program directors and undergraduate students for Mind Style scores. The null hypothesis stated that there would be no difference between the linear combination of Mind Style scores for faculty and students.

Results and Conclusions. The decision was to reject the null hypothesis for the main effect of academic role. Univariate analyses indicated that academic role affected both the concrete sequential and abstract random Mind Styles, but not the abstract sequential and concrete random Mind Styles.

This study indicates that undergraduate students were less likely to prefer the CS style and more likely to prefer the AR style than program directors. Reckinger (1980) supports this finding by noting that differences in dominant personality types for teachers are almost always different than that of students. Wakefield (1993) also supports this study’s findings by noting differences between undergraduate education majors and secondary school
teachers and that undergraduate students preferred the AR (i.e., emotional) Mind Style more than secondary school teachers. The results from this study and supportive studies appear to corroborate in that educators preferred more concrete styles (specifically the CS style) more often than undergraduate students who preferred than AR style more. However, these studies appear to contradict Gregorc’s Mind Style model that academicians would prefer AS styles more often. These results beg the following questions:

1. Do undergraduate students “grow” into the dominant Mind Styles that program directors prefer?

2. Do the characteristics of a discipline attract individuals that have a high affinity for those characteristics?

Personal experience and intuition suggest that students will “grow” into the dominant Mind Style that is preferred by the educator. This “growth” would be further nurtured if the students were not encouraged to “grow” in other non-dominant Mind Styles. Further, personal experience and intuition suggest that students are attracted to professions that require characteristics of their dominant Mind Style.
Faculty and Student Differences on Teaching Preferences: $H_{05}$

This hypothesis attempted to determine if there was a difference between program directors and undergraduate students on preferred teaching methods. The null hypothesis stated that there would be no difference between the linear combination of preferred teaching method scores for faculty and students.

Results and Conclusions. The decision was to reject the null hypothesis for the main effect of academic role. Univariate analyses indicated that academic role affected teaching method five (individual project), six (self-guided learning), seven (writing assignment), and eight (computer-assisted instruction), but not teaching methods one through four (structured lecture, group discussion, group project, and short lecture with question & answer session respectively).

This study suggests that undergraduate athletic training students were less likely to prefer teaching methods five through eight than program directors. Seidel (1999) provides additional support for these findings noting that students classified as Dual Sequential (CS and AS) learners preferred structured activities and independent lab experiments more than those individuals
classified as Dual Random. Conversely, students classified as Dual Random learners preferred group discussion and group projects more than those learners classified as Dual Sequential. Although the current study did not classify individuals as “dual”, undergraduate students significantly preferred the CS Mind Style supporting Seidel’s (1999) claims.

Herbster, et al. (1987) reported findings from an investigation on student teachers that were consistent with Gregorc’s assertions about preferred style. Student teachers that were classified Concrete Sequential used teaching methods where students were asked to logically analyze. Student teachers classified as Abstract Random preferred the use of teaching methods where the teacher was a facilitator and methods were flexible to the students needs. Furthermore, student teachers who were classified as Concrete Random preferred the use of teaching methods that encouraged self-paced learning and self-evaluation (Herbster, et al., 1987).

Another interesting interpretation of these results is that the types of instructional methods that faculty and students differed on were individual and active in nature (i.e., individual project, self-guided learning, writing
assignment, and computer-assisted instruction). This could suggest that students prefer passive learning experiences. If athletic training students do prefer these types of instructional experiences, the implication for educators is to design curriculum that challenges students to choose instructional styles that allow students to “flex” from their dominant instructional preferences.

Mind Style Differences of Faculty and Student for Teaching Preferences: \( H_{06} \)

This hypothesis attempted to determine if there was a difference between Mind Styles on preferred teaching methods for faculty and on preferred teaching methods for undergraduate students. The null hypothesis stated that there would be no difference between the linear combination of preferred teaching method scores for either faculty or students’ Mind Styles.

Results and Conclusions. The decision was to fail to reject the null hypothesis for the main effect of Mind Styles. A post-hoc power analysis reaffirmed that power and Type II error were within acceptable ranges (see Appendix O). Therefore, the conclusion can be made that the effect was not present in this simple random sample of
Summary and Conclusions of the Study

This study began by asking several research questions that inquired as to the status of learning styles in athletic training education and the relationship between learning styles and preferred teaching methods. Stylistic differences in how athletic training students perceive education material should be of paramount importance to athletic training educators. Research in the area of learning styles has shown that differences exist in how students prefer to learn educational material (Smith & Renzulli, 1984; Friedman & Alley, 1984; O’Brien, 1990, 1994; Sternberg & Grigorenko, 1997; Seidel 1999; Orr, Park, Thompson & Thompson, 1999). This study provides additional support of previous claims and extends them into the allied health discipline of athletic training.

One tool implemented in this study (i.e., the GSD) found that athletic training students and program directors have a clear learning preference for the concrete sequential Mind Style. Specifically, there were significant differences between program directors and undergraduate students for the concrete sequential and abstract random
Mind Styles. Although both groups clearly preferred the concrete sequential style, program directors preferred the CS style to a greater extent. Conversely, undergraduate students preferred to use the AR style to a greater extent. The implications of these findings are that educators need to be aware of their preferred style when building a curriculum so that students have opportunities to learn in styles that are not limited to the educator’s preferred style.

Additionally, national statistics indicate that there is an increase in the number of female students in the athletic training profession (NATA, 2001). This study also shows that gender has an effect on learning style. Female students clearly differ from male students on the abstract random style. Abstract random styles prefer open-ended, non-linear structure while filtering perceived information through their emotions. The implications for this finding is that educators should also be sensitive to gender differences when building a curriculum so that females feel that expression an alternative options are available for learning activities.

The other tool implemented in this study (i.e., the PTMI) found that athletic training program directors and
undergraduate athletic training students prefer different teaching methods. Undergraduate students were less likely to prefer teaching methods that require active, individual participation (e.g., individual projects, self-guided learning, writing assignments, and computer-assisted instruction). According to Butler (1987), concrete sequential learners may have difficulty with open-ended activity and individual expression. These findings about instructional preference appear to make sense because both undergraduate students and program directors clearly prefer the concrete sequential Mind Style. Intuitively, undergraduate athletic training students should prefer (and do prefer) instructional methods that are group-oriented, highly structured, and require a mostly passive nature.

This study also attempted to relate the Mind Styles of undergraduate athletic training students and program directors to preferred teaching methods. The results of this sample indicated that no relationship was present. Additional attempts with other samples should be done before these results can be substantiated. However, the immediate implications for athletic training educators is that an individual’s learning style, as measured by the GSD, have no relationship to the type of instructional
method preferred by that individual. Therefore, athletic training educators should primarily construct curriculum that accentuates the preferred experiences of the students’ learning styles taking into account preferred teaching method only secondarily.

The GSD Instrument Revisited

Two principal components analyses (i.e., one in the pilot and one in the actual study) were performed on the GSD in this study. Both analyses resulted in a high level of indeterminancy at the item level. Two principal components analyses at the construct level did provide support for the Mind Styles Model including the bipolar opposition scales of CS:AR and AS:CR. An intercorrelation matrix of the four Mind Styles provided moderate support for the bipolar opposition scales. The GSD met minimal standards for evidence of internal consistency providing alpha coefficients ranging from .62 for CS, .52 for AS, .56 for AR, and .59 for CR respectively.

Although these validity and reliability measures meet minimal standards for acceptance, the GSD should be used with caution in the future. The GSD probably suffers from a psychometric flaw known as the primacy effect. The word list for the GSD is ordered in such a way that the concrete
sequential Mind Style is always listed first (see Appendix A). This kind of ordering is usually done for ease of scoring. Remember that the concrete sequential style was the most preferred by both samples in this study. The primacy effect begs the following question, “Would the scores for the CS style be the same if the word matrix listed the abstract sequential term first or if the word matrix used a counterbalanced design?” Therefore, the following recommendations regarding the future use of the GSD are given:

1. The GSD should be revised to incorporate a counterbalanced word matrix to rid the instrument of the primacy effect.

2. Researchers should implement the GSD with caution. No instrument should be used to strictly classify individuals into groups. This instrument should be used to gain quick information that can provide a thumbnail of an individual’s preferred learning style.

Recommendations for Further Study

1. This study was the first attempt to link categorical Mind Styles with preferred teaching methods. Weak design of the PTMI instrument may be responsible for
the fail-to-reject conclusion drawn from hypothesis six. Therefore, recommendations for future study should begin with the refining of the PTMI instrument. Specifically, the instrument should be enhanced with teaching methods that will increase the polarization of responses based on an individual’s Mind Style. This can be accomplished through principal components analysis of teaching methods. The latent constructs would be the four Mind Styles. The teaching methods that load highly on the latent constructs would be considered preferred teaching methods of that construct. By doing so and re-administering the instrument, the differences in categorical Mind Style and preferred teaching method may be more clearly discriminated.

2. Several researchers have noted that learning style is affected by an institutional effect (Seidel, 1999; Hendrichson, Berlocher, & Herbert, 1987). Therefore, future studies by athletic training educators should ascertain the learning styles of students prior to their arrival to the institution. By doing so, it would be possible to perform longitudinal research of incoming freshmen through their senior year. The effect of the institution on our athletic training students (i.e., Do athletic training students “grow” into the dominant Mind Style that program directors
prefer?) as well as the stability of learning style over their academic careers would be better understood using the longitudinal design.

Researchers have further postulated that learning style is a by-product of choosing a profession (Hendrichson, Berlocher, & Herbert, 1987; Wakefield, 1993). Therefore, ascertaining students learning styles after they choose athletic training as a major, but before they arrive on campus will help athletic training educators understand the homogeneous nature of learning styles in our profession. Currently, athletic training students and faculty seem to prefer concrete sequential Mind Styles. Athletic training educators should consider that there might be high attrition from students that are “pointy-headed” in other Mind Styles. If this is found to be true, athletic training educators need to discuss the curricular implications of such attrition.

3. Future studies may choose to collect information on preferred testing method. Athletic training educators may be able to discriminate between categorical Mind Styles and preferences toward specific testing methods.

4. Athletic training educators should investigate the possibility that faculty may not teach in congruence with
their preferred learning style. Design implications include qualitative follow-up of faculty to ascertain if athletic training faculty teach in the same style that they prefer to learn. The implications could indicate an institutional effect or some other effect on faculty that may cause incongruence between teaching style and preferred learning style.

5. Athletic training educators need to conduct experimental design research that compares the educational outcomes of athletic training students in environments that match and mismatch learning styles. Educational outcomes that could be compared are NATA-BOC exam performance, core course grades, and clinical course grades. If learning styles research is going to overcome its limitations, educators are going to have to causally link the learning styles paradigm with outcomes. Further, researchers are going to have to establish the magnitude of the learning styles effect on educational outcomes.

6. Future studies should include the use of other research designs such as factorial vignettes. Vignettes are short stories that study how individuals make judgments, decisions, or attributions (Converse & Presser, 1986). These short stories can use factors such as age, gender,
race, GPA, teaching style, Mind Style, etc. that when varied create many levels of interest. Particularly, these factorialized versions of the story can be randomly assigned to individuals creating an experimental design.

Future studies could incorporate factorial vignettes and attempt to derive causal links between learning styles and characteristic or educational variables. These vignettes could take the form of traditional pencil-and-paper questionnaires or through the use of web-based questionnaires posted on athletic training listservs.

7. Future researchers may want to consider the use of hierarchical multiple regression analysis. This analysis technique is quite useful especially if you take the factorial vignette scenario presented in the previous recommendation. Hierarchical regression takes “blocks” of variables and enters them in a user-defined fashion. The researcher is typically trying to enter the most important or interesting variable last. The researcher enters this variable last trying to show that it still accounts for a significant amount of the variance in the dependent variable even after the other blocks are entered. This procedure is quite similar to the analysis of covariance technique.
Future researchers may wish to investigate educational outcomes, as defined earlier, utilizing it as a dependent variable. The researcher could then substantively choose “blocks” of variables to enter into the regression equation. The last variable to enter would be the Mind Styles. The question asked would be if learning styles still accounts for a significant amount of variance in the dependent variable (i.e., specific educational outcome) even after the other “blocks” of variables have been entered.

8. A limitation of this study was that students might orient their preferred teaching method answers according to specific courses or topics. Therefore, prior attitudes toward subject matter may confound the results. Future research should ascertain information regarding attitudes toward specific courses or topics. Attitude scores could be entered as a covariate in a MANCOVA design. Therefore, conclusions drawn about attitudes toward teaching method could be more strongly supported when the effects of topic or course are removed.

9. Another limitation of this study was the unbalanced design between undergraduate athletic training students and program directors. Any generalizations about program
directors require an adequate representation of the population. Although the sample size met the required amount determined a priori for the statistical procedures, future researchers should attempt to ascertain a larger sample size of program directors to achieve cells that are nearer equal.

10. Athletic training educators should be aware of other learning style characteristics in addition to those identified by the GSD. The GSD is an information-processing model and the PTMI is an instructional preference model. According to Curry’s (1987) onion model, there are other layers of learning style that can be investigated. Personality trait models (e.g., Myers-Briggs Type Indicator) and social interaction models (e.g., Witkin’s field dependent versus independent) are the two in particular that have not been investigated in athletic training education literature. Future efforts in these additional areas will help provide better understanding of the entire learning style construct as it applies to athletic training education.
REFERENCES


Cocker, C.A. (2000). Consistency of Learning Styles of Undergraduate Athletic Training Students in the
Traditional Classroom versus the Clinical Setting. 


Multimedia Computer-Assisted Learning Program

Unpublished instrument.

American Psychologist, 27(2): 144-147.


Maynard, MA: Gabriel Systems, Inc.


to Kirton’s Adaptive-Innovative Distinction.


Unpublished doctoral dissertation, St. John’s University, Jamaica, New York.


APPENDIX A

Gregorc Style Delineator Instrument Word List
GSD Word List is Not Available Due to Copyright Protection Laws

Please see Following Website for More Information:

www.gregorc.com
APPENDIX B

Pilot Study Reliability Analysis Results for the Four Mind Style Preferences
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Reliability Coefficients

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N of Items = 10

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Reliability Coefficients

N of Cases = 69.0
N of Items = 10

Alpha = .6813
APPENDIX C

Institutional Review Board Exempt Status Documentation
A determination has been made that the following research study is exempt from IRB review because it involves:

Category 2 research involving the use of educational tests, survey procedures, interview procedures or observation of public behavior

Project Title: Gregorc's Mind Styles: A Correlational Analysis of Undergraduate Athletic Training Students' and University/College Faculty/Staff Educators' Mind Styles and Preferences of Teaching Methods

Project Director: Trenton E. Gould

Department: RSPS

Advisor: Ralph Martin

Rebecca Cale, Associate Director, Research Compliance
Institutional Review Board

6/25/02 Date
Mr. Gould,

Your protocol has been approved and an original signed IRB approval form for protocol 02E044, entitled, "Gregorc's Mind Styles: A Correlational Analysis of Undergraduate Athletic Training Students' and University/College Faculty/Staff Educators' Mind Styles and Preferences of Teaching Methods", will go out in tomorrow morning's Campus Mail.

Best wishes with your research!
Robin

Ms. Robin Stack  
Human Subjects Research Coordinator  
Office of Research Compliance  
Ohio University  
117 RTEC  
Athens, OH 45701  
Phone: (740) 597-1289  
FAX: (740) 593-9838  
stack@ohio.edu
APPENDIX D

Cover Letter
August 26, 2002

Dear Undergraduate Athletic Training Student,

My name is Trent Gould. I am a certified athletic trainer and a doctoral student collecting data for research purposes through Ohio University. I am interested in the learning styles of undergraduate athletic training students and faculty educators. This study also examines your preferred teaching and testing methods. For example, have you ever had to take an essay exam when you knew your strength was multiple choice? Have you ever sat through a structured fifty-minute lecture knowing that you connect better with interactive video? Matching or guided mismatch of educator and student learning styles with preferred teaching and testing methods can greatly benefit all those involved. This study is investigating those relationships.

You can all help by completing the two survey instruments. If you choose to participate, you are not only assisting my efforts, but also the efforts of your program. As an added bonus for your 10 minutes of participation, I will provide your ATEP with a summary of my findings. The summary will include a brief description of the different learning styles, your programs results, and the national results for you to make your own comparisons. As you know, CAAHEP requires many forms of program assessment. At no additional effort or time to you or your program director, I will provide your program with this information. There will be less than 20 programs out of the 166 nationally accredited programs that will receive this information.

Completion of the survey is voluntary and implies your consent to use the data for research purposes. The estimated time to complete the Gregorc Style Delineator is 3 minutes. The estimated time to complete the Preferred Teaching Inventory is 5 minutes. The total estimated time from start to termination of your participation is less than 10 minutes. Please remember that all participants must be 18 years of age. On behalf of Ohio University and myself, I would like to formally thank you for your participation in this research investigation. Remember, your participation is helping investigate athletic training education in this time of curriculum reform!

Sincerely,

Trenton E. Gould
Doctoral Student
Ohio University
APPENDIX E

GSD Instructions Page, Demographics, and Teaching Method

Self-Inventory
GREGORC STYLE DELINEATOR™
RESEARCH INSTRUMENT

DIRECTIONS

Before starting with the word matrix on the next page, carefully read all seven of the following directions and suggestions:

1. Reference Point. You must assess the relative value of the words in each group using your SELF as a reference point; that is, who you are deep down, NOT who you are at home, at work, at school or who you would like to be or feel you ought to be. THE REAL YOU MUST BE THE REFERENCE POINT.

2. Words. The words used in the Gregorc Style Delineator matrix are not parallel in construction nor are they all adjectives or all nouns. This was done on purpose. Just react to the words as they are presented.

3. Rank. Rank in order the ten sets of four words. Put a “4” in the box above the word in each set which is the best and most powerful descriptor of your SELF. Give a “3” to the word which is the next most like you, a “2” to the next and a “1” to the word which is the least descriptive of your SELF. Each word in a set must have a ranking of 4, 3, 2 or 1. No two words in a set can have the same rank.

Example

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>b.</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>moon</td>
</tr>
<tr>
<td></td>
<td>c.</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>stars</td>
</tr>
<tr>
<td></td>
<td>d.</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>clouds</td>
</tr>
</tbody>
</table>

4 = MOST descriptive of you
1 = LEAST descriptive of you

4. React. To rank the words in a set, react to your first impression. There are no “right” or “wrong” answers. The real, deep-down you is best revealed through a first impression. Go with it. Analyzing each group will obscure the qualities of SELF sought by the Delineator.

5. Proceed. Continue to rank all ten vertical columns of words, one set at a time.

6. Time. Recommended time for word ranking: 3 minutes.

7. Start. Turn the page and start now.
Teaching Method Self-Inventory

Dear undergraduate student:

I am interested in studying your preferential attitude toward different instructional methods as they relate to your best learning. It is my objective to provide a deeper understanding of how students view their learning. If you choose to participate in my investigation, your responses will be kept confidential. This survey will take about 5 minutes, or less, to complete. You must be 18 years of age to participate in this study. Thank you for your time invested!

What is your age? __________

What is your gender? (circle one)  Male   Female

What is your current class status? (circle one)  Freshman   Sophomore   Junior   Senior

What is your approximate GPA? __________

For each of the following items, please indicate the extent YOU feel each teaching method affects YOUR learning. Please circle your choice.

1. I feel that a structured lecture instructional format provides:
   - Poorest Learning
   - Poor Learning
   - Neutral
   - Good Learning
   - Best Learning

2. I feel that a group discussion instructional format provides:
   - Poorest Learning
   - Poor Learning
   - Neutral
   - Good Learning
   - Best Learning

3. I feel that a group project instructional format provides:
   - Poorest Learning
   - Poor Learning
   - Neutral
   - Good Learning
   - Best Learning

4. I feel that a short lecture with question, answer session instructional format provides:
   - Poorest Learning
   - Poor Learning
   - Neutral
   - Good Learning
   - Best Learning

5. I feel that an individual project instructional format provides:
   - Poorest Learning
   - Poor Learning
   - Neutral
   - Good Learning
   - Best Learning

6. I feel that a personal discovery instructional format provides:
   - Poorest Learning
   - Poor Learning
   - Neutral
   - Good Learning
   - Best Learning

7. I feel that a writing assignment instructional format provides:
   - Poorest Learning
   - Poor Learning
   - Neutral
   - Good Learning
   - Best Learning

8. I feel that a computer-assisted instructional format provides:
   - Poorest Learning
   - Poor Learning
   - Neutral
   - Good Learning
   - Best Learning
APPENDIX F

E-mail Correspondence to Athletic Training Program Directors
Dear Program Director,

Please read attached message!

# of students total __________

first day of class __________

Kindest regards,

Trent Gould
Ohio University
(740) 593-5732
tg746593@ohio.edu
Dear Program Director,

When you were a student, did you ever have to take an essay exam when you knew your strength was multiple choice? Have you ever sat through a structured fifty-minute lecture knowing that you connect better with interactive video?

Hello! My name is Trent Gould. I am a certified athletic trainer and a doctoral student collecting data for research purposes through Ohio University. If you answered yes to either question, perhaps you may be interested to know your learning style and the learning style of your students. Through a random selection process, I have chosen you to participate in my research. As an added bonus for your 8 minutes of participation, I will provide your ATEP with a summary of my findings. The summary will include a brief description of the different learning styles, your results, and the national results for you to make your own comparisons. As you know, CAAHEP requires many forms of program assessment. I will provide your program with this information at no additional effort or time to you. If you choose to participate, there will be less than 50 programs out of the 166 nationally accredited programs that will receive this information.

Specifically, this IRB-approved study is investigating the learning styles of faculty and students. Additionally, I am investigating how learning style interacts with preferred teaching and testing methods. My premise is that matching or guided mismatch of educator and student-learning styles with preferred teaching and testing methods can greatly benefit each party involved. Your program was selected to obtain responses from the program director.

I know that program directors are getting inundated with surveys every year. In an effort to assist you and my return rate, I am contacting each randomly selected program director early in the academic year for their support.

If you decide not to participate, please take a minute to list one reason for non-response and return the unused inventory in the postage-paid envelope. If you decide to participate, please read and follow the directions of the three inventories enclosed. Upon completion, please return the inventories in the postage-paid envelope provided by Friday, October 11, 2002!

Thank you for your time and support in this research project!

Kindest regards,

Trenton E. Gould, MS, ATC
Doctoral Candidate
Ohio University
APPENDIX G

Actual Study Factor Analysis Results for the Four Mind Styles at the Construct Level
<table>
<thead>
<tr>
<th>Item</th>
<th>1</th>
<th>2</th>
<th>Communality</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUM_CR</td>
<td>-.935</td>
<td></td>
<td>.88</td>
</tr>
<tr>
<td>SUM_CS</td>
<td>.857</td>
<td></td>
<td>.79</td>
</tr>
<tr>
<td>SUM_AR</td>
<td></td>
<td>-.925</td>
<td>.86</td>
</tr>
<tr>
<td>SUM_AS</td>
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<td>.833</td>
<td>.73</td>
</tr>
<tr>
<td>Eigenvalues</td>
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<td></td>
</tr>
<tr>
<td>% of variance</td>
<td>53.04</td>
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<td></td>
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</table>
APPENDIX H

Actual Study Reliability Analysis Results for the Four Mind Style Preferences
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<th>ITEM</th>
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<th>Scale Variance</th>
<th>Corrected Item-Total Correlation</th>
<th>Alpha Corrected Item-Deleted Correlation</th>
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<tr>
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Reliability Coefficients

N of Cases = 243.0
N of Items = 10

Alpha = .6213
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<th>Item-Correlation</th>
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Reliability Coefficients

N of Cases = 243.0       N of Items = 10

Alpha = .5167
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<th>Alpha if Item Deleted</th>
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<td>.5324</td>
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Reliability Coefficients

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N of Items = 10
Alpha = .5605
| ITEM_1CR    | 21.1934 | 20.6938 | .3021 | .5507 |
| ITEM_2CR    | 21.1070 | 21.1703 | .2542 | .5627 |
| ITEM_3CR    | 21.1070 | 20.5835 | .3085 | .5490 |
| ITEM_4CR    | 21.3457 | 22.1941 | .1645 | .5834 |
| ITEM_5CR    | 21.1934 | 18.9831 | .4118 | .5176 |
| ITEM_6CR    | 21.4938 | 21.9452 | .1832 | .5795 |
| ITEM_7CR    | 21.1687 | 20.7441 | .3455 | .5418 |
| ITEM_8CR    | 20.8354 | 20.4521 | .2860 | .5546 |
| ITEM_9CR    | 21.0823 | 21.7370 | .2075 | .5738 |
| ITEM_10CR   | 21.0658 | 21.7229 | .1769 | .5825 |

Reliability Coefficients

N of Cases = 243.0
N of Items = 10

Alpha = .5862
APPENDIX I

Pilot and Actual Study Reliability Comparisons
<table>
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<tr>
<th>Subscale</th>
<th>Pilot Cronbach’s Alpha</th>
<th>Study Cronbach’s Alpha</th>
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<th>Study Undergrad Students</th>
</tr>
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<td>Concrete</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sequential</td>
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</tr>
<tr>
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<td>.69</td>
<td>.50</td>
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<tr>
<td>Concrete</td>
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<td>.59</td>
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APPENDIX J

Demographics of Undergraduate Students by Gender and Educational Level
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<tr>
<th>Educational Level</th>
<th>Frequency Males</th>
<th>Frequency Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underclassmen</td>
<td>37</td>
<td>65</td>
</tr>
<tr>
<td>Freshmen</td>
<td>22</td>
<td>36</td>
</tr>
<tr>
<td>Sophomore</td>
<td>15</td>
<td>29</td>
</tr>
<tr>
<td>Upperclassmen</td>
<td>31</td>
<td>67</td>
</tr>
<tr>
<td>Juniors</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td>Seniors</td>
<td>21</td>
<td>34</td>
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APPENDIX K

Multivariate and Univariate Source Table for $H_0^2$ and $H_0^3$
<table>
<thead>
<tr>
<th>Source</th>
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<th>CS</th>
<th>AS</th>
<th>AR</th>
<th>CR</th>
</tr>
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<tbody>
<tr>
<td>Gender (G)</td>
<td></td>
<td>3.13*</td>
<td>1.51</td>
<td>5.21*</td>
<td>9.50**</td>
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<td>Education</td>
<td></td>
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<tr>
<td>G x E</td>
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<tr>
<td>MSE</td>
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<td>24.31</td>
<td>15.98</td>
<td>20.35</td>
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</tr>
</tbody>
</table>

Note. Multivariate F ratios generated from Wilks’ lambda statistic.

*aMultivariate df = 4, 194. bUnivariate df = 1, 198. *p < .05. **p < .01.
APPENDIX L

Multivariate and Univariate Source Table for $H_{04}$
### Univariate

<table>
<thead>
<tr>
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<th>AR</th>
<th>CR</th>
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<td>Multivariate Mind</td>
<td>F&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Style&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Style&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Style&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Role (R)</td>
<td>4.49*</td>
<td>6.57*</td>
<td>0.49</td>
<td>13.82**</td>
</tr>
<tr>
<td>MSE</td>
<td>25.08</td>
<td>18.19</td>
<td>23.04</td>
<td>24.90</td>
</tr>
</tbody>
</table>

**Note.** Multivariate F ratios generated from Wilks’ lambda statistic.

<sup>a</sup>Multivariate df = 4, 239.  <sup>b</sup>Univariate df = 1, 241.

*p < .05.  **p < .001.*
APPENDIX M

Repeated Measures ANOVA Source Table for $H_{05}$
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<th>SS</th>
<th>MS</th>
<th>F</th>
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<td><strong>Between Subjects</strong></td>
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<td></td>
</tr>
<tr>
<td>Role (R)</td>
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<td>24.55</td>
<td>24.55</td>
<td>27.08**</td>
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<td><strong>Within Subjects</strong></td>
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<td></td>
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<tr>
<td>Method (M)</td>
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<td>78.89</td>
<td>11.27</td>
<td>19.04**</td>
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<td>998.79</td>
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*p < .05. **p < .001
APPENDIX N

Multivariate and Univariate Source Table for $H_{06}$
<table>
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<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
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</thead>
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<tr>
<td><strong>Between Subjects</strong></td>
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<td></td>
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<tr>
<td>Style (S)</td>
<td>1</td>
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<td>1.29</td>
<td>1.28</td>
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<td>Error 1</td>
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<td>239.21</td>
<td>1.01</td>
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<td><strong>Within Subjects</strong></td>
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<tr>
<td>Method (M)</td>
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<td>138.04</td>
<td>19.72</td>
<td>33.08*</td>
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<tr>
<td>S x M</td>
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<td>.87</td>
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<td>Error 2</td>
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*_{p < .001}
APPENDIX O

Post-Hoc Power Analysis and Percent Chance of Type II Error
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<th>Hypothesis</th>
<th>Decision</th>
<th>Post-hoc</th>
<th>Type II</th>
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<td>One</td>
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<td>1.000</td>
<td>.0000</td>
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<td>.0024</td>
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<td>PD</td>
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