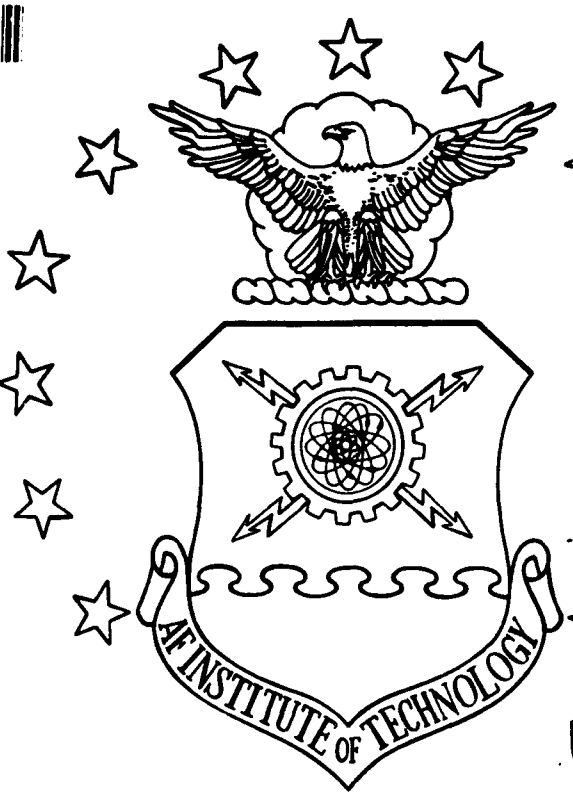

THE DEVELOPMENT AND RETENTION OF CRITICAL THINKING DISPOSITIONS AMONG STUDENTS OF THE AIR FORCE INSTITUTE OF TECHNOLOGY GRADUATE MANAGEMENT PROGRAMS

THESIS

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The opinions and conclusions in this paper are those of the author and are not intended to represent the official position of the DOD, USAF, or any other government agency.

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THESIS

Presented to the Faculty of the School of Systems and Logistics of the Air Force Institute of Technology
Air University
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Requirements for the Degree of
Master of Science in Systems Management

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Luke J. Schaub

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Abstract

This effort analyzed the development and retention of critical thinking dispositions in students of the Air Force Institute of Technology's School of Systems and Logistics graduate management program. The Myers-Briggs Type Indicator was used as a measure of subjects' dispositions. Pre- and post-test surveys were administered when subjects entered and exited the program, and a follow-up administered two to five years later. The pre- and post-tests were administered to 427 subjects and the follow-up to 201 of those subjects. It was found that subjects increased their preference for logical, objective decision-making while enrolled in the program. Subjects also increased their preference for flexible, open-minded thinking, and for systematic, goal-oriented thinking, while enrolled in the program. After leaving the program, subjects retained part of the increase in the preference for logical, objective decision-making, none of the increased preference for flexible, open-minded thinking, and all of the increased preference for systematic, goal-oriented thinking.

THE DEVELOPMENT AND RETENTION OF CRITICAL THINKING DISPOSITIONS AMONG STUDENTS OF THE AIR FORCE INSTITUTE OF TECHNOLOGY GRADUATE MANAGEMENT PROGRAMS

I. Introduction

Introduction to the Chapter

This chapter introduces the general problem and research questions, and presents the relevant investigative questions, scope, limitations, and assumptions.

Introduction to the Problem

The Mission of Education. There are two primary missions of educational institutions, the provision of knowledge and the development of the ability to think critically (19:363). For many years, the emphasis has been placed on the provision of knowledge, while ignoring the development of critical thinking. With the realization that schools are producing graduates with a store of memorized facts but little ability to think critically or use their stored knowledge, the emphasis has changed. The development of critical thinking has become the top priority of educators throughout the country (3:ix-x: 14:9-10, 44:1).

These missions are not ends by themselves, but merely the means by which students relate competently to the world around them and solve its problems. "Education ideally aims not at the final exam but at the applications the students

may make of what they have learned in further study and outside of school" (41:50).

The Mission of the Air Force Institute of Technology.

The Air Force Institute of Technology (AFIT) provides graduate-level and professional continuing education to Air Force officers and civilians. The mission statement of AFIT explains:

> University-level work is designed to give the carefully selected officers and Air Force civilians the broad educational background that will equip them both to understand their technological and cultural environment and to analyze and attempt to solve its problems. (13:2)

Thus, the mission of AFIT, like that of civilian educational institutions, is to equip students with the knowledge needed to interact with their environment, and the thinking skills necessary to effectively use that knowledge to solve problems in their environment. AFIT is unique only in that its students have a predetermined environment to which they will apply their learned knowledge and skills.

The AFIT School of Systems and Logistics (AFIT/LS) is the primary Air Force provider of management education. A previous dean of the school, Col Richard Cammarota stated: "The school [AFIT/LS] has worked for many years to improve the critical thinking of its students as part of their development" (7:11). According to Cammarota, all AFIT/LS courses contribute to the development of critical thinking skills. In addition, a master's thesis is required of all students enrolled in the masters program. The thesis is used to further develop and solidify the student's critical

thinking skills, and is considered proof that the student meets minimum standards of critical thinking (7:11).

The Requirements for Critical Thinking. Robert Ennis, a leading authority on critical thinking, defines critical thinking as "reasonable reflective thinking that is focused on deciding what to believe and do" (14:10). Critical thinking is "purposeful and goal-directed" (22:3). Problem solving, creative thinking, and decision making are forms of critical thinking.

The process of critical thinking requires the abilities and the dispositions to think critically. According to Ennis, critical thinking abilities or skills include the abilities of a person to analyze arguments, judge credibility, judge inferences, make value judgements, identify assumptions, and decide on an action. Critical thinking dispositions, on the other hand, include the tendencies of a person to seek reasons, be well informed, look for alternatives, be open-minded, and take a position when the evidence supports it (14:11-15). In other words, critical thinking abilities or skills are the thinking tools learned by a person, while critical thinking dispositions are the attitudes and inclinations a person has toward using those tools.

The Importance of Critical Thinking Dispositions. Critical thinking dispositions are vital to the use of critical thinking:

> Substantial amounts of recent research suggest that good thinkers and problem solvers differ from

> poorer ones not so much in the particular skills they possess as in their tendency to use them. (44:6)

A person who possesses the skills to think critically, but lacks the dispositions to use the skills will not think critically.

In addition, critical thinking dispositions are important to the application of critical thinking in unfamiliar situations. Critical thinking abilities will generally not transfer from one domain to another. For instance, a person may be proficient at analyzing and solving a mathematical word problem, yet may not have the ability to analyze and solve a philosophical problem. The ability to analyze and solve problems in the mathematics domain does not automatically transfer to the ability to analyze and solve problems in the philosophy domain. However, if that person has the dispositions to seek reasons, see the total situation, look for alternatives, and take a position, then the philosophical problem might be more easily solved, even with no previous ability in that domain. Critical thinking dispositions make it possible to think critically in unfamiliar situations, while critical thinking abilities do not (47:59,62-63).

Critical thinking dispositions are a reflection of cognitive styles. Cognition refers to "the mental process or faculty by which knowledge is acquired... something that comes to be known, as through perception, reasoning, or intuition" (1:289). Cognition is the process by which all

mental activity, including critical thinking, takes place. Cognitive styles refer to the dispositions of a person to behave in certain ways when undertaking mental activities (4:379).

These styles reflect a person's intellectual personality traits. Examples of cognitive styles include field-independence, the ability to ignore irrelevant information; impulsivity, the tendency to make errors by coming to conclusions too quickly; and sensitivity to evidence against one's favored position. (4:366,379). These examples correspond with Ennis' critical thinking dispositions of trying to remain relevant to the main point, taking a position only when the evidence and reasons are sufficient to do so, and remaining open-minded.

The Measurement of Critical Thinking Dispositions. There are currently no tests specifically designed to measure critical thinking dispositions. However, psychological tests developed to measure the general dispositions or cognitive styles of people might serve the purpose if they measure the same dispositions or cognitive styles that are associated with critical thinking. One such psychological test is the Myers-Briggs Type Indicator (MBTI).

The MBTI is a measure of the way people prefer to perceive and judge information. Figure 1.1 summarizes the areas of measurement of the MBTI. The first area of measurement (E/I) measures a person's orientation toward

EXTRAVERSION (E):	disposition to relate well with the outer world of people and things
VS	
INTROVERSION (I):	disposition to relate well with the inner world of ideas and concepts
SENSING (S):	disposition to focus perceptions on solid, observable facts
VS	
INTUITION (N):	disposition to focus perceptions on possibilities, meanings, and relationships
THINKING (T):	disposition to objectively analyze facts and make decisions impersonally
VS	
FEELING (F):	disposition to weigh the relative importance of each issue and make decisions based on personal values
JUDGING (J):	disposition to live in a planned, orderly manner, preferring to control the situation
VS	
PERCEPTION (P):	disposition to live in a flexible, spontaneous manner, adapting to the situation

FIGURE 1.1 MEASUREMENT AREAS OF THE MBTI

life. The second area (S/N) measures a person's preferred method of perceiving information. The third area of measurement (T/F) determines a person's preferred method of judging or decision making. Finally, the last area measures a person's preference for perceiving or judging when dealing with the outer world. Together, these four areas make up the psychological type of a person.

The four dispositions which make up the second and third areas (S, N, T, F) are cognitive functions. When one disposition from each of the two cognitive function areas is combined, they make up the four cognitive styles measured by the MBTI (ST, SF, NT, NF). Thus, by measuring cognitive styles, the Myers-Briggs Type Indicator can be used to determine critical thinking dispositions of students.

Problem Statement

The AFIT School of Systems and Logistics has an objective to develop critical thinking skills of students in its masters degree program. As such, three questions are important. First, are critical thinking skills developed in students of the graduate program? If they are not, then the objective is not being met. Second, are critical thinking dispositions developed in students of the graduate program? If critical thinking skills are developed, but the dispositions necessary to use them are not, then graduates have not been prepared to use critical thinking to solve problems. Third, if critical thinking dispositions are developed while enrolled, are these dispositions retained by the graduates upon returning to the Air Force work environment? If the dispositions are not retained, then the effort to develop them will be for naught. In order for the school to achieve its mission of equipping graduates to think critically to solve the Air Force's problems, all three of the above questions must be answered in the affirmative.

The scope of the research necessary to answer all three questions is beyond the focus of this research. Thus, this research effort seeks to determine if critical thinking dispositions are developed among the students and, if so, to what extent these dispositions are retained upon graduation. The problem addressed by this research is: To what degree are critical thinking dispositions developed at the AFIT School of Systems and Logistics and retained by graduates when they return to the Air Force work environment?

Research Question

There are two research questions for this effort. The research questions and their corresponding null and research hypotheses are as follows:

Research Question #1: Are critical thinking dispositions developed in students of the AFIT/LS graduate program?

Ho: Critical thinking dispositions are not developed in students of the AFIT/LS graduate program.

Ha: Critical thinking dispositions are developed in students of the AFIT/LS graduate program.

Research Question #2 is only applicable if the research hypothesis of Research Question #1 is confirmed:

Research Question #2: Are the critical thinking dispositions which are developed by AFIT/LS retained by students after leaving AFIT?

Ho: The critical thinking dispositions which are developed by AFIT/LS are not retained by students after leaving AFIT.

Ha: The critical thinking dispositions which are developed by AFIT/LS are retained by students after leaving AFIT.

Investigative Questions

Five investigative questions are framed to answer Research Question #1. Investigative Question 1 is essential to answering Research Question #1. Investigative Questions 2-5 are only applicable if the research hypothesis for Investigative Question 1 is accepted. The investigative questions for Research Question #1, with their associated null and research hypotheses are:

1. Is there a difference in pre-AFIT and post-AFIT psychological types for students who graduated between 1986 and 1989? The answer to this question will identify whether there were any generalizable changes in the psychological types of students while they attended AFIT.

   Ho: Students who attended the graduate program between 1986 and 1989 maintained the same psychological type throughout the program.

   Ha: Students who attended the graduate program between 1986 and 1989 changed psychological type while at AFIT.

2. If changes are evident, do these changes from pre-AFIT to post-AFIT psychological types differ by option for AFIT/LS students who graduated between 1986 and 1989?

The answer to this question will identify whether changes in the psychological types of students were related to the option in which they were enrolled. Since each option has different course requirements, it is possible that some curriculums had more influence on changes in student psychological types than others.

Ho: Students in any one option were no more likely than students in any other option to change psychological type while at AFIT.

Ha: Students in any one option were more likely than students in any other option to change psychological type while at AFIT .

3. If changes are evident, do these changes from pre-AFIT to post-AFIT psychological types differ by year for AFIT/LS students who graduated between 1986 and 1989? The answer to this question will identify whether changes in students' psychological types, while at AFIT, were related to the year they attended. Among other things, the influences of faculty or curriculum may have affected student psychological type. Since the AFIT curriculum and faculty are constantly changing, it is possible that the environment in one year affected changes in student psychological types more than the environment in other years.

Ho: There was no difference in the change in students' psychological types from one year to the next.

Ha: There was a difference in the change in students' psychological types from year to year.

4. If changes are evident, do these changes from pre-AFIT to post-AFIT psychological types differ <u>by demographics</u> for AFIT/LS students who graduated between 1986 and 1989? The answer to this question will identify whether demographics (age, sex, military or civilian) were related to changes in psychological types while at AFIT.

   Ho: Students in one demographic group were no more likely than students in another demographic group to change psychological type while at AFIT.

   Ha: Students in one demographic group were more likely than students in another demographic group to change psychological type while at AFIT.

5. If changes are evident, do these changes from pre-AFIT to post-AFIT psychological types differ <u>by pre-AFIT psychological type</u> for AFIT/LS students who graduated between 1986 and 1989? The answer to this question will identify whether certain psychological types were more likely to change than other psychological types.

   Ho: Students of one psychological type were no more likely than students of any other type to change psychological types.

Ha: Students of one psychological type were more likely than students of any other type to change psychological types.

Seven investigative questions are framed to answer Research Question #2. Investigative Question 6 is essential to answering Research Question #2. Investigative Questions 7-12 are relevant if the research hypothesis for Investigative Question 6 is accepted. The investigative questions for Research Question #2 are:

6. Is there a difference between the post-AFIT and current psychological types of AFIT/LS students who graduated between 1986 and 1989? The answer to this question will identify whether graduates retain the same psychological type now as they had when they graduated. It is possible that graduates retained the psychological types that they left AFIT with, that they reverted back to their pre-AFIT types, or that they have developed new psychological types.

   Ho: There is no difference between the current and post-AFIT psychological types of students who graduated between 1986 and 1989.

   Ha: There is a difference between the current and post-AFIT psychological types of students who graduated between 1986 and 1989.

7. If changes are evident, do these changes from post-AFIT to current psychological types differ <u>by option</u> for

AFIT/LS students who graduated between 1986 and 1989? The answer to this question will identify whether the type changes resulting from some options were retained better than those resulting from other programs.

Ho: Changes from post-AFIT to current psychological types do not differ by option for students who graduated between 1986 and 1989.

Ha: Changes from post-AFIT to current psychological types do differ by option for students who graduated between 1986 and 1989.

8. If changes are evident, do these changes from post-AFIT to current psychological types differ <u>by year</u> for AFIT/LS students who graduated between 1986 and 1989? The answer to this question will identify whether the type changes resulting from attending AFIT some years were retained better than those resulting from attending AFIT other years

Ho: Changes from post-AFIT to current psychological types do not differ by year for students who graduated between 1986 and 1989.

Ha: Changes from post-AFIT to current psychological types do differ by year for students who graduated between 1986 and 1989.

9. If changes are evident, do these changes from post-AFIT to current psychological types differ <u>by demographics</u> for AFIT/LS students who graduated between 1986 and

1989? The answer to this question will identify whether demographics played a role in the retention of the psychological types developed at AFIT.

Ho: Changes from post-AFIT to current psychological types do not differ by demographics for students who graduated between 1986 and 1989.

Ha: Changes from post-AFIT to current psychological types do differ by demographics for students who graduated between 1986 and 1989.

10. If changes are evident, do these changes from post-AFIT to current psychological types differ <u>by post-AFIT psychological type</u> for AFIT/LS students who graduated between 1986 and 1989? The answer to this question will identify whether some post-AFIT psychological types were retained better than others.

Ho: Changes from post-AFIT to current psychological types do not differ by post-AFIT type for students who graduated between 1986 and 1989.

Ha: Changes from post-AFIT to current psychological types do differ by post-AFIT type for students who graduated between 1986 and 1989.

11. If changes are evident, is there a relationship between these changes from post-AFIT to current psychological type and current work environment? The answer to this question will identify whether aspects of the work environment, such as amount of thinking required,

amount of creativity required, amount of stress, and amount of socialization, are related to the retention of the psychological types developed at AFIT.

Ho: Work environment had no effect on changes from post-AFIT to current psychological types for students who graduated between 1986 and 1989.

Ha: Work environment had an effect on changes from post-AFIT to current psychological types for students who graduated between 1986 and 1989.

12. If changes are evident, is there a relationship between these changes from post-AFIT to current psychological type and changes in current home environment? The answer to this question will identify whether changes in the home environment since leaving AFIT, such as marital status, birth of a child, and death in the family, are related to changes in psychological type since leaving AFIT.

Ho: Changes in the home environment of students who graduated between 1986 and 1989 had no influence on the change from post-AFIT to current psychological type.

Ha: Changes in the home environment of students who graduated between 1986 and 1989 influenced the change from post-AFIT to current psychological type.

Scope

This research encompasses the approximately 600 students who have completed the AFIT/LS masters program between 1986 and 1989. These students are primarily Air Force officers with the rank of Captain, Major, or Lieutenant Colonel and Air Force civilians of equivalent rank. The majority of students returned to a military work environment as managers after completing the program.

Limitations

The following limitations apply to this research:

1. This research applies only to the Air Force Institute of Technology's School of Systems and Logistics. AFIT/LS is a unique educational environment. Generalizing the results of this research to other educational institutions must be done with caution.

2. This research only applies to critical thinking dispositions measurable with the MBTI. Neither critical thinking dispositions not measurable with the MBTI, nor critical thinking skills, are included in this research.

3. The findings of this research will be limited by survey response. While MBTI pre-AFIT and post-AFIT surveys were completed by the majority of students, the exclusion of those who did not complete both surveys limits the generalizability of the results. In addition, the response rate of the AFIT graduates in returning the current MBTI surveys will further limit these results.

Assumptions

The following are the assumptions made for this research:

1. The samples to be used in this research are representative of all students who have completed AFIT/LS graduate programs since 1986.

2. The subjects will answer all questions on the surveys honestly, without attempting to misrepresent data.

3. The subjects' personality types will reflect their critical thinking dispositions.

4. Changes in psychological type while at AFIT are due primarily to the influences of the AFIT program.

Summary

This chapter has introduced the general problem and research questions, and presented the relevant investigative questions, scope limitations, and assumptions. Chapter II will provide a review of literature relevant to this research effort.

II. Discussion of Literature

Introduction to the Chapter

This chapter provides a review of literature relevant to this research. It begins with a discussion of critical thinking, its development, and its measurement. It then presents the theory behind the Myers-Briggs Type Indicator (MBTI), and concludes with a discussion of the use of the MBTI at the Air Force Institute of Technology (AFIT).

Critical Thinking Abilities and Dispositions

Robert Ennis. Robert Ennis defines critical thinking as "reasonable reflective thinking that is focused on deciding what to believe and do" (14:10). Ennis has said that the process of critical thinking requires the abilities and the dispositions to think critically. Critical thinking abilities are the thinking skills used by a person to reason, while critical thinking dispositions are the attitudes and inclinations a person has toward thinking critically (14:11-24). Both are necessary for a person to think critically. Without critical thinking abilities, a person cannot think critically. Without critical thinking dispositions, a person will not think critically.

Ennis developed a widely used taxonomy of critical thinking abilities and dispositions. According to Ennis, the critical thinking abilities are:

1. Focusing on a question
2. Analyzing arguments

3. Asking and answering questions of clarification and/or challenge
4. Judging the credibility of a source
5. Observing and judging observation reports
6. Deducing and judging deductions
7. Inducing and judging inductions
8. Making value judgements
9. Defining terms, and judging definitions in three dimensions [form, definitional strategy, content]
10. Identifying assumptions
11. Deciding on an action
12. Interacting with others (14:12-15,15:14-17)

Thus, a person has the knowledge and skills necessary to think critically if that person has the ability to focus on a question, analyze arguments, etc.

Ennis' taxonomy lists the critical thinking dispositions as:

1. Seek a clear statement of the thesis or question
2. Seek reasons
3. Try to be well informed
4. Use and mention credible sources
5. Take into account the total situation
6. Try to remain relevant to the main point
7. Keep in mind the original and/or basic concern
8. Look for alternatives
9. Be open-minded
   a. Consider seriously other points of view than one's own
   b. Reason from premises with which one disagrees--without letting the disagreement interfere with one's reasoning
   c. Withhold judgement when the evidence and reasons are insufficient
10. Take a position (and change a position) when the evidence and reasons are sufficient to do so
11. Seek as much precision as the subject permits
12. Deal in an orderly manner with the parts of a complex whole
13. Use one's critical thinking abilities
14. Be sensitive to the feelings, level of knowledge, and degree of sophistication of others (14:12,15:14)

Thus, a person has the disposition to think critically if that person tends to seek a clear statement of the question, seek reasons, etc.

Edward D'Angelo. Edward D'Angelo defines critical thinking as "the process of evaluating statements, arguments, and experiences" (12:7). D'Angelo also sees critical thinking as consisting of critical thinking skills and critical thinking attitudes. He lists 50 skills which he considers necessary for critical thinking. Many of these correspond directly with Ennis' critical thinking abilities, including the use of deduction and induction, defining key terms, and recognizing assumptions. Most of D'Angelo's other skills fall under one of Ennis' abilities. For example, D'Angelo lists 15 fallacies--which fall under Ennis' ability to interact with others--and three skills involving ethical disputes--which fall under Ennis' ability to make and judge value judgements (12:8-15).

D'Angelo also describes ten attitudes which he considers necessary for the development of critical thinking:

1. Intellectual curiosity
2. Objectivity
3. Open-mindedness
4. Flexibility
5. Intellectual skepticism
6. Intellectual honesty
7. Being systematic
8. Persistence
9. Decisiveness
10. Respect for other viewpoints (12:7-8)

Many of these attitudes correspond to Ennis' critical thinking dispositions.

Richard Paul. Richard Paul distinguishes between the use of critical thinking in a weak and strong sense. Paul differentiates weak sense and strong sense critical thinking

based on the ability and disposition to think critically with respect to monological problems or with respect to multilogical problems.

Weak sense critical thinking is critical thinking applied to monological problems. Paul defines monological problems are "problems whose solutions can typically be found in a dominant, field-specific conceptual framework without reference to major personal or social bias" (39:376). Monological critical thinking takes place within the individual's frame of reference, including all beliefs and assumptions held by the person. As long as the solution follows logically from the individual's frame of reference, the thinking is weak sense critical thinking.

Strong sense critical thinking is critical involves multilogical thinking. Paul defines multilogical thinking as the ability to "think accurately and fairmindedly within opposing points of view and contradictory frames of reference" (39:376). Humans have a natural tendency to think egocentrically and ethnocentrically. That is, humans tend to think in ways that reinforce their existing personal, social, and cultural beliefs and assumptions. Only by overcoming this tendency can multilogical, strong sense, critical thinking be achieved. A person who thinks critically in the strong sense has the abilities and dispositions to question his own framework, reconstruct the strongest arguments for the opposing view, and come to a logical decision on the best position (39:377). Paul sees

strong sense critical thinking as the ideal. Only when a person is capable of putting his own beliefs aside can he truly think critically.

Critical thinking skills used in the weak sense are external to the character of the person. That is, the skills are available to the person, but are generally used to support existing beliefs. Critical thinking skills used in the strong sense, on the other hand, are intrinsic to the character of the person. That is, the skills are an integral part of the person because the disposition to use them multilogically exists in the person (40:5). Paul states that a person with Ennis' critical thinking disposition to be open-minded (consider seriously other points of view, reason from premises with which one disagrees, and withhold judgement when evidence are reasons are insufficient) is a person who thinks critically in the strong sense (39:378-379).

Harvey Siegel. Harvey Siegel agrees that, in addition to critical thinking abilities, a critical thinker must possess what he refers to as the "critical spirit". Siegel sees the critical spirit as more than just dispositions to think critically which can be possessed by anyone. Attainment of the critical spirit molds the thinker into a specific type of person:

> For a critical thinker is not simply a person who acts rationally (and who has well-developed skills of reason assessment). A critical thinker not only acts in certain ways. A critical thinker *is*, in addition, a certain sort of person. Dispositions, inclinations, habits of mind, character traits--these features of the

> critical thinker are present, and definitive of the critical thinker, even when they are not being utilized or acted upon. (45:41)

A person with the critical spirit has a "love of reason" (45:39) and a "host of rational passions" (45:40). This type of person has a strong distaste for inaccurate evidence and illogical thinking; he will search out truth.

Siegel views his position of a critical spirit as compatible with Ennis' position of critical thinking dispositions. The critical spirit is a macro-disposition to think critically, while Ennis' dispositions are more specific micro-dispositions. Siegel's critical spirit encompasses Ennis' dispositions, and more, since the critical spirit defines the whole character of the person (45:8-9).

The Research of Bloom and Broder. Benjamin Bloom and Lois Broder performed a series of experiments on problem solving among college students. They found that there were significant differences in four areas between good problem solvers and poor problem solvers, (1) understanding of the nature of the problem, (2) understanding of the ideas contained in the problem, (3) general approach to the solution of problems, and (4) attitude toward the solution of problems (5:25).

In the area of understanding the nature of the problem, they found that successful problem solvers were able to choose a point at which to attack the problem and solve the problem as it was presented. The poor problem solvers, on

the other hand, were indecisive on where to begin, lacked the ability to break the problem into parts, often understood terms in the directions, and often got sidetracked away from the primary goal (5:25-27).

In the area of understanding the ideas contained in the problem, Bloom and Broder found that good problem solvers were able to bring relevant knowledge which they possessed to bear on the problem and make assumptions, where necessary. The poor problem solvers, in contrast, were unable to recognize and call forth relevant information which they possessed and were more likely to give up than make necessary assumptions when dealing with vague terms or concepts (5:27-28).

In the area of general approach to the solution of the problems, the successful problem solvers actively pursued lines of reasoning, developed their own hypotheses when necessary, approached problem solution in a systematic manner, and considered all alternatives before deciding on the best answer. Unsuccessful problem solvers based their solution on their feelings rather than on reasons, approached problem solution in an unsystematic manner, were easily sidetracked, picked their preferred alternative first and then attempted to justify it, and were often unable to follow through on a process of reasoning (5:28-30).

Finally, in the area of attitude toward the solution of problems, Bloom and Broder found that successful problem solvers had a positive attitude toward reasoning, had

confidence in their ability to solve the problems, and left personal opinions and beliefs out of their decision-making process. The poor problem solvers, on the other hand, saw reasoning as having little value in solving problems, were unwilling to make necessary assumptions, were easily discouraged and made little attempt to solve complicated problems, were indecisive as to the correctness of their solutions, and were unable to remain objective, preferring instead to interject their personal biases into the problem (5:30-32).

The good and poor problem solvers differed in their possession of the critical thinking abilities and dispositions necessary for critical thought. The first three areas reflect critical thinking abilities which were possessed by the good problem solvers, but not by the poor problem solvers. The fourth area reflects dispositions which were possessed by the good problem solvers, but not by the poor problem solvers. Thus, Bloom and Broder showed the importance of both abilities and dispositions to think critically when solving problems.

Development of Critical Thinking

Man is not born with the ability to think critically. This ability must be developed over time, through biological development and through education.

Biological Development of Critical Thinking. The development of intelligence from birth to adulthood has been extensively studied by cognitive developmental

psychologists, most notably Jean Piaget. Piaget theorizes human intellectual development as passing through four stages.

The first, from birth to age two, is the sensori-motor stage. In this stage, the child learns to coordinate motor functions with perceptions, and develops dispositions for dealing with external objects. The child learns that objects exist, even when outside of his perceptions (23:xi-xii).

The second stage, the preoperational stage, extends from age two to age seven. During this stage, the child starts to represent the external world through symbols (words, images, etc). He is egocentric and unable to identify with others. The preoperational child thinks in concrete, static images, so is unable to think in the abstract and is unable to reverse directions in thought or to return to an original premise (17:150-161).

The third stage, from age seven to age eleven, is the concrete operational stage. In this stage, the child develops "a coherent and integrated cognitive system with which he organizes and manipulates the world around him" (17:165). His concept of the world is concrete, but flexible enough to adapt to changes.

Finally, the fourth stage of intellectual development, which occurs between ages eleven and fifteen, is the formal operational stage. During this stage the person learns the use of formal logic and reasoning. His orientation changes

from the concrete to the possible and hypothetical. He begins to form hypotheses and deduce their validity. He begins to generate propositions about objects or events and explore their interrelationships. Finally, he gains the ability to list and isolate all relevant variables, and make conclusions about reality. In the formal operational stage, the person develops an orientation toward problem solving (23:xiii-xviii,26:2-3).

The development of intelligence through the four stages is a natural biological evolution. All mentally normal humans pass through these stages, and have the capacity for formal operational thinking by the time they are adults. This does not mean, however, that all adults achieve formal operational thinking. A study by Patricia King reviewed the results of 25 other studies on the attainment of formal operational thinking in adults. She concluded:

> A sizable proportion of the normal adult population does not reason at formal levels when tested on formal operations tasks. The rates of successful performance (i.e., scoring at the fully formal level) averaged 40-70 percent for college students and adults tested in these samples. Further, the successful performance rate for about one-third of the samples tested was below 30 percent. (26:15)

The capacity to think in a formal, logical (critical) manner exists in all adults. But the ability to think critically does not develop automatically, and must be development through education (6:273).

Educational Development of Critical Thinking. The development of critical thinking abilities is relatively straight-forward, since these are skills which can be

taught. Students may be taught tactics and strategies to solve problems, such as using trial and error, working backwards, finding all the possibilities, and drawing pictures or graphs (24:102-108; 22:166-198). Schools throughout the country have added classes designed to teach these abilities.

In addition, regular classes can be taught in a manner that enhances critical thinking skills. For example, a science class may regularly require students to develop and analyze hypotheses, an art appreciation class may require students to develop criteria for making value judgements, or a political science class may require students to find the underlying assumptions in an argument. Normal classes taught in ways that require students to use critical thinking skills can have as great an impact as logic and thinking classes designed specifically to teach these skills (11:69).

A study by Ernest Pascarella examined the effects of college on critical thinking. He took his samples from graduating high school seniors. The study group consisted of those who went on to college. The control group consisted of those who did not attend college immediately, and was used to control for maturation effects. Pascarella found that those who attended college showed an overall improvement in critical thinking abilities, after one year, of 17% over those who did not attend college. He further found that the curricular emphasis by each college (i.e the

number of science and logic classes required) did not have a significant impact on the development of critical thinking abilities. Pascarella concluded that critical thinking:

> ...is a broad dimension of student intellectual development that is unlikely to be substantially influenced by any one specific college experience or curricular emphasis... rather than any one particular experience, it is the student's total engagement in the intellectual and social experience of college that positively influences the development of critical thinking ability. (38:25)

The abilities to think critically are developed in college students. However, the impact of specific courses in logic at developing these abilities is less than the overall impact of a system that encourages critical thinking in every class.

Critical thinking dispositions, in contrast, cannot be taught, but instead must be developed. Dispositions are attitudes, and while it is possible to teach that certain attitudes are more desirable than others, it is not possible to make a student adopt that attitude as his or her own.

> This means that, as educators, we should stop thinking of critical thinking as something that must be taught, and begin thinking of it as something that must be facilitated. In order to facilitate such thinking, teachers should take care to ensure that good critical thinking attitudes are developed, for here is the means whereby the critical thinking skills, once internalized, will transfer. (47:60)

Burton , Kimball, and Wing describe three determiners of critical thinking attitudes, (1) inborn factors, (2) nondirected external influences, and (3) deliberate institutional influences. The inborn factors are the individual differences that make each individual unique.

Inborn factors that can influence critical thinking include intelligence, perception, and suggestibility. Nondirected external influences include the attitudes and beliefs adopted from parents, peers, and society. Finally, deliberate institutional influences are the attempts by school, church, and government to mold attitudes in particular directions (6:41-43).

Nondirected external influences include all of the experiences of life which affect judgements, attitudes and beliefs. In adults, biological cognitive development (development of cognitive abilities) is generally complete. Further cognitive development takes place primarily in the area of attitudes, through the adult's experiences with his environment. Experiences which can alter a person's cognitive attitudes include marriage, child rearing, occupational activities, retirement, and death of a spouse (16:250-253). These nondirected environmental influences can alter the cognitive dispositions of a person at any time during his lifetime.

Deliberate institutional influence is the normal way critical thinking dispositions are developed. Inborn factors cannot be changed, so must be worked with or around in order to develop critical thinking dispositions. Nondirected external influences cannot be controlled, and often result in attitudes contrary to critical thinking and must be modified in order to develop critical thinking dispositions. It is through the deliberate attempts by

educators to influence the development of these attitudes that are developed (6:41-43).

The key to facilitating the development of these attitudes is for educators to provide a learning environment in which critical thinking is encouraged. The degree to which critical thinking dispositions are developed in students is based on the learning atmosphere and general procedures used in the classroom (20:285; 48:116). Classroom environments which encourage discussion, experimentation, questioning, and student led teaching are more conducive to the development of critical thinking dispositions than environments based on lectures and memorization (21:70-71). Students in these classroom environments show higher levels of critical thinking abilities and dispositions than students in classroom environments which discourage student participation and student-to-student interaction (46:188).

Chet Meyers suggests five keys to creating this type of environment. First, begin each class with a problem or controversy. This immediately captures student interest and encourages discussion throughout the class period. Second, use silence to encourage reflection. By pausing after stating an important concept or after asking a question, the teacher can encourage students to reflect on the issue at hand. Third, arrange classroom space to encourage interaction. By arranging desks in circles or semicircles, the students are better able to see and interact with each

other. Fourth, whenever possible, extend class time. Fifty minutes of discussion in one subject followed by another fifty minutes in a different subject makes it difficult for students to seriously reflect on any of their subjects. The longer class time can be made, the more deeply the class can reflect on the subject. Thus, ninety minute classes twice a week are preferable to sixty minute classes three times a week. Finally, create a hospitable environment. In order to develop an interactive environment, students must feel safe and comfortable. If students feel the teacher is not receptive to differing opinions or does not respect the views of the students, students will be reluctant to open up in class (31:61-68).

Harvey Siegel writes that in order to develop the critical spirit in students, teaching must take place in what he calls the critical manner.

> A teacher who utilizes the critical manner seeks to encourage in his or her students the skills, habits, and dispositions necessary for the development of the critical spirit. This means, first, that the teacher always recognizes the right of the student to question and demand reasons; and consequently recognizes an obligation to provide reasons whenever demanded. The critical manner thus demands of a teacher a willingness to subject all beliefs and practices to scrutiny, and so to allow students the genuine opportunity to understand the role reasons play in the justification of though and action. The critical manner also demands honesty of a teacher; reasons presented by a teacher must be genuine reasons, and the teacher must honestly appraise the power of those reasons. (45:45)

In effect, the teacher must posses critical teaching dispositions in order to teach in a manner that encourages critical thinking dispositions.

Measurement of Critical Thinking

Educational institutions with the goal of improving critical thinking need a method of evaluating whether the goal is being met. Testing the critical thinking skills of students is the primary method of evaluating this goal. The *Watson-Glaser Critical Thinking Appraisal* and the *Cornell Critical Thinking Tests* are two of the most widely used tests of critical thinking skills. These multiple choice tests have the advantage of being cheap and easy to administer, and are more objective than observational or essay tests (15:24-28). Shortcomings of multiple choice tests of critical thinking include that many thinking skills cannot be effectively measured with multiple choice questions (42:25) and that the validity of these tests is questionable since they only measure how well the examinees follow the thinking processes laid down in the test and cannot take into account the beliefs, assumptions, and ideologies of the examinees (36:23).

Existing tests measure the critical thinking abilities of students, but not the critical thinking dispositions. These tests are therefore of limited effectiveness in evaluating the use of critical thinking outside of the classroom.

The evaluation of critical thinking dispositions with conventional tests is difficult. First, it is easy to fake the dispositions to think critically. If a person knows he is being tested for critical thinking, he will likely

exhibit the dispositions for critical thinking, even if he does not posses the dispositions outside of a testing environment (15:25,37:30). Second, it is difficult to separate the effects of critical thinking abilities from critical thinking dispositions. If a person fails a portion of a test designed to test for dispositions, it could mean that he does not possess the dispositions, or it could mean that he does not possess critical thinking skills (15:33). Third, there is a strong link between subject-area knowledge and critical thinking. It is difficult to separate lack of subject-area knowledge from lack of the dispositions to use that knowledge (36:23). Finally, the use of critical thinking tests for skills or dispositions may hinder the disposition to think critically by focusing student attention on test performance rather than on improved thinking (45:174, 6:435).

Conventional tests are unable to overcome the above problems. Psychology tests are not subject to the same limitations and may be able to measure critical thinking dispositions where conventional tests cannot. Joan Baron, an authority on critical thinking skills, said:

> If teachers (and perhaps students) can develop observational scales and other measures of dispositions and attitudes, they may be able to amass some very compelling data about the changes in students' dispositions and the effectiveness of instructional programs. Certainly, the idea of measuring students' attitudes is not new. Psychologists have successfully created attitude scales for many decades. In fact, many existing scales may prove useful for teachers who are interested in monitoring changes resulting from an emphasis on thinking skills. (2:242)

One psychological measure which has been successfully used to measure cognitive dispositions for many years is the Myers-Briggs Type Indicator.

Theory Behind the Myers-Briggs Type Indicator (MBTI)

"The Myers-Briggs Type Indicator (MBTI) is one of a growing number of psychological instruments concerned primarily with variations in normal attitudes and behavior..." (28:294). The MBTI is a measure of the way people prefer to perceive and judge information and the way they prefer to use that information. The MBTI is based on the theories of Swiss psychologist Carl Jung. Jung theorized that everyone uses four mental processes-which he called sensing (S), intuition (N), thinking (T), and feeling (F)-and two attitudes-which he called extraversion (E) and introversion (I). Sensing and intuition describe two modes of perceiving, thinking and feeling describe two modes of judging, and extraversion and introversion describe two orientations toward life. Every person uses each of the four mental processes and two orientations, but prefers one type of perception process, one type of judgement process, and one orientation toward life. Everything which enters a person's consciousness enters through a perception process and is used by a judgement process in a manner that is influenced by the person's orientation toward life (27:6; 35:13).

Perception Processes: Sensing and Intuition. The two perception processes, sensing and intuition, refer to the

two ways in which a person can mentally gather information for use. Everyone has the ability to use both of the perception processes. Although the less preferred process will be used when necessary, the preferred process will be used whenever possible (34:2).

Sensing (S) refers to perceiving things which are observable to the senses. Those who prefer sensing over intuition focus on the physical and concrete world around them and generally develop characteristics such as practicality, realism, well developed powers of observation, and enjoyment of the present (35:12).

Intuition (N) refers to perceiving possibilities, meanings, and relationships. While sensing perceives things through the senses, intuition perceives things through insight generated by the subconscious through leaps in logic or hunches. Those who prefer intuition over sensing are generally imaginative, theoretical, abstract, or creative (35:12).

In the general population, there are three times as many sensing types as intuitive types. However, intuitive types are more attracted to higher education, since it requires more abstract thought. Thus, the higher the level of education, the greater the percentage of intuitive types. In one study of 2282 college and university teachers, intuitive types outnumbered sensing types by almost two to one (29:46).

Judgement Processes: Thinking and Feeling. The judgement processes, thinking and feeling, refer to the two methods of using the information which has been gathered by perceptions. Thinking and feeling are the two modes of decision making. Everyone has the ability to use both of the judgement processes. As with the perception processes, the less preferred process will be used when necessary, the preferred process will be used whenever possible (34:2).

Thinking (T) refers to logical, impersonal decision making. Those who prefer thinking processes use the principles of cause and effect and generally develop characteristics such as analytical ability, objectivity, and impartiality (27:8).

Feeling (F) refers to decision making by weighing the relative values and merits of an issue. Feeling relies on an understanding of what is important to the individual and to others. Those who prefer feeling processes develop characteristics such as an understanding of people, a capacity for warmth and compassion, and a desire for harmony (35:12-13).

The judgment function is the only scale on the MBTI in which differences between males and females are observed. In the general population, males tend to prefer thinking processes (55 to 65 percent), while females tend to prefer feeling processes (65 to 75 percent) (29:46).

Attitudes Toward Life: Extraversion and Introversion. The two attitudes, extraversion and introversion, refer to

person's preferred interest in the outer or inner world. Everyone uses extraversion and introversion daily, but each person develops a preference for one attitude which will be used whenever possible (28:297).

Extraversion (E) refers to the desire to focus on the external environment. Those who prefer extraversion are more interested in the outer world of people and things and generally develop characteristics such as sociability, outspokenness, a reliance on the environment for stimulation, and an action oriented outlook on life (33:7; 28:297-299).

Introversion (I) refers to the desire to focus on self-reflection of ideas and thoughts. Those who prefer introversion are more interested in the inner world of ideas and concepts and generally develop characteristics such as a contemplative detachment, reliance on concepts and ideas, and an enjoyment of privacy (33:7; 35:13).

In the general population, extraverts outnumber introverts by two or three to one. However, introverts tend to be more attracted to higher education than extraverts, since education is involved with concepts and ideas. A study of college and university teachers found 54 percent were introverts (29:46).

Attitudes Toward The Outer World: Judgment and Perception. While extraversion and introversion refer to the preference for perceiving and judging in the outer or inner world, judgement and perception refer to the preference for

using judgement processes or perception processes when relating to the outer world. Every person has the ability to use judgement processes or perception processes when relating to the outer world. However, each person has a preferred process which will be used whenever possible (35:13).

The six preferences detailed above (E, I, S, N, T, and F) were all specifically developed in Jung's theories. Jung also mentioned, but did not fully develop, the attitude toward the outer world. Isabel Myers and Katharine Briggs developed this attitude to make Jung's psychological types match all the actual personalities they observed (28:301-302).

Judgement (J) refers to the preference for using judging processes (either thinking or feeling, depending on which is preferred) when dealing with the outer world. Those who rely on judgement when relating with the outer world are concerned with decision making. They tend to shut off perception processes as soon as enough information has been gathered to make a decision. People with this attitude are generally organized, purposeful, and decisive (34:6;35:14).

Perception (P) refers to the preference for using perception processes (either sensing or intuition, depending on which is preferred) when dealing with the outer world. Those who rely on perception when relating with the outer world are concerned with gathering information. They tend

to delay the judgement process as long as possible so they can keep gathering more information. People with this attitude are generally curious, spontaneous, flexible, and adaptable to change (34:6; 35:14).

Judging types make up 55 percent of the general population (29:47).

Order of Function Preference. Everyone uses each of the four mental functions (S, N, T, F), however they are not all used with the same frequency or ability. For each person, one function will be the most preferred, or dominant, function. This is the function which the person has developed to the greatest extent and feels is most reliable. People will typically use their dominant function in their favorite attitude, extraversion or introversion. If a person feels most comfortable with the sensing function and is oriented toward the outer world, that person will use the sensing function primarily when dealing with the outer world. If that person is oriented toward the inner world, he will use his sensing function primarily when dealing with ideas and concepts (27:8-9).

The function opposite the dominant function is the least developed, and least used, function. The opposite functions cannot be used simultaneously. When a person is using sensory perceptions, his mind is focused on his senses and cannot focus on intuitive perceptions. Likewise, when he is in the feeling mode of judgement, he cannot simultaneously be in the thinking mode of judgement. Since

the dominant function is used the most and is the most well developed function, the opposite function is the least used and least developed of the four functions, and is called the inferior function (27:8-9).

The second, or auxiliary, function balances the dominant function. If the dominant function is a perception function, the auxiliary function will be a judgement function. Likewise, if the dominant function is a judgement function, the auxiliary function is a perception function. The auxiliary function provides the balance a person needs to be able to gather information and make decisions based on that information. The opposite function from the auxiliary is called the tertiary function (35:16).

The Judgement-Perception dimension of the MBTI indicates which function is dominant and which is auxiliary. Since the dominant function will always be used in a person's preferred orientation, extraversion or introversion, the dominant function will be used in the outer world by extraverts and in the inner world by introverts. The J-P dimension determines whether a person prefers to use the perception or judgement function when dealing with the outer world (i.e. when extraverting). Thus, for extraverts, the J-P dimension indicates the dominant function, and for introverts, it indicates the auxiliary function. If an extravert prefers judgement, his dominant function will be whichever of the judgement functions he prefers most (thinking or feeling), and his

auxiliary function will be the sensing function he prefers most (sensing or intuition). If an introvert prefers judgement, he uses his preferred judgement function in the outer world and his preferred sensing function in the inner world. Since the introvert's dominant function is the one used in the inner world, the preferred sensing function is the dominant and the preferred judgement function is the auxiliary (35:16).

The MBTI not only identifies which mental functions are preferred by a person; it also identifies the order of preference and use of the mental functions.

Summary of Preferences. Every person has a preference for extraversion or introversion (E or I), for sensing or intuition (S or I), for thinking or feeling (T or F), and for judgement or perception (J or P), creating sixteen possible outcomes for preferences:

ISTJ	ISFJ	INFJ	INTJ
ISTP	ISFP	INFP	INTP
ESTP	ESFP	ENFP	ENTP
ESTJ	ESFJ	ENFJ	ENTJ

These sixteen psychological types can all be accurately identified using the Myers-Briggs Type Indicator (28:303).

The Development of Type. Type theory assumes that every person is born with the predisposition to favor some mental functions over others. As the person grows older, he uses and develops most the functions he is comfortable with,

while those he is less comfortable with are developed to a lesser degree (35:14).

Type development is sensitive to the environment in which it is developed. A person's dispositions may be to develop his natural type, but environmental influences can lead to the use and development of less preferred functions by reinforcing activities which encourage specific functions.

> Environmental interference with type development can result in a "falsification" of type. Falsified individuals may become skillful in using an initially less-preferred function, but may also be less content, may feel less competent, or may be out of touch with their own best gifts. (35:14-15)

Crises and stress can also inhibit the development and expression of a person's natural type (43:14-15).

As examples, a person who is predisposed to prefer the intuition perception may instead develop his sensing function if his environment demands that he concentrate on the existing facts and memorize data, without giving him time to focus on the possibilities (a school, perhaps). Or, a person who is predisposed to favor feeling judgement may instead develop thinking judgement if he works in an environment that encourages strict compliance with rules, without regard to people's feelings (a courtroom, perhaps). In each of these cases, the person's natural type development would be discouraged by the environment.

Type development is a life-long process. Each type has a preferred perception and preferred judgement function. These are the most interesting to the person and are most

likely to be developed. However, the environment may force or encourage the interest in another of the functions. While the person may prefer one function, he may see the necessity of developing an opposing function, at least to a passable level. A feeling type enrolled in an advanced math class may see the necessity of strengthening his thinking function, so actively seek to develop it while enrolled in the class. An adult confident in his dominant and auxiliary functions may strive to develop his tertiary and inferior functions. As such, type development is a life-long process influenced by environment (35:15).

The MBTI cannot measure a person's natural type. Instead, it measures type as currently existing. If the environment has influenced the development of functions which would not normally be preferred, these are the functions which will be indicated as preferred. Therefore, a person may take the MBTI a number of times and end up with different results each time, due to the influences of the environment on the development of type (43:15).

Optimum development of type does not mean an equal preference for all of the functions. In fact, an equal preference for all of the functions most likely means that all of them are underdeveloped. Optimum development comes through selective development of each function. The dominant function is developed to a high level of proficiency. At the same time, the auxiliary function is developed to an adequate level of proficiency. Eventually,

the tertiary and inferior functions are developed to a level appropriate to its importance in the person's life. A person with optimum type development uses each of the functions, as appropriate, rather than relying on their favored dominant and auxiliary functions (35:15).

The educational environment can be set up to enhance the development of type to the optimum extent. One method is to encourage students to systematically use all four perception and judgment functions when solving problems or making decisions. The process involves first using senses to identify the facts of the situation, then using intuition to discover all of the alternatives and possible outcomes, then using judgement analyze all of the consequences and weigh the alternatives, and, finally, using feeling to weigh the alternatives from the perspective of the feelings of self and others. This process forces students to use, and therefore develop all, of the perception and judgement functions (34:4).

Another way to strengthen all aspects of students' type is by using a variety of different teaching styles. Each type has preferred learning styles--that is, preferred methods of learning new material. For instance, introverts tend to prefer lectures and working alone while extraverts tend to prefer group projects and class reports; sensing types favor audiovisuals and direct experiences while intuitive types favor reading and open-ended instruction; thinking types like lectures while feeling types prefer

harmonious group projects; and judging types may have a strong need for order while perceiving types may need help in organizing (32:52-53). Teaching in a style that is not preferred by a student allows the student to use and develop the type dimensions associated with those styles. For instance, a lecture would encourage intuitive types to develop their sensing function, while assigning reading would encourage sensing types to develop their intuitive function. By varying the teaching styles used in the classroom, students can be encouraged to utilize all of their type dimensions, leading to a more fully developed type (10:44-48).

Longitudinal Studies Using The MBTI. Longitudinal studies compare the changes in psychological type of a group of people over a period of time. These studies were executed primarily for the purpose of determining test-retest reliabilities of the MBTI, but also provide information about changes in psychological type over time.

Many longitudinal studies have been completed to show the test-retest reliability of the MBTI. A number of these are summarized in the MBTI manual (35:170-174). These studies were performed over time intervals of one week to six years. They generally show the MBTI to have a good level of test-retest reliability. Test-retest product-moment correlations vary from .93 to .51 for the EI scale, .93 to .58 for the SN scale, .91 to .45 for the TF scale, and .89 to .45 for the JP scale (35:172). For the MBTI, the

percentage of people who remained within the same type category is also an important measure. In the studies, between 72 and 89 percent remained within the same EI category, between 64 and 92 percent within the same SN category, between 68 and 90 percent within the same TF category, and between 66 and 92 percent remained within the same JP category (35:173).

It is difficult to separate the effects of instrument reliability from the effects of type change in these longitudinal studies. However, some trends can be observed. First, the longer the time was between tests, the lower the test-retest reliability tended to be. For example, the product-moment correlations for test-retest intervals of one week, one year, and four years for students enrolled in university or medical school are shown in Table 2.1. As can be seen, the greater the interval

TABLE 2.1

TEST-RETEST PRODUCT MOMENT CORRELATIONS

INTERVAL BETWEEN TESTS	EI SCALE	SN SCALE	TF SCALE	JP SCALE
1 WEEK	.89	.88	.86	NA
1 YEAR	.73	.69	.60	.69
4 YEARS	.51	.58	.45	.45

Source: (35:172)

between tests, the greater the reduction test-retest reliability. Without developmental changes to type, the test-retest reliabilities should remain about the same,

regardless of the time interval. The reduction in test-retest reliabilities over time is consistent with the greater likelihood of type change as the time interval increases. This provides evidence that higher education influences the development of psychological type.

In addition, most of these studies used samples consisting of students in universities or medical programs. Thus, these samples were of students exposed to the type of environment most likely to influence the development and expression of type--one designed to change people's attitudes and strengthen weak cognitive areas. If these environments result in changes to students' psychological types, test-retest reliabilities for these students should be lower than test-retest reliabilities for a sample of people in a more stable environment (i.e. an environment which has little influence on the development of type. Table 2.2 shows that this is the case. Elementary school

TABLE 2.2

TEST-RETEST AGREEMENT OF TYPE CATEGORIES

DESCRIPTION OF SAMPLE	INTERVAL BETWEEN TESTS	PERCENT OF AGREEMENT EI	SN	TF	JP
MISSISSIPPI STATE UNIV	5 WEEKS	81	89	83	84
WESLEYAN FRESHMEN	8 MONTHS	84	88	79	75
AUBURN UNIV SOPHOMORES	2 YEARS	74	71	73	77
U OF NM NURSING STUDENTS	2.5 YEARS	68	77	77	74
MEDICAL STUDENTS (ST. MARY'S HOSPITAL)	4.5 YEARS	72	66	68	66
ELEMENTARY TEACHERS	6 YEARS	83	89	90	90

Source: (35:173)

teachers had higher test-retest reliabilities over a six year period than most of the students did, even over a short period of time. This is further indication that developmental changes to psychological type occur as a result of exposure to a higher-education environment.

The MBTI and Critical Thinking Dispositions

A 1978 study compared the correlation between the MBTI and the *Watson-Glaser Critical Thinking Appraisal*, one of the widest used critical thinking tests. The study found that there was a significant correlation between the perception attitude (characterized by open-mindedness, flexibility, and desire to find all relevant information) and the critical thinking skills of inference and deduction. No significant correlation was found between any of the other MBTI functions and attitudes and any of the thinking skills measured by the *Watson-Glaser Critical Thinking Appraisal*, including recognition of assumptions, interpretation, and evaluation of arguments (35:204).

The *Watson-Glaser Critical Thinking Appraisal* measures critical thinking skills, not critical thinking dispositions, so it is not unexpected that there was little correlation between it and the MBTI.

Traditional tests of critical thinking are unable to measure critical thinking dispositions and, due to the difficulty of measuring these dispositions, may never be able to measure them. The MBTI was designed to measure the cognitive aspects of thought which determine critical

thinking dispositions. While not designed specifically the measure of critical thinking dispositions, it nevertheless is logical to use it for this purpose.

Figure 2.1 presents some of the characteristics associated with each of the MBTI functions and attitudes (35:12-14;27:24-25;30:2-3) and Ennis' and D'Angelo's critical thinking dispositions which apply to each. As can be seen, the critical thinking dispositions correspond well with the functions and attitudes of the MBTI.

The development of a critical thinking disposition should result in the strengthening of the related mental function or attitude. For instance, if a classroom environment is set up to strengthen the disposition to be objective, that same environment will work to enhance the thinking function. In order for the disposition to be objective to improve, the thinking function must be strengthened. The development of any of the critical thinking dispositions takes place by creating an environment which encourages the development of the function or attitude associated with that disposition. Thus, successful development of a critical thinking disposition should be measurable by measuring the strengthening of the mental function or attitude associated with that disposition.

Use of the MBTI at AFIT

The MBTI has been administered at the AFIT School of Systems and Logistics since 1985 to help students and faculty to better understand the similarities and

Characteristics of:	Applicable Critical Thinking Dispositions
EXTRAVERSION	
Scans environment for information	
Sociable	
Action-oriented	
Impulsive	
Focuses on tangible things	
INTROVERSION	
Reflective	
Interest in clarity	
Enjoys solitude	
Thinks before acting	
Focuses on ideas	
SENSING	
Attention to details	Seek precision
Confines attention to what is said and done	
Realism	
Good powers of observation	
Focuses on the facts	
Systematic	Being systematic
Memory for details	
INTUITION	
Looks for the big picture	Take total situation into account
Sees possibilities	Look for alternatives
Sees patterns and meanings	
Imaginative	
Theoretical	
Creative	
Possesses insight into complexity	Deal orderly with parts of a complex whole

FIGURE 2.1 CRITICAL THINKING DISPOSITIONS APPLICABLE TO THE MYERS-BRIGGS TYPE INDICATOR

Characteristics of:	Applicable Critical Thinking Dispositions
THINKING	
Logical	
Objective	Objectivity
Seeks cause-effect relationships	Seeks reasons
Impersonal	
Analytical	Deal orderly with parts of complex whole
Skeptical	Intellectual skepticism
Critical	Uses critical thinking abilities
Impartial	Intellectual honesty
Firm-minded	
FEELING	
Uses personal priorities	
Weighs own and other's values	Respects other's point of view
Subjective	
Trusting	
Seeks Harmony	
PERCEPTION	
Seeks to take in all information	Try to be well informed
Adaptable	
Curious	Intellectual curiosity
Open-minded	Open-minded
Spontaneous	
Flexible	Flexibility
JUDGEMENT	
Goal oriented	
Organized	
Systematic	Systematic
Decisive	Decisiveness
Orderly	Deal orderly with parts of complex whole

FIGURE 2.1 (continued) CRITICAL THINKING DISPOSITIONS APPLICABLE TO THE MYERS-BRIGGS TYPE INDICATOR

differences in their preferred methods learning and teaching. The MBTI is administered when students first enter the graduate program and when they graduate,to measure changes in their preferred learning methods. Table 2.3 shows the type distribution of the same group of students as they entered the AFIT program in May 1985 and as they left the program in July 1986, and also shows the observed shifts in personality type and temperament.

TABLE 2.3

OBSERVED AFIT LEARNER MBTI PRE-TEST AND POST-TEST DISTRIBUTIONS

	PRETEST DIST.	EXIT SURVEY	POSTTEST BEGIN	CHANGED INTO	CHANGED OUT OF	POSTTEST END DIST
ISTJ	27	6	21	14	8	27
ISTP	9	-	9	3	5	7
ESTP	1	1	-	3	-	3
ESTJ	18	3	15	9	5	19
ISFJ	11	1	10	-	8	2
ISFP	0	-	-	-	-	0
ESFP	0	-	-	-	-	0
ESFJ	4	-	4	2	2	4
INFJ	3	-	3	2	1	4
INFP	5	1	4	3	4	3
ENFP	3	-	3	0	1	2
ENFJ	0	-	-	-	-	0
INTJ	16	2	14	4	10	8
INTP	7	-	7	6	1	12
ENTP	7	1	6	2	2	6
ENTJ	11	1	10	5	6	9

Source: (9)

More of these students developed into ISTJs than into any other type. ISTJs tend to be systematic, thorough,

practical, and hard working. They tend to have a large capacity for attention to detail and emphasize logic, analysis, and decisiveness (33:104-107). From Figure 2.1, it can be seen that ISTJs should possess the following critical thinking dispositions:

1. Seeks precision
2. Systematic
3. Objectivity
4. Seeks reasons
5. Deals in an orderly manner with the parts of a complex whole
6. Intellectual skepticism
7. Uses critical thinking abilities
8. Intellectual honesty
9. Decisiveness

If the shift into ISTJ were statistically significant, it would be a positive signal that the above critical thinking dispositions were developed in the students while they attended AFIT.

Summary

This chapter reviewed literature relevant to this research. Critical thinking, its development, and its measurement were discussed. Next, the Myers-Briggs Type Indicator, its applicability to critical thinking, and its use at AFIT were discussed. The next chapter will detail the methodology used in this research.

III. Methodology

Introduction to the Chapter

This chapter introduces the methodology to test the hypotheses of the two research and twelve investigative questions. This chapter starts with a discussion of the research design, then looks at the population and sample of interest, the survey instruments, and the data collection procedures. The chapter concludes with a description of the data analysis techniques.

Research Design

This study will be a preexperimental one-group pre-test-post-test survey design. This study is exploratory and longitudinal in nature. As such, the design of this study is to use the Myers-Briggs Type Indicator (MBTI) to determine the psychological type of students when they enter the graduate program (pre-test), when they complete the program (post-test), and several years after completing the program (follow-up). An environmental influences survey will be administered with the follow-up MBTI to account for historical changes in the subjects since the post-test.

A survey methodology was chosen for the following reasons:

1. The purpose of this research is to analyze the change in critical thinking dispositions of AFIT/LS students. Critical thinking dispositions are the tendencies

and attitudes a person has toward thinking critically. They take place within the mind of a person, and are not directly observable. The easiest method of measuring them is with a psychological survey such as the MBTI.

2. The use of a standardized test of psychological dispositions provides much greater internal validity than observations by a group of observers.

3. The time and cost necessary to observe a large group of students while at AFIT and for several years after graduation is prohibitive.

Population and Sample

Population. The population for this research is all people who have attended and completed an AFIT/LS graduate management program since 1986. The results of this research are likely generalizable to graduates before 1986, since the programs have remained essentially the same for many years. However, some changes have occurred in curriculum and faculty every year, and without a better understanding of these influences, it is more accurate to define the population excluding those who graduated before 1986.

The population consists of approximately 160 people per year since 1986, or about 800 people. These subjects are predominantly Air Force officers of rank First Lieutenant, Captain, and Major. In addition, a small percentage of the students are Air Force civilians, officers from other branches of the U.S. military, and officers from the militaries of other countries.

Sample. Different samples will be used to answer the two research questions. The sample for Research Question #1 includes all students who completed the graduate program between 1986 and 1989. This sample was pre- and post-surveyed using the MBTI. The pre-AFIT MBTI was almost a complete census. The MBTI was administered as part of student orientation, so only those students who missed the orientation failed to take the pre-AFIT MBTI. The post-AFIT MBTI was voluntary, so the response rate for it was lower. Table 3.1 shows the student participation in the pre-AFIT and post-AFIT surveys. Only those who took the pre-AFIT MBTI were given the post-AFIT MBTI.

TABLE 3.1

STUDENT RESPONSE SIZES

GRADUATING YEAR	PRE-AFIT	POST-AFIT
1986	123	102
1987	147	95
1988	147	97
1989	167	133
TOTALS	584	427

The sample for Research Question #2 is a subset of the sample for Research Question #1, and will consist of all US Air Force officers who completed an AFIT/LS masters program between 1986 and 1989 and completed the pre-AFIT and post-AFIT MBTIs. Research Question #2 investigates the retention of psychological type after leaving AFIT. The sample will include those whose psychological type was measured while at AFIT. In addition, because of the unavailability of

addresses for Air Force civilians, officers of other U.S. military services, and officers of other countries, only those who are Air Force officers will be surveyed.

Survey Instrument

Variables. The following are the relevant variables for Research Question #1:

Independent Variable: exposure to the AFIT/LS learning environment

Dependent Variables: critical thinking dispositions

Moderating Variables: AFIT/LS program, year enrolled, demographics, and pre-AFIT psychological type.

These are the relevant variables for Research Question #2:

Independent Variable: removal from the AFIT/LS learning environment

Dependent Variables: critical thinking dispositions

Moderating Variables: AFIT/LS program, year enrolled, demographics, post-AFIT psychological type, work environment since leaving AFIT, and home environment since leaving AFIT.

Myers-Briggs Type Indicator (MBTI). The MBTI will be used as a measure of the dependent variables for both research questions. The MBTI measures the dispositions of a person toward perceiving information and making decisions. The dispositions measurable with the MBTI are consistent with many of the critical thinking dispositions, so the MBTI will be used as an indication of the presence of these critical thinking dispositions.

The MBTI has proven to be a survey instrument which has a high degree of validity and reliability. Content validity (the extent to which the test represents all possible outcomes) has been established for the MBTI:

> Content validity will not be discussed in this chapter in any detail. While the theory was taken very seriously in developing items, as was also observation of the behaviors of different types, item selection was ultimately based only on the empirical evidence that the items separate persons with opposing preferences. (35:175)

Construct validity (the extent to which the test measures what it intends to measure) has also been established for the MBTI:

> For example, if the type table for a given occupation has significantly more of the types predicted by theory to have interest in, and therefore be more likely to be member of, that occupation, then the type table contributes to construct validity. Type distributions presented throughout this Manual provide evidence for the construct validity of the MBTI. (35:176)

Finally, the MBTI meets the criteria for predictive validity (the extent to which the test really does predict or distinguish what it intends to measure):

> The preceding description of research is by no means comprehensive, but it is designed to give the reader an understanding of the range of validity studies with the MBTI and to show that relationships found tend to be in the directions predicted from type theory. (28:331)

The MBTI is also a reliable instrument. Its internal reliability and test-retest reliability confirm this.

> In summary, the estimates of internal consistency reliabilities for the continuous scores of the four MBTI scales are acceptable for most adult samples. (35:169)

> In conclusion, test-retest reliabilities of the MBTI show consistency over time. When subjects report a change in type, it is most likely to occur in only one preference, and in scales where the original preference was low. (35:171)

The MBTI has the validity and the reliability to accurately measure the dispositions of the sample groups in the pre-AFIT, post-AFIT, and follow-up tests.

Environmental Influences Survey. An environmental influences survey will be developed to assess the effects of work environment since leaving AFIT, and home environment since leaving AFIT (moderating variables for Research Question #2) on the critical thinking dispositions (dependent variables for Research Question #2). This survey will use a five point Likert scale as a measure of the level of various work environment variables (including amount of problem solving required, amount of creativity required, amount of stress, and amount of socialization) and home environment variables (including change of marital status, birth of a child, and death in the family). The environmental influences survey will accompany the follow-up MBTI survey.

Three ways of improving the validity of subjective surveys are to make the survey as reliable as possible, to include enough possible responses for each respondent to find the one that is appropriate, and to ask each question several times, in different ways. The reliability of a survey can be improved by asking each respondent the same

questions, and by writing questions that are clear and have the same meaning to all respondents (18:74-84, 95-96).

The environmental influences survey will be designed to maintain high validity and reliability. All respondents will be given the same questions. The questions will be written clearly and pre-tested to ensure that there are no confusing questions. Finally, a five point Likert scale will be used which will provide the respondents with a wide range of answers to choose from.

Data Collection

The pre-AFIT MBTI survey was given to each student at the initial student orientation. Instructions for the MBTI were written on the MBTI booklets, and students were given as much time as they needed to complete the survey. Each student was then sent a letter detailing his or her psychological type. Near the end of the graduate program, post-AFIT MBTI surveys were placed in the AFIT mailbox of each student who had completed the pre-AFIT MBTI, with a letter requesting that he or she help with a continuing AFIT research effort by filling out the survey. Response was completely voluntary.

The follow-up MBTI survey will be mailed to each Air Force officer who completed the post-AFIT survey. A cover letter, the environmental influences survey, and a stamped, addressed return envelope will be included with the MBTI survey. The cover letter will stress that this survey is not anonymous since changes between post-AFIT and follow-up

psychological types must be compared. In addition, the cover letter will offer to provide the results of the follow-up MBTI to any respondent who is interested, if he or she provides an autovon number with the returned survey. Letters of reminder will be sent to those who do not return the survey within two weeks. All personal data collected will be controlled in accordance with the guidelines of the Privacy Act of 1974.

The returned MBTI surveys will be scored using a preprogrammed scoring machine. The environmental influences surveys will be hand scored. All data will be entered into a data-base to be analyzed statistically.

Data Analysis

Data will be analyzed using the Statistix 3.1 interactive statistical analysis program for microcomputers. Where necessary, Statistical Analysis System (SAS) for VAX/VMS mini-computers will be used to supplement Statistix 3.1. The paired t-test, one-way Analysis of Variance (ANOVA), and Kruskal-Wallis ANOVA statistical techniques will be used to analyze the data. For all tests, the level of significance of the test (alpha) will be 0.05. Thus, all tests will have a confidence level of 0.95.

Investigative Question 1. A paired t-test will be performed on the score for each of the four MBTI scales (E-I, S-N, T-F, J-P) for the pre-AFIT and post-AFIT MBTI surveys to determine whether there is a statistically

significant change in psychological type (dependent variable) while at AFIT (independent variable).

Investigative Questions 2-5. A one-way ANOVA will be performed on the dependent variables (changes between pre-AFIT and post-AFIT MBTI scores) and the moderating variables (AFIT program, year enrolled, demographics, and pre-AFIT MBTI) to determine whether the moderating variables are correlated with a change in psychological type.

Investigative Question 6. A paired t-test will be performed on the MBTI scores for the post-AFIT and follow-up MBTI surveys to determine whether there is a statistically significant change in psychological type (dependent variable) after leaving AFIT (independent variable).

Investigative Questions 7-10. A one-way ANOVA will be performed on the dependent variables (changes between post-AFIT and follow-up MBTI scores) and the moderating variables (AFIT program, year enrolled, demographics, and pre-AFIT MBTI) to determine whether the moderating variables are correlated with a change in psychological type.

Investigative Questions 11-12. A one-way ANOVA will be performed on the changes between post-AFIT and follow-up MBTI scores (dependent variables) and the responses to the environmental influences survey (moderating variables) to determine whether work environment since leaving AFIT and home environment since leaving AFIT are correlated with a change in psychological type.

Summary

This chapter introduced the methodology used to test the hypotheses of the two research questions and twelve investigative questions. The research design, population and samples of interest, survey instruments, data collection procedures, and data analysis techniques were discussed. The next chapter will detail the results of the research.

IV. Data Analysis

Introduction to the Chapter

This chapter presents an analysis of the data gathered using the methodology presented in chapter three. The data gathered are presented and analyzed for the five investigative questions associated with Research Question #1 and then for seven investigative questions associated with Research Question #2.

Research Question #1

Research Question #1 asked whether critical thinking dispositions were developed in students of the AFIT/LS graduate program. Investigative question 1, whether there was a difference between pre-AFIT and post-AFIT psychological types for the students, was critical to answering the research question. Investigative questions 2-5 analyzed what factors played a part in any difference between pre-AFIT and post-AFIT psychological types, and were only relevant if a difference between pre-AFIT and post-AFIT types existed.

Sample #1 Demographic Data. Sample #1 included all students who graduated from the AFIT masters program between 1986 and 1989. This sample was used to answer Research question #1 and its five investigative questions.

Of the approximately 639 students who attended the program between 1986 and 1989, 584 took the Pre-AFIT MBTI

and 427 of those also took the Post-AFIT MBTI, as shown in Table 4.1. The 584 who took the Pre-AFIT test represent approximately 91 percent of those enrolled in the program.

TABLE 4.1

STUDENT RESPONSE BY YEAR OF GRADUATION

Graduating Year	Enrolled	Pre-AFIT	Post-AFIT
1986	145	123	102
1987	158	147	95
1988	159	147	97
1989	177	167	133
TOTALS:	639	584	427

The 427 who took the Pre-AFIT and Post-AFIT MBTIs represent approximately 67 percent of those enrolled in the program and 73 percent of those who took the Pre-AFIT MBTI. Only the 427 who completed both the Pre-AFIT and Post-AFIT MBTIs were included for further analysis.

Of the 427 completing the pre- and post-AFIT surveys, 63, or 14.8 percent, were females and 364, or 85.2 percent, were males, as shown in Table 4.2.

TABLE 4.2

SEX OF THOSE COMPLETING PRE-AFIT AND POST-AFIT SURVEYS
(N=427)

SEX	FREQUENCY	PERCENT OF TOTAL
FEMALE	63	14.8
MALE	364	85.2
TOTALS:	427	100.0

Table 4.3 presents the frequency distribution of ages for those in the sample. Ages ranged from 25 to 47 years old, with 61 percent between the ages of 26 and 31.

TABLE 4.3

AGES, UPON ENTERING THE PROGRAM, OF THOSE WHO COMPLETED PRE-AFIT AND POST-AFIT SURVEYS (N=427)

AGE	FREQUENCY	PERCENT OF TOTAL
25	9	2.1
26	41	9.6
27	45	10.5
28	40	9.4
29	38	8.9
30	46	10.8
31	51	11.9
32	28	6.6
33	22	5.2
34	26	6.1
35	20	4.7
36	16	3.7
37	18	4.2
38	9	2.1
39	4	0.9
40	5	1.2
41	2	0.5
43	5	1.2
45	1	0.2
47	1	0.2
TOTALS:	427	100.0

US Air Force officers and civilians attended the program, as well as officers from other branches of the US military and officers from the militaries of allied countries. US Air Force officers accounted for 87.3 percent of the sample, US Air Force civilians for 6.8 percent, other US military officers for 2.6 percent, and allied military officers for 3.3 percent. This breakdown for those in the sample is shown in Table 4.3. Note that the ranks and

grades listed were those when the student first entered the program.

TABLE 4.4

MILITARY STATUS/RANK UPON ENTERING AFIT OF THOSE WHO COMPLETED PRE-AFIT AND POST-AFIT SURVEYS (N=427)

MILITARY STATUS/RANK	FREQUENCY	PERCENT OF TOTAL
US AIR FORCE OFFICERS		
SECOND LIEUTENANT	3	0.7
FIRST LIEUTENANT	133	31.1
CAPTAIN	227	53.2
MAJOR	10	2.3
US AIR FORCE CIVILIAN		
GS-11	4	0.9
GS-12	16	3.7
GS/GM-13	7	1.6
GS/GM-14	2	0.5
OTHER US MILITARY	11	2.6
ALLIED MILITARY	14	3.3
TOTALS:	427	99.9

NOTES: Other US Military includes officers from the US Army, Navy, and Marine Corps. Allied Military included military officers from Singapore, Pakistan, Australia, Spain, and Korea.

Investigative Question 1. Investigative question 1 asked whether there was a difference in the pre-AFIT and post-AFIT psychological type of students in the sample. By comparing the changes in type dimensions for each student from the pre-AFIT to the post-AFIT survey, it can be determined whether a significant change in type preferences occurred while the students were at AFIT.

The psychological type distributions, measured when the students arrived at AFIT, are shown in Table 4.5 for the 427 students who completed both the pre-AFIT and post-AFIT MBTI

surveys. A cursory look at this data shows that some types in this sample were significantly over or under represented

TABLE 4.5

TYPE DISTRIBUTION OF THOSE COMPLETING PRE-AFIT AND POST-AFIT MBTI, AS MEASURED BY THE PRE-AFIT MBTI (N=427)

ISTJ 116 27.2%	**ISFJ** 24 5.6%	**INFJ** 8 1.9%	**INTJ** 39 9.1%
ISTP 37 8.7%	**ISFP** 6 1.4%	**INFP** 9 2.1%	**INTP** 29 6.8%
ESTP 16 3.7%	**ESFP** 4 0.9%	**ENFP** 6 1.4%	**ENTP** 17 4.0%
ESTJ 62 14.5%	**ESFJ** 11 2.5%	**ENFJ** 5 1.2%	**ENTJ** 38 8.9%

compared with the MBTI data bank (35:50-51). ISTJs make up approximately 15 percent of the general male population and 10 percent of the general female population, but accounted for 27 percent of this sample. In addition, all feeling types with the exception of ISFJ were represented at a lower rate in this sample than in the general population.

Table 4.6 shows the frequency of each type dimension in the pre-AFIT survey. A cursory look at the data shows that the sample of AFIT students varied from the general population in most of the dimensions. While extraverts make

TABLE 4.6

FREQUENCY OF EACH TYPE DIMENSION IN PRE-AFIT SURVEY FOR THOSE WHO COMPLETED PRE-AFIT AND POST-AFIT SURVEYS (N=427)

E/I			S/N		
	NUMBER	PERCENT		NUMBER	PERCENT
E:	159	37.2	S:	276	64.6
I:	268	62.8	N:	151	35.4
T/F			**J/P**		
	NUMBER	PERCENT		NUMBER	PERCENT
T:	354	82.9	J:	303	71.0
F:	73	17.1	P:	124	29.0

up 65-75 percent of the general population, they made up 37 percent of this sample. Thinking types make up 55% of the male population and 35% of the female population, but made up 83% of this sample. And, while judgement types make up 55% of the general population, they accounted for 71% of this sample. Only in the sensing/intuition dimension did this sample resemble the general population.

The distribution of psychological types of students graduating from the AFIT program are detailed in Table 4.7. The same over-representation of ISTJs and under-representation of all feeling types that was present in the pre-AFIT data is still present in these data.

Table 4.8 details the frequency of each type dimension in the post-AFIT survey of the students. A comparison of this table with Table 4.6 shows that the distribution within

TABLE 4.7

TYPE DISTRIBUTION OF THOSE COMPLETING PRE-AFIT AND POST-AFIT MBTI, AS MEASURED BY THE POST-AFIT MBTI (N=427)

ISTJ 119 27.9%	ISFJ 10 2.3%	INFJ 13 3.0%	INTJ 31 7.3%
ISTP 44 10.3%	ISFP 5 1.1%	INFP 15 3.5%	INTP 35 8.2%
ESTP 13 3.0%	ESFP 4 0.9%	ENFP 4 0.9%	ENTP 26 6.1%
ESTJ 63 14.8%	ESFJ 10 2.3%	ENFJ 4 0.9%	ENTJ 31 7.3%

TABLE 4.8

FREQUENCY OF EACH TYPE DIMENSION IN POST-AFIT SURVEY FOR THOSE WHO COMPLETED PRE-AFIT AND POST-AFIT SURVEYS (N=427)

E/I			S/N		
	NUMBER	PERCENT		NUMBER	PERCENT
E:	155	36.3	S:	268	62.8
I:	272	63.7	N:	159	37.2
T/F			**J/P**		
	NUMBER	PERCENT		NUMBER	PERCENT
T:	362	84.8	J:	281	65.8
F:	65	15.2	P:	146	34.2

each type dimension was similar from pre-AFIT to post-AFIT surveys, with the exception of the J/P dimension. In the pre-AFIT survey, 71 percent of the students were judgement types, while in the post-AFIT survey, the percentage of judgement types had dropped to 66 percent.

Table 4.9 summarizes the changes, by type, that took place while the students were enrolled at AFIT. Of the 427 students, 199 (46.6 percent) changed at least one letter dimension of their type while at AFIT. 53 percent of the students maintained the same type over the 12 to 14 months between the pre- and post-AFIT surveys. The percentage of students who maintained the same type over the length of the program was greater than seen in previous studies. In six different longitudinal studies of university students performed with intervals of 8 months to two years, between 31 and 47 percent of students maintained the same type over the duration of the study (35:173).

The types with the greatest increase from pre- to post-AFIT surveys were ENTP (+9), ISTP (+7), INTP (+6), and INFP (+6). The types with the greatest decrease from pre- to post-AFIT surveys were ISFJ (-14), INTJ (-8), and ENTJ (-7). Those with the greatest increase were perception types, while those with the greatest decrease were judgement types.

Table 4.10 summarizes the changes, from pre-AFIT to post-AFIT surveys, by type dimension. The table reports a net shift of 22 students from judgement to perception, eight from sensing to intuition, seven from feeling to thinking,

TABLE 4.9

SUMMARY OF CHANGES IN TYPE WHILE AT AFIT FOR THOSE WHO COMPLETED PRE-AFIT AND POST-AFIT SURVEYS (N=427)

TYPE	PRE-AFIT SURVEY	SWITCHED INTO	SWITCHED OUT OF	POST-AFIT SURVEY	NET CHANGE
ESTJ	62	27	26	63	+1
ESTP	16	6	9	13	-3
ESFJ	11	5	6	10	-1
ESFP	4	3	3	4	0
ENTJ	38	12	19	31	-7
ENTP	17	16	7	26	+9
ENFJ	5	2	3	4	-1
ENFP	6	1	3	4	-2
ISTJ	116	45	42	119	+3
ISTP	37	21	14	44	+7
ISFJ	24	6	20	10	-14
ISFP	6	3	4	5	-1
INTJ	39	17	25	31	-8
INTP	29	16	10	35	+6
INFJ	8	7	2	13	+5
INFP	9	12	6	15	+6
TOTALS:	427	199	199	427	0

TABLE 4.10

SUMMARY OF CHANGES, BY TYPE DIMENSION, WHILE AT AFIT FOR THOSE WHO COMPLETED PRE-AFIT AND POST-AFIT SURVEYS (N=427)

E/I		S/N	
E --> I:	35	S --> N:	37
I --> E:	31	N --> S:	29
NET CHANGE:	+4 I	NET CHANGE:	+8 N
T/F		**J/P**	
T --> F:	27	J --> P:	49
F --> T:	35	P --> J:	27
NET CHANGE:	+7 T	NET CHANGE:	+22 P

and four from extraversion to introversion.

To perform statistical analyses of psychological types, the convention is to use continuous scores. The preference scores for each dimension of type are added to 100 for I, N, F, and P, and subtracted from 100 for E, S, T, and J. This provides a continuous scale of 49-157 for E/I, 33-151 for S/N, 35-143 for T/F, and 45-161 for J/P, with numbers below 100 representing E, S, T, or J. The further the continuous score is from 100, the stronger the preference for that dimension is.

Table 4.11 presents continuous score data for the pre-AFIT survey, while Table 4.12 presents data for the post-AFIT survey. These data show the relative strength of each preference for each dimension. For instance, approximately the same percentage of subjects preferred thinking on the pre-AFIT and post-AFIT surveys. However, the mean score of 75.36 for the post-AFIT survey is further from 100 than the mean score of 79.00 for the pre-AFIT survey, indicating a stronger preference for thinking on the post-AFIT survey than on the pre-AFIT survey.

In order to determine whether there was a statistically significant difference between the pre-AFIT and post-AFIT psychological types of the students, a paired t-test was performed on the continuous scores for each dimension. The paired t-test provides a more accurate way of determining whether there was a shift in type than comparing the number of subjects who changed into and out of a type or dimension.

TABLE 4.11

SUMMARY OF CONTINUOUS SCORES OF PRE-AFIT MBTI (N=427)

	E/I	S/N	T/F	J/P
CASES	427.00	427.00	427.00	427.00
MEAN	107.8	88.77	79.00	84.97
S. D.	24.91	26.96	20.90	27.21
MEDIAN	109.00	89.00	77.00	81.00
MINIMUM	49.00	33.00	35.00	45.00
MAXIMUM	155.00	147.00	141.00	155.00

TABLE 4.12

SUMMARY OF CONTINUOUS SCORES OF POST-AFIT MBTI (N=427)

	E/I	S/N	T/F	J/P
CASES	427.00	427.00	427.00	427.00
MEAN	107.9	89.46	75.36	88.19
S. D.	25.49	29.81	22.52	28.66
MEDIAN	109.00	89.00	73.00	83.00
MINIMUM	53.00	33.00	35.00	45.00
MAXIMUM	157.00	151.00	137.00	159.00

It is possible for subjects to maintain the same preferences in both surveys, but at a stronger or weaker level. Changes in strength of preference cannot be detected simply by comparing pre- and post-AFIT types. T-test analysis of the continuous scores must be performed to achieve this. The results of the t-tests are shown in Table 4.13.

The t-tests show that there was no difference between the pre- and post-AFIT psychological types in the extraversion/introversion dimension (p=.92) or in the sensing/intuition dimension (p=.47). However, there were significant differences in the thinking/feeling dimension

TABLE 4.13

PAIRED T-TESTS FOR PRE-AFIT TO POST-AFIT CONTINUOUS SCORES (N=427)

	POST - PRE E/I	POST - PRE S/N	POST - PRE T/F	POST - PRE J/P
MEAN	0.08	0.69	-3.65	3.21
STD ERROR	0.77	0.96	0.83	0.96
T	0.10	0.72	-4.41	3.36
DF	426	426	426	426
P	0.918	0.471	0.0000***	0.0008***

NOTE: * p<.05, ** p<.01, *** p<.001

(p < .001) and in the judging/perceiving dimension (p < .001). The shift in the thinking/feeling dimension was towards an increased preference for thinking (mean = -3.65), while the shift in the judgement/perception dimension was towards an increased preference for perceiving (mean = 3.21).

To summarize investigative question 1, 199 of the 427 students who took the pre-AFIT and post-AFIT surveys changed at least one dimension of their psychological type while at AFIT. There was a significant shift away from feeling and towards thinking (p < .001), and away from judging and towards perceiving (p < .001) while the students were enrolled at AFIT. Based on these findings, the null hypothesis can be rejected and the alternate hypothesis accepted. The alternate hypothesis stated that students who attended the program changed psychological type while at AFIT.

Investigative Question 2. Investigative question 2 asked whether the changes in type, while at AFIT, differed by the program option of the students. By comparing the shift in type preferences with the program option of each student, it can be determined whether particular options had a greater impact on the shifts in preferences than other options.

Data on the program option of each of the 427 students who completed the pre-AFIT and post-AFIT surveys was not available. However, this data was collected as part of the follow-up survey, so was available for the 201 students who returned the follow-up survey. The sample of those who returned the follow-up survey is statistically the same as the sample of those who took the pre- and post-AFIT surveys, as will be discussed under Research Question #2 below. Therefore, these data were used to answer the investigative question.

Table 4.14 details the frequency distribution of the sample by program. Programs which were offered at AFIT between 1986 and 1989 included Engineering Management, Systems Management, Cost Analysis, Logistics Management, and Information Resource Management. Logistics Management included several different majors within the curriculum including Maintenance Management, Supply Management, Transportation Management, Acquisition Logistics Management, Contracting Management, and Logistics Management.

TABLE 4.14

AFIT GRADUATE PROGRAM OF THOSE WHO COMPLETED THE PRE-AFIT, POST-AFIT, AND FOLLOW-UP MBTIs

PROGRAM	FREQUENCY	PERCENT OF TOTAL
ENGINEERING MANAGEMENT	27	13.9
SYSTEMS MANAGEMENT	39	20.0
COST ANALYSIS	19	9.7
LOGISTICS MANAGEMENT	102	52.3
INFORMATION RESOURCE MGMT	8	4.1
TOTALS:	195	100.0

NOTE: THE PROGRAM IN WHICH SIX OF THE STUDENTS WERE ENROLLED IS UNKNOWN.

Table 4.15 provides the correlation between the shift in each type dimension while at AFIT and the program in which the students were enrolled. The only correlation which was statistically significant was for the Graduate Logistics Management (GLM) program ($p < .05$). The positive

TABLE 4.15

CORRELATION OF CHANGE IN TYPE FROM PRE-AFIT TO POST-AFIT SURVEYS WITH AFIT GRADUATE PROGRAM (N=195)

PROGRAM	POST-PRE E/I	POST-PRE S/N	POST-PRE T/F	POST-PRE J/P
ENGINEERING MGMT	-.0116	-.0407	-.1370	.0456
SYSTEMS MGMT	-.0407	.0014	-.0993	.0238
COST ANALYSIS	-.0593	-.0792	-.0413	-.0735
LOGISTICS MGMT	.0703	.0946	.1392*	.0162
INFO RESOURCE MGMT	.0912	-.0596	.0453	-.0333

NOTE: * p<.05, ** p<.01, *** p<.001

correlation between the GLM program and a shift towards feeling indicates that the GLM students were less likely

than students of other programs to shift towards a preference for thinking.

The relationship between the GLM program and the T/F shift can be seen more clearly in Table 4.16. Table 4.16 presents the results of paired t-tests between pre-AFIT and post-AFIT continuous scores on the T/F dimension for GLM students and non-GLM students. As can be seen, there was a significant ($p<.001$) shift towards thinking for the non-GLM

TABLE 4.16

PAIRED T-TESTS FOR CHANGES FROM PRE-AFIT TO POST-AFIT CONTINUOUS SCORES ON THE THINKING/FEELING DIMENSION FOR LOGISTICS MANAGEMENT AND NON-LOGISTICS MANAGEMENT MAJORS

	GLM STUDENTS POST - PRE T/F	NON-GLM STUDENTS POST - PRE T/F
MEAN	-1.28	-6.24
STD ERROR	1.81	1.73
T	-0.71	-3.60
DF	101	98
P	0.482	0.0005***

NOTE: GLM = GRADUATE LOGISTICS MANAGEMENT
* p<.05, ** p<.01, *** p<.001

students, but no significant shift towards thinking or feeling for the GLM students. Whether there was an influence by individual options within the Logistics Management program cannot be determined from this data since the options were not separately identified.

To summarize investigative question 2, there was a significant shift towards thinking for those who majored in

programs other than Logistics Management, while the Logistics Management majors showed no significant shift in either direction on the T/F dimension. No other significant differences existed between shifts in any of the dimensions for the various program options. Based on the lack of a shift towards thinking by the Logistics Management majors, the null hypothesis is rejected and the alternate hypothesis accepted. The alternate hypothesis stated that students in any option were more likely than students in other options to change psychological type while at AFIT.

Investigative Question 3. Investigative question 3 asked whether changes in type while students were enrolled in the AFIT graduate program differed by the year of enrollment. By comparing the shift in student type with the year of enrollment, it can be determined whether any year was more influential in the shift than other years.

The survey response, by year, was shown in Table 4.1 above. Table 4.17 details the correlation between the shift in each type dimension while at AFIT and the year of graduation. As can be seen, only the 1986 shifts in the E/I and S/N dimensions were significantly correlated with year of graduation.

Table 4.18 shows the results of paired t-tests comparing the pre-AFIT and post-AFIT scores on the E/I and S/N dimensions for the 1986 graduates and those graduating in the other years. There was a significant shift towards extraversion by those who graduated in 1986, but no

TABLE 4.17

CORRELATION OF CHANGE IN TYPE FROM PRE-AFIT TO POST-AFIT SURVEYS WITH YEAR OF GRADUATION (N=427)

YEAR OF GRADUATION	POST - PRE E/I	POST - PRE S/N	POST - PRE T/F	POST - PRE J/P
1986	-0.1331**	-0.1337**	-0.0771	-0.0079
1987	0.0080	0.0438	0.0160	-0.0197
1988	0.0318	0.0888	0.0445	-0.0350
1989	0.0866	0.0071	0.0164	0.0567

NOTE: * p<.05, ** p<.01, *** p<.001

TABLE 4.18

PAIRED T-TESTS FOR CHANGES FROM PRE-AFIT TO POST-AFIT CONTINUOUS SCORES ON THE E/I AND S/N DIMENSIONS FOR STUDENTS WHO GRADUATED IN 1986 AND THOSE WHO GRADUATED IN 1987, 1988, OR 1989 (N=427)

	86 GRADUATES POST - PRE E/I	NON-86 GRADUATES POST - PRE E/I	86 GRADUATES POST - PRE S/N	NON-86 GRADUATES POST - PRE S/N
MEAN	-3.69	1.26	-4.18	2.22
STD ERROR	1.63	0.86	1.96	1.09
T	-2.26	1.47	-2.13	2.04
DF	101	324	101	324
P	0.026*	0.144	0.036*	0.042*

NOTE: * p<.05, ** p<.01, *** p<.001

significant shift towards extraversion or introversion for those who graduated in the other years. Likewise, there was a significant shift towards sensing for those who graduated in 1986, while those who graduated in 1987, 1988, or 1989 showed a significant shift towards intuition. No other shifts in type dimension were significantly correlated with year of graduation. Due to the significant correlation

between change in type and 1986, the null hypothesis is rejected and the alternate hypothesis accepted. The alternate hypothesis stated that there were differences in the change in students' psychological types from year to year.

Investigative Question 4. Investigative question 4 asked whether changes in type while at AFIT differed by the demographics (sex, age, military status/rank) of the students. By comparing the changes in type dimensions while the students were enrolled at AFIT with their demographic data, it can be determined whether some demographic groups were more likely than others to change type.

Tables 4.2, 4.3, and 4.4 above detail the response rates by sex, age, and military status/rank respectively. Table 4.19, shows the correlations between changes in type while at AFIT and sex, age, and military status/rank.

There was a significant correlation between the subjects' gender and the shift in the T/F dimension, and between civilians and the shift in the J/P dimension. The nature of these shifts is more easily seen in Table 4.20 which details the results of paired t-tests on the T/F shift by gender and the J/P shift by civilian/military status. There was a significant shift towards thinking for the male students, but no significant shift towards thinking or feeling for the female students. Likewise, there was a significant shift towards perception for the military officers, but no significant shift for the civilians. No

TABLE 4.19

CORRELATION OF CHANGES IN TYPE FROM PRE-AFIT TO POST-AFIT SURVEYS WITH SEX, AGE, AND MILITARY STATUS/RANK (N=427)

	POST - PRE E/I	POST - PRE S/N	POST - PRE T/F	POST - PRE J/P
SEX	-0.0812	0.0599	-0.1375**	0.0189
AGE	0.0205	0.0503	-0.0177	-0.0352
USAF OFFICER				
2 LT	-0.0043	0.0565	0.0110	0.0119
1 LT	0.0057	0.0019	0.0518	0.0082
CAPT	0.0224	-0.0387	-0.0463	0.0266
MAJOR	0.0320	0.0618	-0.0571	0.0203
USAF CIVILIAN	0.0189	0.0046	0.0180	-0.1376**
OTHER US MIL	-0.0594	0.0092	-0.0183	0.0665
ALLIED MIL	-0.0765	0.0095	0.0292	0.0166

NOTE: * p<.05, ** p<.01, *** p<.001

TABLE 4.20

PAIRED T-TESTS FOR CHANGES FROM PRE-AFIT TO POST-AFIT CONTINUOUS SCORES FOR FEMALES AND MALES ON THE T/F DIMENSION AND FOR CIVILIANS AND MILITARY OFFICERS ON THE J/P DIMENSION

	FEMALES POST - PRE T/F	MALES POST - PRE T/F	CIVILIANS POST - PRE J/P	MILITARY POST - PRE J/P
MEAN	2.00	-4.63	-6.83	3.95
STD ERROR	2.56	0.86	3.73	0.98
T	0.78	-5.40	-1.83	4.03
DF	62	363	28	396
P	0.437	0.0000***	0.078	0.0001***

NOTE: * p<.05, ** p<.01, *** p<.001

other changes in any type dimension were significantly correlated with the demographics sex, age, or military

status/rank. However, due to the significant correlations between change in type and the demographics sex and civilian status, the null hypothesis is rejected and the alternate accepted. The alternate hypothesis stated that students in one demographic group were more likely than students in other demographic groups to change psychological type while at AFIT.

Investigative Question 5. Investigative question 5 asked whether the shift in type while at AFIT was dependent on the psychological type of the students when they entered the program. By comparing the changes in type while at AFIT with pre-AFIT type, it can be determined whether some types were more likely to change than other types.

Table 4.21 presents the correlation between the shift in type dimensions while enrolled at AFIT and the continuous type scores for each dimension as measured with the pre-AFIT MBTI. As can be seen, there was an inverse relationship between each dimension of pre-AFIT type and the change in that dimension while at AFIT. Students tended to shift towards the opposite dimensions while at AFIT. In addition, there was a significant relationship between pre-AFIT type in the E/I dimension and changes in the S/N dimension while at AFIT. The more a student preferred introversion when he or she arrived at AFIT, the greater the student tended to shift his or her preference towards intuition.

TABLE 4.21

CORRELATION OF CHANGES IN TYPE FROM PRE-AFIT TO POST-AFIT SURVEYS WITH PRE-AFIT CONTINUOUS TYPE DIMENSION SCORES (N=427)

PRE-AFIT TYPE DIMENSION	POST-PRE E/I	POST-PRE S/N	POST-PRE T/F	POST-PRE J/P
E/I	-0.2812***	0.1046*	0.0415	0.0651
S/N	-0.0407	-0.2167***	0.0179	0.0845
T/F	-0.0433	0.0768	-0.3109***	-0.0151
J/P	-0.0108	0.0172	-0.0114	-0.2872***

NOTE: * p<.05, ** p<.01, *** p<.001

Table 4.22 provides a more detailed look at the relationship between type upon entering AFIT and the shift in type while at AFIT. First, extraverts showed a statistically significant shift towards introversion ($p < .01$), while introverts shifted significantly towards extraversion ($p < .01$). Second, sensing types shifted towards a preference for intuition and intuitive types shifted towards a preference for sensing. However, neither of these shifts were statistically significant. Third, feeling types showed a significant shift towards a preference for thinking ($p < .001$), while thinking types also showed a significant shift towards a greater preference for thinking ($p < .05$). However, the magnitude of the shift for feeling types was almost four times greater than the magnitude of the shift for the thinking types (a mean shift of -10.16 for feeling types and of - 2.31 for thinking types). Fourth, judging types shifted significantly towards a preference for perception ($p < .001$), while perceptive

TABLE 4.22

PAIRED T-TESTS FOR CHANGES FROM PRE-AFIT TO POST-AFIT CONTINUOUS SCORES FOR THOSE PRE-AFIT TYPES WHICH WERE CORRELATED WITH CHANGES IN TYPE WHILE AT AFIT (N=427)

	POST-AFIT - PRE-AFIT PAIRED T-TEST					
PRE-AFIT TYPE	DIMENSION	MEAN	STD ER	T	DF	P
EXTRAVERSION	E/I	4.34	1.29	3.36	158	.001**
INTROVERSION	E/I	-2.45	0.92	-2.66	267	.008**
EXTRAVERSION	S/N	-1.78	1.67	-1.08	158	.282
INTROVERSION	S/N	2.17	1.16	1.87	267	.062
SENSING	S/N	2.28	1.19	1.92	275	.056
INTUITION	S/N	-2.20	1.61	-1.36	150	.175
THINKING	T/F	-2.31	0.89	-2.59	353	.010*
FEELING	T/F	-10.16	2.04	-4.98	72	.000***
JUDGEMENT	J/P	6.18	1.02	6.06	302	.000***
PERCEPTION	J/P	-4.07	2.00	-2.03	123	.045*

NOTE: * p<.05, ** p<.01, *** p<.001

types shifted significantly towards a preference for judging ($p < .05$). Finally, though neither shift was statistically significant, there was a trend by extraverts to shift towards sensing and by introverts to shift towards intuition.

The relationship between the shift in type while at AFIT and the dominant function of the students when they arrived was also analyzed. It would be possible for a J/P shift to mask a significant relationship between pre-AFIT dominant function and the shift in type. For example, if the AFIT environment had encouraged the development of judgement as the dominant function in all students, a shift by those who preferred judgement towards perception and by those who preferred perception towards judgement would have been likely. Extraverted judging types and introverted

perceiving types entered the program with judgement as their dominant function, so little or no shift would have been likely from the influence of the AFIT environment. Extraverted perceiving types and introverted judging types, however, would have entered the program with perception as their dominant function, so would have been more likely to shift preferences as a result of the AFIT environment. In order to make judgement their dominant function, the extraverted perceiving types would have shifted towards judgement while the introverted judging types would have shifted towards perception. This would have resulted in a net shift by perceiving types towards judgement and by judgement types towards perception.

Table 4.23 shows that there was no shift towards a particular dominant function. Those who entered with judgement as the dominant function shifted significantly towards perception as the dominant function, while those who entered with perception as the dominant function shifted significantly towards judgement as the dominant function. These data confirm the above data which showed a significant shift towards the opposite end of the J/P dimension while at AFIT.

Due to the significance of the correlation between the psychological type of the students upon entering AFIT in each of the four type dimensions and the change in type while at AFIT, the null hypothesis for investigative question 5 is rejected, and the alternate hypothesis

TABLE 4.23

PAIRED T-TEST RESULTS OF THE CHANGE IN DOMINANT FUNCTION FROM PRE-AFIT TO POST-AFIT SURVEYS (N=427)

TYPE	PRE-AFIT DOMINANT FUNCTION	POST - PRE PAIRED T-TEST MEAN	T	DF	P	DOMINANT FUNCTION CHANGED TOWARDS
EJ	JUDGEMENT	5.29	3.40	115	0.0009***	PERCEPTION
EP	PERCEPTION	-9.54	-3.01	42	0.004**	JUDGEMENT
IP	JUDGEMENT	-1.16	-0.46	80	0.646	PERCEPTION
IJ	PERCEPTION	6.74	5.01	186	0.0000***	JUDGEMENT

NOTE: * p<.05, ** p<.01, *** p<.001

accepted. The alternate hypothesis stated that students of one psychological type were more likely than students of another type to change psychological types while at AFIT.

Summary of Research Question #1. The null hypothesis was rejected for each of the five investigative questions. Students who attended the graduate program changed psychological type towards thinking and perception while at AFIT. Students enrolled in the Graduate Logistics Management program were less likely to increase their preference for thinking than students of other programs. Students who graduated in 1986 were more likely to increase their preference for extraversion and sensing than students who graduated in 1987, 1988, or 1989. Males were more likely than females to increase their preference for thinking, while civilians were less likely than military officers to increase their preference for perception.

Finally, type tended to shift towards the opposite type on each dimension.

Research Question #1 was dependent primarily on investigative question 1. There was a significant shift in type towards thinking and towards perception while students were enrolled at AFIT. Since the development of critical thinking dispositions has been linked to development of type, it can be concluded from this data that the critical thinking dispositions associated with thinking and perception were developed at AFIT. Therefore, the null hypothesis for Research Question #1 is rejected and the alternate accepted. The alternate hypothesis was that critical thinking dispositions were developed in students of the AFIT/LS graduate program.

Research Question #2

Research Question #2 asked whether the critical thinking dispositions developed at AFIT were retained by the students after they returned to the Air Force work environment. This research question was only relevant if the null hypothesis for Research Question #1 was not accepted. Investigative question 6 was critical to answering the research question, while investigative questions 7-12 analyzed what factors affected the retention of the critical thinking dispositions, and only applied if the null hypothesis for Research Question #2 was rejected.

Sample #2 Demographic Data. Sample #2 included all those graduate students enrolled in the program between 1986

and 1989 who completed the pre-AFIT and post-AFIT MBTIs. This sample was used to answer Research Question #2 and its seven investigative questions. Sample #2 is a subset of sample #1, the original 427 students who completed the pre-AFIT and post-AFIT surveys.

Of the 427 students who completed both pre- and post-AFIT MBTIs, 343 (80 percent of the sample) were surveyed with the follow-up MBTI. The civilians, other US military officers, and allied military officers were not surveyed. In addition, 30 of original USAF officers were no longer in the Air Force, so were not surveyed.

The follow-up survey was returned by 201 of the 343 who were sent surveys, for a response rate of 58.6 percent. This represented 47.1 percent of the original 427 in the sample, and 31.5 percent of the 639 students enrolled in the program during those four years. The response rate is shown by year of graduation from AFIT in Table 4.24 and by gender in Table 4.25.

TABLE 4.24

FOLLOW-UP SURVEY RESPONSE RATE BY GRADUATION YEAR

GRADUATING YEAR	# FOLLOW-UP SURVEYS MAILED	# FOLLOW-UP SURVEYS RETURNED	RESPONSE RATE
1986	77	44	57.1%
1987	67	36	53.7%
1988	80	47	58.8%
1989	119	74	62.2%
TOTALS:	343	201	

TABLE 4.25

FOLLOW-UP SURVEY RESPONSE RATE BY GENDER (N=201)

SEX	# FOLLOW-UP SURVEYS MAILED	# FOLLOW-UP SURVEYS RETURNED	RESPONSE RATE
FEMALE	49	30	61.2%
MALE	294	171	58.2%
TOTALS:	343	201	

Of the 201 who returned the follow-up survey 14.9 percent, were female and 85.1 percent, were male, as Table 4.25 shows. These percentages are almost identical to those of the entire 427 who completed the pre- and post-AFIT surveys.

Table 4.26 shows the ages at which those who completed the follow-up survey entered the AFIT graduate program. Ages ranged from 25 to 43 with 65.2 percent between the ages of 26 and 31.

Table 4.27 shows the ranks, upon entering AFIT, of those who completed the pre-, post-, and follow-up surveys. Note that this table does not include civilians, officers of other US military organizations, or officers of allied countries, since they were not included in sample #2.

Finally, Table 4.28 details the frequency distribution of the sample by program. Programs which were offered at AFIT between 1986 and 1989 included Engineering Management, Systems Management, Cost Analysis, Logistics Management, and Information Resource Management. Logistics Management included several different majors within the curriculum

TABLE 4.26

AGES, UPON ENTERING AFIT, OF THOSE WHO COMPLETED FOLLOW-UP SURVEY (N=201)

AGE	FREQUENCY	PERCENT OF TOTAL
25	5	2.5
26	23	11.4
27	20	10.0
28	23	11.4
29	16	8.0
30	20	10.0
31	29	14.4
32	15	7.5
33	10	5.0
34	10	5.0
35	10	5.0
36	5	2.5
37	8	4.0
38	2	1.0
39	3	1.5
40	1	0.5
43	1	0.5
TOTALS:	201	100.0

TABLE 4.27

RANK UPON ENTERING AFIT OF THOSE WHO COMPLETED THE FOLLOW-UP MBTI (N=201)

RANK	FREQUENCY	PERCENT OF TOTAL
SECOND LIEUTENANT	1	0.5
FIRST LIEUTENANT	77	38.3
CAPTAIN	117	58.2
MAJOR	6	3.0
TOTALS:	201	100.0

including maintenance Management, Supply Management, Transportation Management, Acquisition Logistics Management, Contracting Management and Logistics Management.

The 201 students who completed the pre-AFIT, post-AFIT, and follow-up MBTI surveys is a subset of the 427 students

TABLE 4.28

AFIT GRADUATE PROGRAM OF THOSE WHO COMPLETED THE PRE-AFIT, POST-AFIT, AND FOLLOW-UP MBTIs (N=195)

PROGRAM	FREQUENCY	PERCENT OF TOTAL
ENGINEERING MANAGEMENT	27	13.9
SYSTEMS MANAGEMENT	39	20.0
COST ANALYSIS	19	9.7
LOGISTICS MANAGEMENT	102	52.3
INFORMATION RESOURCE MGMT	8	4.1
TOTALS:	195	100.0

NOTE: THE PROGRAM IN WHICH SIX OF THE STUDENTS WERE ENROLLED IS UNKNOWN.

who completed the pre-AFIT and post-AFIT surveys. In order to extrapolate the results from the 201 students to the entire 427 students, it must first be shown that the two samples are similar. Since civilians, officers of other branches of DOD and allied military officers were excluded from the follow-up survey, the follow-up sample may not have been representative of the larger sample. In addition, if the 40 percent of those surveyed with the follow-up MBTI who did not respond were of a particular demographic group or psychological type, the resulting data could have been further skewed by a non-representative sample.

In order to ensure that the 201 who returned the follow-up survey were representative of the entire sample, chi-square tests were performed to compare the sex, age, and graduating year distributions of the two samples. Chi-square tests compare the distributions of two samples and test whether the two samples are homogeneous or

heterogeneous. The null hypothesis is that the two samples are homogeneous. Table 4.29 shows the results of these tests. The null hypothesis, that the two samples are homogeneous, is accepted for sex, age, and year of graduation. Therefore, even though civilians, officers of other branches of DOD, and foreign military officers were excluded from the follow-up sample, the two samples are statistically the same on the basis of sex, age, and graduating year of those responding.

TABLE 4.29

CHI-SQUARE TEST RESULTS COMPARING DEMOGRAPHICS OF THOSE WHO COMPLETED FOLLOW-UP SURVEY WITH THOSE WHO COMPLETED PRE-AFIT AND POST-AFIT SURVEYS (N=201)

	OVERALL CHI SQUARE	DEGREES OF FREEDOM	P VALUE
SEX	0.003	1	0.9550
AGE	7.749	19	0.9890
YEAR OF GRADUATION	2.826	3	0.4193

Chi-square tests were also completed to determine whether the pre-AFIT and post-AFIT psychological types of those who completed the follow-up survey were representative of the entire sample. If some types were more or less likely to respond to the follow-up survey than other types, the resulting sample would not be representative of the entire group. However, if the pre-AFIT and post-AFIT type distributions of those who returned the follow-up survey were representative of the entire group, then the data

obtained from the follow-up survey could be applied to the entire group.

Table 4.30 presents the results of the chi-square tests comparing the pre-AFIT and post-AFIT psychological types of the two samples. For both the pre-AFIT and post-AFIT surveys, the null hypotheses were not rejected, and the two samples were statistically homogeneous. From these tests, it can be concluded that the sample of 201 who completed the follow-up survey was an accurate representation of the psychological types of the entire group.

TABLE 4.30

CHI-SQUARE TEST RESULTS COMPARING PSYCHOLOGICAL TYPES OF THOSE WHO COMPLETED FOLLOW-UP SURVEY WITH THOSE WHO COMPLETED PRE-AFIT AND POST-AFIT SURVEYS (N=201)

	OVERALL CHI SQUARE	DEGREES OF FREEDOM	P VALUE
PRE-AFIT TYPE	3.065	15	0.9995
POST-AFIT TYPE	4.732	15	0.9942

Investigative Question 6. Investigative question 6 asked whether there were differences in the post-AFIT and follow-up psychological types of the students. By comparing the psychological types of the students when they left AFIT with their type several years later, it can be determined whether the changes in type that occurred while at AFIT were retained by the students or whether some other preferences were developed.

Table 4.31 details the type distribution of the sample based on the follow-up survey. As with the pre-AFIT type distribution, ISTJs were over-represented compared to with the general population, and all of the feeling types were under-represented.

TABLE 4.31

TYPE DISTRIBUTION AS MEASURED BY THE FOLLOW-UP MBTI (N=201)

ISTJ 66 32.8%	**ISFJ** 6 3.0%	**INFJ** 2 1.0%	**INTJ** 21 10.4%
ISTP 13 6.5%	**ISFP** 2 1.0%	**INFP** 2 1.0%	**INTP** 17 8.5%
ESTP 7 3.5%	**ESFP** 0 0.0%	**ENFP** 9 4.5%	**ENTP** 3 1.5%
ESTJ 32 15.9%	**ESFJ** 6 3.0%	**ENFJ** 3 1.5%	**ENTJ** 12 6.0%

Table 4.32 shows the frequency of each type dimension in the follow-up survey. These frequencies were very similar to the frequencies measured in the pre-AFIT survey, and again varied significantly from the general population, with a greater frequency of introversion, thinking, and judgement types than would be expected from the general population.

The summary of changes in type while at AFIT and after leaving AFIT for those who completed the follow-up survey

TABLE 4.32

FREQUENCY OF EACH TYPE DIMENSION IN FOLLOW-UP SURVEY (N=201)

E/I			S/N		
	NUMBER	PERCENT		NUMBER	PERCENT
E:	72	35.8	S:	132	65.7
I:	129	64.2	N:	69	34.3
T/F			**J/P**		
	NUMBER	PERCENT		NUMBER	PERCENT
T:	171	85.1	J:	148	73.6
F:	30	14.9	P:	53	26.4

are shown in Tables 4.33 and 4.34. Table 4.33 presents the same data shown in Table 4.9 above, but only includes those who returned follow-up surveys. Table 4.34 details the shifts in type by the students since leaving AFIT. The greatest shifts after leaving AFIT were out of ENTP (-9), and ISTP (-11) and into ENFP (+7), ISTJ (+7), and INTJ (+7). The shifts in and out of these types were in the opposite direction while students were at AFIT. While at AFIT, the greatest shifts were into ENTP (+6) and ISTP (+6), and out of ISFJ (-7) and INTJ (-5).

Table 4.35 provides a clearer picture of the changes while at AFIT and after leaving the program. While at AFIT, there was a net gain of seven for thinking and 11 for perception. After leaving the program, there was a slight shift back towards feeling (a net increase of 2), and a

TABLE 4.33

SUMMARY OF CHANGES IN TYPE WHILE AT AFIT FOR THOSE WHO COMPLETED FOLLOW-UP SURVEY (N=201)

TYPE	PRE-AFIT SURVEY	SWITCHED INTO	SWITCHED OUT OF	POST-AFIT SURVEY	NET CHANGE
ESTJ	28	15	10	33	+5
ESTP	8	4	5	7	-1
ESFJ	5	1	2	4	-1
ESFP	3	0	2	1	-2
ENTJ	14	6	9	11	-3
ENTP	6	8	2	12	+6
ENFJ	2	0	2	0	-2
ENFP	3	0	1	2	-1
ISTJ	60	22	23	59	-1
ISTP	18	10	4	24	+6
ISFJ	13	2	9	6	-7
ISFP	1	1	0	2	+1
INTJ	19	6	11	14	-5
INTP	13	6	6	13	0
INFJ	4	4	1	7	+3
INFP	4	5	3	6	+2
TOTALS:	201	90	90	201	0

TABLE 4.34

SUMMARY OF CHANGES IN TYPE AFTER LEAVING AFIT FOR THOSE WHO COMPLETED PRE-AFIT AND POST-AFIT SURVEYS (N=201)

TYPE	POST-AFIT SURVEY	SWITCHED INTO	SWITCHED OUT OF	FOLLOW-UP SURVEY	NET CHANGE
ESTJ	33	16	17	32	-1
ESTP	7	5	5	7	0
ESFJ	4	4	2	6	+2
ESFP	1	0	1	0	-1
ENTJ	11	10	9	12	+1
ENTP	12	2	11	3	-9
ENFJ	0	3	0	3	+3
ENFP	2	7	0	9	+7
ISTJ	59	27	20	66	+7
ISTP	24	4	15	13	-11
ISFJ	6	3	3	6	0
ISFP	2	1	1	2	0
INTJ	14	14	7	21	+7
INTP	13	9	5	17	+4
INFJ	7	2	7	2	-5
INFP	6	1	5	2	-4
TOTALS:	201	108	108	201	0

large shift back towards judging (a net shift of 14). After leaving the program, there was also a slight shift towards intuition (a net gain of 4) and a slight shift towards extraversion (a net gain of 2).

TABLE 4.35

SUMMARY OF CHANGES, BY TYPE DIMENSION, WHILE AT AFIT FOR THOSE WHO COMPLETED PRE-AFIT AND POST-AFIT SURVEYS (N=201)

E/I	PRE TO POST	POST TO FOLLOWUP	S/N	PRE TO POST	POST TO FOLLOWUP
E --> I:	14	19	S --> N:	15	22
I --> E:	15	21	N --> S:	15	18
NET:	+ 1E	+ 2E	NET:	0	+ 4N
T/F	**PRE TO POST**	**POST TO FOLLOWUP**	**J/P**	**PRE TO POST**	**POST TO FOLLOWUP**
T --> F:	11	14	J --> P:	22	15
F --> T:	18	12	P --> J:	11	29
NET:	+ 7T	+ 2F	NET:	+11P	+14J

An analysis of the type dimension continuous scores provides additional information which cannot be obtained from the type data itself. The type data shows changes in preferences that result in a change in type, while the continuous scores can also identify changes in preferences which do not result in a change in type. A summary of continuous score data for the follow-up survey is shown in Table 4.36.

A comparison of the means from the follow-up survey with those from the pre-AFIT and post-AFIT surveys (Tables

TABLE 4.36

SUMMARY OF CONTINUOUS SCORES OF FOLLOW-UP MBTI (N=201)

	E/I	S/N	T/F	J/P
CASES	201.00	201.00	201.00	201.00
MEAN	109.80	88.18	75.22	81.96
S. D.	26.17	30.02	22.90	26.40
MEDIAN	113.00	87.00	73.00	75.00
MINIMUM	49.00	35.00	35.00	45.00
MAXIMUM	157.00	151.00	165.00	161.00

4.11 and 4.12) shows that for the E/I dimension and the S/N dimension, the means stayed relatively constant. For the T/F dimension the mean changed from 79 to 75 while at AFIT and remained at 75 after leaving. For the J/P dimension, the mean shifted from 85 to 88 while at AFIT, then back to 82 after leaving the program.

The paired t-test analysis done for Research Question #1 confirmed that the pre- to post-AFIT shifts from feeling to thinking and from judgement to perception were significant (see Table 4.13 above). A paired t-test analysis was performed on the follow-up data to determine whether there were significant shifts in the T/F and J/P dimensions from the post-AFIT to follow-up surveys. These results are shown in Table 4.37.

The paired t-tests confirm that, after leaving AFIT, there was a significant change in student preference towards judgement, but no significant change in preference for any of the other dimensions. This means that the change in preference towards thinking while at AFIT was not reversed

TABLE 4.37

PAIRED T-TESTS FOR POST-AFIT TO FOLLOW-UP CONTINUOUS SCORES (N=201)

	FOLLOW-UP - POST-AFIT			
	E/I	S/N	T/F	J/P
MEAN	0.18	1.38	0.01	-4.21
STD ERROR	1.31	1.52	1.56	1.60
T	0.14	0.91	0.06	-2.63
DF	200	200	200	200
P	0.891	0.363	0.949	0.009**

NOTE: * p<.05, ** p<.01, *** p<.001

after leaving the program, while the change in preference towards perception while at AFIT was reversed after returning to the Air Force work environment.

These findings are further confirmed by comparing student preferences when they entered AFIT with their preferences after returning to the work environment. Table 4.38 shows the results of paired t-tests of the pre-AFIT type scores with the follow-up type scores. These t-tests show that the only significant long term shift in preferences that occurred in students who attended AFIT was an increased preference for thinking over feeling. This is consistent with the above results which showed a shift towards thinking and perception while at AFIT, but a shift away from perception after leaving AFIT. Only the increased preference for thinking is retained after returning to the Air Force work environment.

Since there was a significant difference between the post-AFIT and follow-up psychological types of students in

TABLE 4.38

PAIRED T-TESTS FOR PRE-AFIT TO FOLLOW-UP CONTINUOUS SCORES (N=201)

	FOLLOW-UP - PRE-AFIT			
	E/I	S/N	T/F	J/P
MEAN	1.38	1.84	-3.62	-1.32
STD ERROR	1.33	1.63	1.57	1.64
T	1.04	1.13	-2.31	-0.80
DF	200	200	200	200
P	0.300	0.261	0.022*	0.423

NOTE: * p<.05, ** p<.01, *** p<.001

the J/P dimension, the null hypothesis for investigative question 6 is rejected, and the alternate hypothesis accepted. The alternate hypothesis stated that there were differences between the current and post-AFIT psychological types of students who graduated from the AFIT program.

Investigative Question 7. Investigative question 7 asked whether the changes in type which occurred after the students left AFIT were dependent on the program option the student was enrolled in. By comparing changes in type continuous scores with program option, it can be determined whether any option resulted in changes in type preferences that were retained more or less strongly than for the other program options.

Table 4.39 details the correlations between program option and changes in type dimensions after leaving AFIT. None of the correlations is significant, so no program was more or less likely than any other to result in changes to type after leaving AFIT. Therefore, the null hypothesis for

TABLE 4.39

CORRELATION OF CHANGE IN TYPE FROM POST-AFIT TO FOLLOW-UP SURVEYS WITH AFIT GRADUATE PROGRAM (N=201)

PROGRAM	FOLLOW-UP - POST-AFIT E/I	S/N	T/F	J/P
ENGINEERING MGMT	0.0928	0.0074	0.0260	0.0147
SYSTEMS MGMT	-0.0518	-0.0157	-0.0507	0.0449
COST ANALYSIS	-0.0257	0.0217	-0.0382	0.0559
LOGISTICS MGMT	-0.0022	0.0068	0.0728	-0.0583
INFO RESOURCE MGMT	-0.0508	-0.0171	0.0050	-0.0445

NOTE: * p<.05, ** p<.01, *** p<.001 (NO SIGNIFICANT CORRELATIONS)

investigative question 7 in not rejected. The null hypothesis stated that changes from post-AFIT to current psychological types did not differ by program option.

Investigative Question 8. Investigative question 8 asked whether changes in type after leaving AFIT differed by the year of graduation. By comparing changes in type with the year of graduation, it can be determined whether students of a particular graduating year were more likely than those of the other years to maintain the type preferences that were developed while at AFIT.

Table 4.40 presents the correlations between change in type after leaving the program and the year of graduation. The only statistically significant correlation between year of graduation and change in type after leaving AFIT occurred for those who graduated in 1986. The class of 1986 was significantly correlated with a shift towards introversion.

TABLE 4.40

CORRELATION OF CHANGE IN TYPE FROM POST-AFIT TO FOLLOW-UP SURVEYS WITH YEAR OF GRADUATION (N=201)

YEAR OF GRADUATION	FOLLOW-UP - POST-AFIT E/I	S/N	T/F	J/P
1986	0.1420*	0.0171	0.0580	-0.0074
1987	-0.0068	0.0213	-0.0015	0.0158
1988	-0.0942	-0.1028	-0.0671	-0.0511
1989	-0.0344	0.0018	0.0099	0.0383

NOTE: * p<.05, ** p<.01, *** p<.001

This shift can be seen from the results of the paired t-tests for 1986 and non-1986 graduates shown in Table 4.41. While neither shift is significant, there was a shift by those who graduated in 1986 towards introversion and by those who graduated in other years towards extraversion. Note from Table 4.16 above that the 1986 graduates shifted significantly towards extraversion while at AFIT. So, while enrolled in the program, the class of 1986 became more extraverted, but after the students returned to the work environment they shifted back towards introversion. No other significant relationship existed between year of graduation and change in type after leaving the program.

Since there was a significant difference in the change in type for the E/I dimension between the class of 1986 and the other graduating classes, the null hypothesis for investigative question 8 is rejected. The alternate hypothesis stated that changes from post-AFIT to current psychological types differed by year.

TABLE 4.41

PAIRED T-TESTS FOR PRE-AFIT TO FOLLOW-UP CONTINUOUS SCORES (N=201)

	1986 GRADUATES FOLLOW-POST E/I	NON-1986 GRADUATES FOLLOW-POST E/I
MEAN	5.05	-1.19
STD ERROR	2.64	1.49
T	1.91	-0.80
DF	43	156
P	0.063	0.427

NOTE: * p<.05, ** p<.01, *** p<.001

Investigative Question 9. Investigative question 9 asked whether changes in type which occurred after students left AFIT were affected by the demographics of the students. By comparing the changes in type with the sex, age, and rank of the students, it can be determined whether these demographic variables had an impact on the change in type after leaving AFIT. Since this sample consisted entirely of Air Force officers, the affect of military/civilian status on changes in type could not be judged.

Table 4.42 shows the correlations between changes in each type dimension since leaving AFIT and sex, age, and rank of the students. There were no significant correlations between the shift in type after leaving AFIT and sex, age, or rank. However, the p-value for rank and the J/P dimension was p = .0571, not low enough to declare the correlation significant, but low enough to signify that a relationship might exist. If this relationship does

TABLE 4.42

CORRELATION OF CHANGES IN TYPE FROM POST-AFIT TO FOLLOW-UP SURVEYS WITH SEX, AGE, AND RANK (N=201)

	FOLLOW-UP - POST-AFIT			
	E/I	S/N	T/F	J/P
SEX	-0.1504	0.0150	-0.0364	0.0114
AGE	0.0449	-0.0104	0.1049	0.0095
RANK	0.0282	-0.0420	0.0716	0.1348

NOTE: * p<.05, ** p<.01, *** p<.001 (NO SIGNIFICANT CORRELATIONS)

exist, it signifies that as rank increases, the preference for perception over judgement increases. However, since no significant difference existed for any of the demographics, the null hypothesis for investigative question 9 is not rejected. The null hypothesis stated that changes from post-AFIT to current psychological types did not differ by the demographics of the students.

Investigative Question 10. Investigative question 10 asked whether the changes in type which occurred after students left AFIT were dependent on their type when they left AFIT. By comparing the post-AFIT type scores for each student with changes in type which occurred after they left the program, it can be determined whether certain types were more likely than others to change type preferences after leaving AFIT.

The correlations between post-AFIT type and change in type after leaving the program are detailed in Table 4.43. For each of the four dimensions, there was a significant

inverse correlation between post-AFIT type and the shift in type after leaving AFIT. Those who preferred extraversion while at AFIT shifted towards introversion; those who preferred sensing moved towards intuition; etc.

TABLE 4.43

CORRELATION OF CHANGES IN TYPE FROM POST-AFIT TO FOLLOW-UP SURVEYS WITH POST-AFIT CONTINUOUS TYPE DIMENSION SCORES (N=201)

POST-AFIT DIMENSION	FOLLOW-UP - POST-AFIT E/I	S/N	T/F	J/P
E/I	-0.3286***	0.1121	0.0255	0.0223
S/N	0.1606*	-0.2898***	-0.1547*	-0.1109
T/F	-0.0401	-0.1914**	-0.4584***	-0.0889
J/P	0.0642	-0.1717*	-0.0983	-0.5000***

NOTE: * p<.05, ** p<.01, *** p<.001

In addition, there were significant relationships between post-AFIT type and follow-up type in four other areas. First, there was a direct correlation between the post-AFIT S/N continuous score and the shift on the E/I dimension. Second, there was an inverse relationship between the post-AFIT S/N continuous score and the shift on the T/F dimension. Third, there was an inverse relationship between the post-AFIT T/F continuous score and the shift on the S/N dimension. And finally, there was an inverse relationship between the post-AFIT continuous score on the J/P dimension and the shift on the S/N dimension.

These shifts can be better understood by looking at the results of paired t-tests shown in Table 4.44. Those who

left AFIT as extraverts, shifted significantly towards introversion upon returning to the work environment ($p < .01$). Those who left as intuitive types shifted significantly towards introversion ($p < .05$) and towards a preference for sensing ($p < .05$), while those who left AFIT as sensing types shifted significantly towards a preference for intuition after returning to the work environment ($p < .05$). Students who left AFIT as feeling types shifted significantly towards a preference for thinking ($p < .01$). Finally, those who left AFIT as judgement types shifted significantly towards a preference for intuition ($p < .05$) and perception ($p < .05$), while perceptive types shifted significantly towards a preference for thinking ($p < .001$).

Table 4.45 presents the data from a different perspective. Rather than comparing shift in type after leaving AFIT with the type of the students when they left AFIT (as Table 4.44 does), Table 4.45 compares the shift in type after leaving AFIT with the shift in type while at AFIT. This data shows that a shift towards any preference other than judgement while at AFIT resulted in a significant shift in the opposite direction after leaving AFIT. Those students who shifted towards extraversion while at AFIT shifted significantly towards introversion after leaving ($p < .001$), while those who shifted towards introversion while at AFIT shifted significantly towards extraversion after leaving ($p < .01$). Likewise, those students who shifted towards sensing while at AFIT shifted significantly

TABLE 4.44

PAIRED T-TESTS FOR CHANGES FROM POST-AFIT TO FOLLOW-UP CONTINUOUS SCORES FOR THOSE POST-AFIT TYPES WHICH WERE CORRELATED WITH CHANGES IN TYPE AFTER LEAVING AFIT (N=201)

	FOLLOW-UP - POST-AFIT PAIRED T-TEST					
POST-AFIT TYPE	DIMENSION	MEAN	STD ER	T	DF	P
EXTRAVERSION	E/I	5.71	1.88	3.04	69	0.003**
INTROVERSION	E/I	-2.78	1.68	-1.65	130	0.101
SENSING	E/I	-1.78	1.69	-1.05	135	0.295
INTUITION	E/I	4.28	1.87	2.29	64	0.025*
SENSING	S/N	4.40	1.95	2.25	135	0.026*
INTUITION	S/N	-4.92	2.12	-2.32	64	0.024*
SENSING	T/F	2.18	1.90	1.13	135	0.259
INTUITION	T/F	-4.19	2.68	-1.56	64	0.123
THINKING	S/N	1.33	1.67	0.80	172	0.427
FEELING	S/N	1.71	3.52	0.49	27	0.630
THINKING	T/F	2.45	1.62	1.52	172	0.132
FEELING	T/F	-14.43	4.11	-3.51	27	0.002**
JUDGEMENT	S/N	4.02	1.88	2.13	133	0.035*
PERCEPTION	S/N	-3.88	2.45	-1.59	66	0.118
JUDGEMENT	J/P	3.40	1.63	2.08	133	0.039*
PERCEPTION	J/P	-19.43	2.68	-7.24	66	0.000***

NOTE: * p<.05, ** p<.01, *** p<.001

TABLE 4.45

PAIRED T-TESTS FOR CHANGES FROM POST-AFIT TO FOLLOW-UP CONTINUOUS SCORES BASED ON SHIFT IN TYPE WHILE AT AFIT (N=201)

WHILE AT AFIT	FOLLOW-UP - POST-AFIT PAIRED T-TEST					
SHIFTED TOWARD	DIMENSION	MEAN	STD ER	T	DF	P
EXTRAVERSION	E/I	7.02	1.70	4.13	83	0.000***
INTROVERSION	E/I	-5.76	1.83	-3.14	107	0.002**
SENSING	S/N	7.62	1.95	3.91	89	0.000***
INTUITION	S/N	-6.67	2.05	-3.26	92	0.002**
THINKING	T/F	6.70	1.79	3.73	117	0.000***
FEELING	T/F	-12.26	2.25	-5.46	68	0.000***
JUDGEMENT	J/P	2.23	2.59	0.86	87	0.392
PERCEPTION	J/P	-10.10	2.02	-5.00	101	0.000***

NOTE: * p<.05, ** p<.01, *** p<.001

towards intuition after leaving ($p < .001$), while those who shifted towards intuition at AFIT shifted significantly towards sensing after leaving ($p < .01$). Students who shifted towards a preference for thinking or feeling while at AFIT shifted significantly towards the opposite end of the dimension after leaving ($p < .001$). Finally, those who shifted towards perception at AFIT shifted significantly towards judgement after leaving ($p < .001$), while those who shifted towards judgement at AFIT did not show a significant shift back to perception after leaving. A shift towards a preference for any type other than judgement while at AFIT led to a significant shift away from that preference after returning to the work environment.

Since the changes in type after leaving AFIT were significantly correlated with type when students left AFIT, and with the direction of shift while at AFIT, the null hypothesis for investigative question 10 is rejected. The alternate hypothesis stated that changes from post-AFIT to current psychological types differed by the post-AFIT type of the students.

Investigative Question 11. Investigative question 11 asked whether changes in type since leaving AFIT were related to the current work environment. Questions on the amount of problem solving, creativity, stress, and socialization experienced at work were included in the environmental influences survey, which was part of the follow-up survey package. By comparing the levels of

problem solving, creativity, stress, and socialization on the job with changes in type since entering the work environment, it can be determined whether a relationship exists between these aspects of the work environment and the change in type while in that environment.

The correlations between these aspects of the work environment and changes in type since leaving AFIT are presented in Table 4.46. Work environments requiring high use of creativity were significantly correlated with increases in the preferences for intuition and perception. In addition, jobs with high stress were significantly correlated with an increase in the preference for thinking. Frequency of use of problem solving skills and socialization with co-workers were not significantly correlated with any changes in type.

TABLE 4.46

CORRELATION OF CHANGES IN TYPE FROM POST-AFIT TO FOLLOW-UP SURVEYS WITH VARIOUS ASPECTS OF THE WORK ENVIRONMENT (N=201)

FREQUENCY OF EXPERIENCE/USE	FOLLOW-UP - POST-AFIT			
ON THE JOB	E/I	S/N	T/F	J/P
PROBLEM SOLVING	0.0939	-0.1396	-0.0639	0.0179
CREATIVITY	-0.0907	0.1545*	0.1370	0.2221**
STRESS	0.0638	-0.0203	-0.1923*	0.0072
SOCIALIZATION	-0.0581	0.0413	0.1245	-0.0217

NOTE: * p<.05, ** p<.01, *** p<.001

Since significant changes in psychological type were related to the work environment variables creativity and stress, the null hypothesis for investigative question 11 is rejected. The alternate hypothesis was that work environment had an effect on changes from post-AFIT to current psychological types.

Investigative Question 12. Investigative question 12 asked whether there was a relationship between changes in type after leaving AFIT and changes in the home environment in the areas of change in marital status, birth of a child, death of a friend or relative, or change in some other aspect of life (health, spiritual, etc.). By comparing the changes in type since leaving AFIT with the changes in the home environment, it can be determined whether the changes in home environment were related to the changes in type.

Table 4.47 summarizes the correlations between changes in type after leaving AFIT and changes in marital status, birth of a child, death of a friend or relative, and changes in other aspects of life.

The death of a friend or relative was significantly correlated with a shift towards a preference for intuition over sensing. In addition, changes in other aspects of life (health, spiritual, etc.) were significantly correlated with a shift towards a preference for extraversion over introversion. Change in marital status and birth of a child were not significantly correlated with any changes in type. However, because death of a friend or relative and changes

TABLE 4.47

CORRELATION OF CHANGES IN TYPE FROM POST-AFIT TO FOLLOW-UP SURVEYS WITH VARIOUS ASPECTS OF THE HOME ENVIRONMENT (N=201)

	FOLLOW-UP - POST-AFIT			
CHANGES AT HOME	E/I	S/N	T/F	J/P
MARITAL STATUS	-0.0894	0.0427	0.1288	-0.0484
BIRTH OF CHILD	-0.1161	0.1244	0.0498	0.0928
DEATH IN FAMILY	-0.1294	0.1786*	0.2086	0.1275
OTHER	-0.1191*	0.1166	0.0675	0.0428

NOTE: * p<.05, ** p<.01, *** p<.001

in other aspects of life were significantly correlated with changes in type, the null hypothesis for investigative question 12 is rejected. The alternate hypothesis was that changes in the home environment of students influenced changes from post-AFIT to current psychological types.

Summary of Research Question #2. The null hypotheses were rejected for investigative questions 6, 8, 10, 11, and 12, but were not rejected for investigative questions 7 and 9. It was found that there was a significant difference between the post-AFIT and follow-up psychological types of students in the J/P dimension, with a significant shift towards judgement after leaving AFIT. No difference was found in the changes in type after leaving AFIT on the basis of program option. However, there was a significant difference in the shift in the E/I dimension between those who were enrolled in the program in 1986 and those who were enrolled in the other years. There was no significant correlation found between changes in type after leaving AFIT

and the demographic variables sex, age, and rank. Changes from post-AFIT to follow-up psychological types were found to differ, based on the post-AFIT psychological type of the students. Finally, changes in type since leaving AFIT were found to be significantly correlated with the level of creativity and stress on the job, and with the death of a friend or relative and changes in other aspects (health, spiritual, etc.) of a student's life.

Research Question #2 was dependent primarily on investigative question 6. There was a significant shift in type towards judgement and away from perception after the students left AFIT, but no change in the thinking/feeling dimension. Research Question #1 found that the critical thinking dispositions associated with thinking and perception were developed while the students were at AFIT. Investigative question 6 concluded that the change in preference towards perception which occurred while at AFIT was reversed once the students returned to the work environment, while the change in preference towards thinking while at AFIT was not reversed after returning to the work environment. Based on these findings, it is concluded that the critical thinking dispositions associated with thinking were retained, while those associated with perception were not retained after the students left AFIT. Therefore, the null hypothesis for Research Question #2, that the critical thinking dispositions developed at AFIT were not retained by

students, is rejected, since those associated with thinking were retained.

Summary

This chapter presented the data gathered using the methodology presented in chapter 3, and analyzed the data in order to answer the two research questions and twelve investigative questions. The null hypothesis was rejected for both research questions and all but two of the investigative questions. The next chapter will present the conclusions that were drawn, based on this data analysis.

V. Discussion and Conclusions

Introduction to the Chapter

This chapter presents a discussion of the findings detailed in the preceding chapter. The data are summarized and interpreted for each of the twelve investigative questions and two research questions. Finally, the relevant conclusions of this research effort are identified.

Research Question #1

Research Question #1 asked whether critical thinking dispositions were developed in students while enrolled in the AFIT/LS graduate program. Five investigative questions were relevant to this research question.

Investigative Question 1. The null hypothesis for investigative question 1 was that students who attended the graduate program maintained the same psychological type throughout the program. This hypothesis was rejected . There were significant shifts ($p < .001$) towards a preference for thinking over feeling and towards a preference for perception over judgement.

Type development theory says that changes in type occur throughout a person's life as the environment and experiences of life act to change the person's cognitive preferences. A random group of people would be expected to show no significant shift in type over a given time period, since the unique environment of each person would result in

different, often opposite, changes in type. Causation cannot be established between the AFIT program and changes in type. The influences of other aspects of students' environment could have been responsible for shifts in type. However, since these other environmental influences would likely be different for each student, the likelihood of a significant shift in type occurring without the influence of AFIT is small. The fact that there is a significant shift in type while at AFIT provides strong evidence that the AFIT environment was responsible for a shift in type.

The shift towards a preference for thinking over feeling indicates the influence of an environment that emphasized logical, objective decision-making instead of subjective, value-oriented decision-making. The classroom environment could have been intentionally set up to encourage logical, objective thinking, or these traits could have been encouraged inadvertently by instructor attitudes, types of homework assignments, materials emphasized on tests, etc. Whether this emphasis on logical, objective decision-making was consciously pursued or inadvertently created by the school and its faculty is impossible to determine from this research.

The shift towards a preference for the use of perception over judgement when interacting with the environment indicates the influence of an environment which emphasized a flexible, open-minded attitude instead of a systematic, decisive attitude. As with the shift towards

thinking, whether this emphasis was consciously pursued or inadvertently created by the school and its faculty cannot be determined from this research.

It should be noted that the shifts towards thinking and perception, while significant, were not large enough to drastically affect type. The average type score shifted less than four points for each of these dimensions. This was enough to result in a net shift of only seven out of 427 people (1.6 percent) from feeling types to thinking types and 22 out of 427 people (5.2 percent) from judgement types to perception types. What did occur significantly, however, was strengthening or weakening of the preferences. Those who started out with a strong preference for feeling shifted to a weaker preference for feeling, while those who started with a preference for thinking shifted to an even stronger preference for thinking. And, those who started with a strong preference for judgement shifted to a weaker preference, while those who started with a preference for perception developed a stronger preference for it. Only the few who had weak preferences for feeling or judgement actually shifted into the opposite type.

Investigative Question 2. The null hypothesis for investigative question 2 was that students in any one option were no more likely than students in other options to change type while at AFIT. The null hypothesis was rejected because there was a significant correlation ($p < .05$) between the shift on the T/F dimension and whether the

student majored in Graduate Logistics Management (GLM) or another program option. The mean shift in the T/F dimension for non-GLM students was a 6.24 point shift towards thinking, while the mean shift for the GLM students was only 1.28 towards thinking. The mean shift for the non-GLM students was statistically significant ($p < .001$) while the shift for the GLM students was not. Note that even with the lack of a significant shift by the GLM students, the overall shift when all students were included was still statistically significant to $p<.001$ due to the strong shift by the non-GLM students and a slight shift by the GLM students.

The presence of a significant change towards thinking by the non-GLM students, but not by the GLM students indicates that the environment encountered by the non-GLM students influenced students towards logical, objective decision-making, while the environment encountered by the GLM students did not. This does not imply that the environment encountered by the GLM students influenced students towards subjective, value-oriented decision-making either. The mean shift by GLM students was still towards a preference for logical, objective decision-making. However, this shift was not large enough to be statistically significant.

Many environmental factors could account for the shift towards logical, objective decision-making among the non-GLM students, but not among the GLM students. Differences in

course content, program goals, faculty attitudes and teaching styles, or even the types of thesis research performed could all have resulted in the shift in preference by the non-GLM students and not by the GLM students.

Investigative Question 3. The null hypothesis for investigative question 3 was that there was no difference in the change in psychological types from year to year. The null hypothesis was rejected due to a statistically significant ($p < .01$) correlation between the shifts in the E/I and S/N dimensions and whether the students graduated in 1986 or in other years (1987, 1988, or 1989). For the students who graduated in 1986, there was a significant shift towards extraversion while at AFIT ($p < .05$), while the students who graduated in the other years showed a slight, though not statistically significant, shift towards introversion while at AFIT. In addition, the students who graduated in 1986 had a significant shift towards a preference for sensing while enrolled at AFIT ($p < .05$), while students graduating between 1987 and 1989 showed a significant shift towards a preference for intuition while at AFIT ($p < .05$).

These differences between those graduating in 1986 and those graduating in other years can be partially explained by the classroom environment at AFIT. The shift towards extraversion by those who graduated in 1986 could be due to a greater use of group projects and class participation in their classes than in the classes of the other years'

students. On the other hand, the environment outside of the classroom could also explain the shift towards extraversion. If the class of 1986 had more group study sessions, intermural sports teams, and after work social gatherings than the other classes, then that could also explain the shift towards extraversion in their class and not in the other classes.

The shifts towards a preference for sensing in the class of 1986 and intuition in the classes of 1987, 1988, and 1989 could also be due to the classroom environment. Sensing types prefer audiovisuals and direct learning experiences, while intuitive types favor reading and open-ended instruction. In addition, highly theoretical or abstract concepts require students to employ their intuitive capabilities to a greater extent than do practical, concrete concepts. Thus, differences in the teaching methods employed and concepts emphasized could account for the differences between the class of 1986 and those that followed.

Investigative Question 4. The null hypothesis for investigative question 4 was that students in one demographic group were no more likely than students in another demographic group to change type while at AFIT. The null hypothesis was rejected due to significant correlations in the T/F shift and whether the students were males or females ($p < .01$) and in the J/P shift and whether the students were civilians or military officers ($p < .01$). For

male students, there was a statistically significant ($p < .001$) shift in preference toward thinking while at AFIT, while for females there was a small, but statistically insignificant, shift toward feeling. Likewise, for military officers (US and allied) there was a significant ($p < .001$) shift toward perception, while for civilians there was an insignificant shift toward judgement.

A possible explanation for the difference between the changes in preferences for males and females is the inherent differences in male and female type preferences. Between 55 and 65 percent of males in the general population prefer thinking over feeling, while 65 to 75 percent of females in the general population prefer feeling over thinking. While the AFIT environment was designed to be gender neutral, females may have approached the program from a different perspective than males. If the females were more comfortable using subjective, value-oriented decision-making than males, the females would have been less influenced towards the logical, objective decision-making process associated with thinking types. This research was not designed to identify specific reasons for shift in type while at AFIT, so it is not possible to do more than speculate on the reasons for this gender difference. Additional research is needed to explore this issue.

The difference between the J/P shift for civilians and military officers may be due to differences in their type upon entering the AFIT program. The data for investigative

question 5 showed that there was a statistically significant inverse correlation between type upon entering AFIT and type upon leaving AFIT. Those who entered as judgement types were more likely to shift towards a preference for perception, while those who entered as perception types were more likely to shift towards a preference for judgement. The military officers entered AFIT with a strong preference for judging (mean continuous score of 83.9), while the civilians entered the program with a weak preference for perception (mean continuous score of 100.2). Therefore, a slight shift by the civilians towards judgement and a strong shift by the officers towards perception would be consistent with the shift by each type towards the opposite end of the dimension, and could explain the difference between the two groups.

Investigative Question 5. The null hypothesis for investigative question 5 stated that students of one psychological type were no more likely than students of another type to change types while at AFIT. The null hypothesis was rejected. There were statistically significant ($p < .001$) inverse correlations between pre-AFIT type and the shift in type while at AFIT. Those who entered as extraverts shifted significantly towards introversion ($p < .01$), while those who entered as introverts shifted significantly towards extraversion ($p < .01$). Those who entered as sensing or intuitive types shifted slightly, though not significantly, towards the opposite type. Those

who entered as thinking or feeling types shifted significantly towards a greater preference for thinking ($p < .05$ for thinkers, $p < .001$ for feelers), although those who entered as thinking types shifted slightly (mean shift of -2.31) while those who entered as feeling types experienced a large shift (mean shift of -10.16). Finally, those who entered as judgement types shifted significantly towards a preference for perception ($p < .001$), while those who entered as perception types shifted statistically significantly towards a preference for judgement ($p < .05$). There was also a significant ($p < .05$) correlation between type on the E/I dimension and on the S/N dimension. Those who entered as extraverts shifted towards sensing, while those who entered as introverts shifted towards a preference for intuition. Neither of these shifts was significant.

The shift towards the opposite type for the E/I, S/N, and J/P dimensions while at AFIT could indicate that the AFIT environment encouraged the development of type on both ends of each dimension. If the environment encouraged the development of both sensing and intuition or both judgement and perception, then those on either end of the dimension would shift toward the center of the dimension, as their preferences balanced each other. As an example, those who entered the program as strong sensing types might have been required to use intuitive skills to a greater extent than they would have preferred and thus shifted their preference towards intuition, while those who entered as intuitive

types might have been exposed to sensing functions and shifted towards sensing. A balanced exposure to all of the functions would account for the shift on each end of these dimensions towards the opposite type.

The shift on the T/F dimension was toward thinking for both those who entered as thinking types and those who entered as feeling types, although the shift was much greater for the feeling types. This could indicate that the AFIT environment encouraged the development of the thinking function. Those who were already thinking types would have been less influenced by this environment since they already preferred the thinking function, while those who were feeling types would have been influenced towards thinking to a greater extent since their existing preferences were contrary to the thinking function. Thus, both the thinking types and the feeling types would have shifted towards a greater preference for thinking.

The data was also analyzed for the effects of the AFIT environment on the dominant function for the students. It was shown that there were significant shifts towards the opposite dominant function for those whose dominant function was judgement when they entered AFIT ($p < .001$ for EJs) and for those whose dominant function was perception when they entered AFIT ($p < .01$ for EPs, $p < .001$ for IJs). This indicates that the AFIT environment did not influence the students' choice of dominant function. Regardless of what function was dominant when they entered AFIT, the preference

for that function as the dominant one decreased while the students were enrolled in AFIT.

This can also be explained by an AFIT environment which encouraged the use of both judgement and perceptive functions when dealing with the external environment. Those who entered with a preference for using perceptive functions when dealing with the external environment (EPs and IPs) might have experienced an environment which required them to use judgement more often than they would have liked while extraverting. Likewise, those who entered with a preference for using judgement when dealing with the external environment (EJs and IJs) might have experienced an environment which required them to use sensing functions more often than they would have liked while extraverting. For example, if one class project required students to gather as much evidence as possible before drawing conclusions while a second project required the students to systematically work their way through the problem until an answer could be derived, the environment would have encouraged the use of perceptive and judgement functions. Those who preferred to use judgement functions when dealing with the environment might have developed a greater preference for perception through the use of perceptive functions when solving the first project. Likewise, those who preferred to use perception functions when dealing with the environment might have developed a greater preference for judgement through the use of judgement functions when

solving the second project. An environment which encourages the development and use of both judgement and perceptive functions should result in type shifting towards the opposite end of the J/P dimension.

Summary of Research Question #1. Investigative question 1 showed that there were significant shifts toward thinking and toward perception while students were enrolled in AFIT. However, the data analyzed for investigative question 5 presented a clearer picture. The data showed that the overall shift toward thinking occurred by both those who entered AFIT as thinking types and those who entered as feeling types. However, the overall shift toward perception only occurred for those who entered AFIT as judgement types. Those who entered as perceptive types shifted preferences significantly toward judgment. The reason for the significance of the overall shift towards a preference for perception is probably that judgement types far outnumbered perceptive types (303 to 124), so that the shift by judgement types towards perception remained significant even when the perceptive types were taken into account. These shifts indicate that the overall AFIT environment influenced type development towards a preference for thinking over feeling, but encouraged the development of judgement and perception when dealing with the external environment.

The AFIT environment resulted in a greater preference for thinking among its students. It can be concluded that

AFIT was also responsible for the greater development of the critical thinking dispositions associated with the thinking function. These include: objectivity, seeking reasons, dealing in an orderly manner with parts of a complex whole, intellectual skepticism, and intellectual honesty. The preference for thinking was developed at the expense of the preference for feeling. Therefore, these critical thinking dispositions were likely developed at the expense of the critical thinking disposition associated with a preference for feeling, that is, respect for others' points of view.

The overall AFIT environment also encouraged the development of judgement and perceptive preferences. Those who entered the program with a preference for judgement shifted towards a preference for perception, which indicates the development of the critical thinking dispositions associated with perception. These include: trying to be well informed, intellectual curiosity, open-minded, and flexibility. Those who entered the program with a preference for perception, on the other hand, shifted towards a preference for judgement, which indicates the development of the critical thinking dispositions associated with judgement. These include: systematic, decisiveness, and dealing in an orderly manner with parts of a complex whole.

It is not a surprise that the AFIT environment would encourage the development of thinking over feeling. The AFIT faculty are predominantly thinking types (8). As such,

the influence of the instructors would be towards the use of thinking over feeling to solve problems. The post-graduate management environment is also one which encourages thinking over feeling. Courses such as statistics, operations research, simulation, economics, and accounting are taught with an emphasis on logical, objective decision-making instead of subjective, value-oriented decision-making. Finally, the Air Force work environment which AFIT is preparing students to enter focuses decision-making using objective criteria. The military, out of necessity, places mission needs above personal needs, and demands that decision-making by its officers is done in the same manner.

The emphasis on judgement and perception in the AFIT environment can be explained by differences in teaching styles of the faculty and differences in the courses taught. If some instructors had encouraged a flexible, open-minded approach to problem solving, while other instructors encouraged a systematic, goal-oriented approach, the students would have faced an environment which encouraged the development of both judgement and perception skills. The same can be said of course content. Quantitative courses which required the use of specific methods or procedures to solve problems would have encouraged the development of judgement skills, while qualitative courses, particularly those using case study techniques, would have encouraged the development of perception skills by

emphasizing an analysis of all that can be learned from the data.

In summary, students in the AFIT/LS program between 1986 and 1989 developed preferences for thinking, judgement, and perception while enrolled in the program. These preferences correspond to the following critical thinking dispositions: objectivity, seeks reasons, deals in an orderly manner with parts of a complex whole, intellectual honesty, tries to be well informed, intellectual curiosity, open-minded, flexible, systematic, and decisive. These critical thinking dispositions were developed to a greater or lesser extent in each student, depending on the level of their development when they entered the program and on the influence of the program on changing their preferences.

The null and alternate hypotheses for Research Question #1 were as follows:

Ho: Critical thinking dispositions are not developed in students of the AFIT/LS graduate program.

Ha: Critical thinking dispositions are developed in students of the AFIT/LS graduate program.

Based on the data analysis and discussions above, the null hypothesis is rejected.

Research Question #2

Research Question #2 asked whether the critical thinking dispositions developed while at AFIT were retained after the students returned to the Air Force work

environment. Investigative questions 6 through 12 were framed to help answer this question.

Investigative Question 6. The null hypothesis for investigative question 6 was that there was no difference between the post-AFIT and current psychological types of the AFIT/LS students. The null hypothesis was rejected due to a statistically significant ($p < .01$) shift toward judgement after students left the program.

There was a statistically significant shift toward perception while students were enrolled in the program. This shift was reversed after the students returned to work, indicating that the changes in type in the J/P dimension which occurred while at AFIT were not retained by the students after leaving. This could have occurred for two reasons. First, without the influence of the academic environment, students may have returned to their natural, most comfortable preferences (35:14-15). Students who entered the program close to their natural type may have been influenced away from that type while at AFIT, but returned to their natural type when they left the AFIT environment and its influences. Second, the work environment which the students returned to may have encouraged the development of preferences different from those developed at AFIT. If students returned to an environment which encouraged problems to be tackled in a systematic, decisive manner instead of a flexible, open-minded manner, the shift towards perception which occurred

at AFIT would have been reversed by the influences of the work environment.

There was a significant shift toward a preference for thinking while students were at AFIT. The lack of a significant shift back towards feeling after leaving AFIT indicates that the preference for thinking was retained after leaving AFIT. The fact that the only significant change in type from the pre-AFIT survey to the follow-up survey was a shift toward thinking further indicates that there was a long term shift in preferences towards thinking as a result of the AFIT environment.

The retention of the preference for thinking can be explained by similar AFIT and work influences toward the T/F dimension. If the AFIT environment and the work environment both encouraged the development and use of thinking over feeling, then the preference for thinking developed while at AFIT would have been reinforced, and hence retained, after returning to the work environment.

Investigative Question 7. The null hypothesis for investigative question 7 was that changes from post-AFIT to current psychological types did not differ by program option. The null hypothesis was not rejected, since there were no statistically significant correlations between shift in type in any dimension and the program in which the students were enrolled.

This indicates that the level of retention of the type development which occurred while at AFIT was not dependent

on the program in which the students were enrolled. None of the program environments was such that students exposed to it developed types which were more permanent than students who were exposed to the other program environments. A difference in the level of retention would have indicated that some of the programs created a much stronger influence on type than other programs, resulting in differences in the level of retention. Since this was not the case, it indicates that all of the program environments influenced type development to the same relative degree of strength.

Investigative Question 8. The null hypothesis for investigative question 8 was that changes from post-AFIT to current psychological types did not differ by year of graduation. The null hypothesis was rejected due to a significant ($p < .05$) correlation between shift on the E/I dimension and whether the students graduated in 1986 or in the other years (1987, 1988, and 1989). Those who graduated in 1986 were more likely to shift toward a preference for introversion after leaving AFIT than those who graduated in the other years.

The data presented for investigative question 3 showed that there was a statistically significant shift by those who graduated in 1986 toward extraversion while at AFIT. The correlation between the class of 1986 and a shift towards introversion after leaving AFIT indicates that the increased preference for extraversion developed while at

AFIT was reversed after the students returned to the work environment.

There are two possible explanations for the shift back towards introversion after leaving the program. First, students who entered the program close to their natural type may have been influenced away from their natural preference while at AFIT, but returned to it when they left the AFIT environment and its influences. Second, the work environment may have encouraged the development of preferences different than those developed while at AFIT. If the class of 1986 returned to a work environment which encouraged working alone in a quiet, reflective manner, the shift toward extraversion which occurred while these students were enrolled at AFIT could have been reversed.

Since there was no other statistically significant correlation between change in type after leaving AFIT and the year of graduation, this indicates that the shifts which did occur (perception to judgement) probably happened within the first two years after leaving AFIT. If the work environment resulted in shifts in type which took many years to complete, there would have been a noticeable difference in the magnitude of the shift by graduating year. Those who graduated in 1986 went five years between the post-AFIT and follow-up surveys, while those who graduated in 1989 went only two years between the surveys. If changes in type continued for many years, those who graduated in 1986 would have shown a much greater shift than those who graduated in

1989. This was not the case, indicating that most of the shift occurred within two years of leaving AFIT.

Investigative Question 9. The null hypothesis for investigative question 9 was that changes from post-AFIT to current psychological types did not differ by the demographic makeup of the students. The null hypothesis was not rejected since there were no significant correlations between change in type after leaving AFIT and gender, age, or rank.

This indicates that the influences of the Air Force work environment on type were the same regardless of gender, age, or rank. The data presented for investigative question 4 showed that the AFIT environment influenced females differently than males. Males in the AFIT environment were strongly influenced toward a preference for thinking, while females were not. This distinction was not present in the work environment. Whatever existed in the AFIT environment to influence males and females differently was not present in the Air Force work environment to which the students returned.

Note that the data presented for investigative question 4 also showed a significant difference between change in type while at AFIT for civilians and military officers. It was not possible to determine whether that difference was also present in the work environment since civilians were not included in the follow-up survey. Since the difference between civilians and military officers while at AFIT seems

to have been the result of significant differences in type when they entered the program, and post-AFIT type was significantly correlated with the change in type after leaving AFIT (see investigative question 10 below), it is likely that the differences which existed while at AFIT also existed in the work environment.

Investigative Question 10. The null hypothesis for investigative question 10 stated that changes from post-AFIT to current types did not differ by the post-AFIT psychological type of the students. The null hypothesis was rejected due to statistically significant ($p < .001$) inverse correlations between post-AFIT and follow-up types on each dimension. First, those who left AFIT as extraverts shifted significantly toward introversion ($p < .01$). Second, those who left the program as sensing types shifted significantly ($p < .05$) toward intuition, while those who left as intuitive types shifted significantly ($p < .05$) toward sensing. Third, those who left AFIT as feeling types shifted significantly ($p < .01$) toward thinking. Fourth, those who left as judgement types shifted significantly ($p < .05$) toward perception, while those who left as perceptive types shifted significantly ($p < .001$) toward judgement. Finally, there were significant ($p < .05$) shifts by those who left as intuitive types towards introversion and by those who left as judgement types towards intuition.

In addition, those who shifted in one direction on a dimension shifted significantly in the other direction after

leaving the program for every type except judgement types. Those who shifted towards extraversion, sensing, thinking, feeling, or perception while at AFIT shifted towards the opposite end of the dimension at the $p < .001$ level of confidence, while those who shifted towards introversion or intuition while at AFIT shifted towards the opposite end of the dimension at the $p < .01$ level of confidence. Yet, those who shifted toward judgement while at AFIT retained that preference and did not shift toward perception after leaving.

The shifts in the opposite direction from the shifts while at AFIT demonstrate the lack of retention of the preferences developed while at AFIT. Only those who shifted toward a preference for judgement retained the preferences developed at AFIT. For every other type, regardless of the direction of influence at AFIT, the students shifted back toward their original pre-AFIT preferences, indicating a lack of retention.

Again, there are two likely causes for this lack of retention. First, students who entered the program close to their natural type and were influenced away from those preferences may have shifted back to their natural preferences when the influences of the AFIT environment were removed. Second, if the Air Force work environment created influences which were opposite those of the AFIT environment, students returning to this environment may have

been influenced away from the preferences developed while at AFIT.

The second explanation seems less plausible than the first explanation for this lack of retention. It is implausible that the work environment would influence type in the opposite direction of the AFIT environment for every type dimension, especially with students returning to a wide variety of different work environments. It is also unlikely that the work environment could have worked to reverse the direction of preference for those who increased their preference for extraversion (or sensing or thinking or judgement) and at the same time reverse the direction of preference for those who increased their preference for introversion (or intuition or feeling or perception). If the work environment encouraged the development and use of particular type functions (such as thinking or sensing), then there should have been a significant shift toward those functions, regardless of type when the students entered the work environment. If the work environment encouraged the balanced use of the functions on both ends of each type dimension, as the AFIT environment apparently did, then the preferences developed at AFIT should not have been reversed. The shifts in preferences which occurred as a result of the strengthening of the least preferred functions while at AFIT would have been reinforced and retained if the work environment also encouraged the balanced use of type functions.

The fact that there was no correlation between age and the changes in type after leaving AFIT supports the explanation that students entered AFIT close to their natural type, were influenced away from that type while enrolled in the program, and returned to their natural type after leaving AFIT. Type development theory says that people develop their natural type preferences in their childhood and early adulthood. If the younger students were still developing their preferences when they entered the program, they should have been influenced by the environment to a greater extent than the older students whose natural type preferences were fully developed. The fact that there was no correlation between the age of the students and the shift in type indicates that the students had all developed their natural preferences to the same relative degree. This supports the explanation that students entered AFIT with their natural preferences fully developed. If this were the case, the students would have adapted their preferences to conform with the temporary influences of the AFIT environment, but returned to their natural preferences after leaving AFIT.

The retention of the preference for judgement likely indicates that the work environment encouraged judgement over perception. Those who shifted toward a preference for perception at AFIT shifted back toward a preference for judgement, indicating either a shift back to the students' natural preferences or a work environment that encourages

the use of judgement. However, those who shifted toward a preference for judgement at AFIT did not shift back toward a preference for perception, indicating that the work environment reinforced the judgement preference. Since both those who shifted toward perception and those who shifted toward judgement while at AFIT ended up with a preference for judgement, it can be concluded that the work environment encouraged the preference for judgement.

The Air Force work environment tends to be very structured, goal oriented organization. Time pressures often force decision-makers to make decisive decisions with a minimum of facts at their disposal. Procedures are normally rigid, discouraging innovation or adaptability. This type of environment is very compatible with a preference for judgement, and could explain the influence on workers toward this preference.

Investigative Question 11. The null hypothesis for investigative question 11 was that work environment had no effect on changes from post-AFIT to current psychological types. The null hypothesis was rejected due to a statistically significant correlation between the amount of creativity on the job and the shift in the S/N ($p < .05$) and J/P ($p < .01$) dimensions and between the amount of stress on the job and the shift in the T/F dimension. Creativity was positively correlated with increases in the preference for intuition and in the preference for perception, while stress

was positively correlated with increases in the preference for thinking.

Creativity requires a perception of the new or possible. Perception of new or possible things is the function of intuition. It is therefore not surprising that those who entered jobs which required a great deal of creativity were more likely to shift towards a preference for intuition than those who entered jobs which did not require creativity. This correlation between creativity and intuition was confirmed by other studies which significantly ($p < .001$) linked creativity with intuition (35:187,188).

The correlation between creativity and perception was also expected. Creativity requires the use of the perceptive function (intuition) much more than the judgement functions. A person working on a problem that required creativity would need to develop as many alternatives as possible, without judging their merit until later (brainstorming is an example of this process). In addition, the creative person must remain flexible and open-minded to new possibilities. These requirements correspond to perceptive types. The link between creativity and perception has been confirmed by other studies which showed a statistically significant ($p < .001$) correlation between creativity and perception (35:187,188).

The cause for the correlation between stress on the job and a shift towards thinking over feeling is difficult to determine. It is possible that the demands of stressful

jobs forced workers to concentrate on job completion at the expense of coworkers' feelings, resulting in a shift towards thinking. However, it is also possible that those who shifted towards thinking were more likely to focus on job completion at the expense of coworkers' feelings, resulting in increased stress. Whether the stress caused the shift towards thinking or thinking caused the increased stress cannot be determined from this research and should be a topic of future research.

It is of interest to note that there was not a statistically significant correlation between socialization on the job and a shift towards extraversion. A possible explanation for this was provided by several introverts who returned their surveys with comments to the effect that though they had many opportunities to socialize with their coworkers, they chose not to use them.

Investigative Question 12. The null hypothesis for investigative question 12 was that changes in home environment of the students had no influence on the change from post-AFIT to current psychological types. The null hypothesis was rejected due to the statistical significance of the correlation between the death of a friend or family member and the shift in the S/N dimension ($p < .05$), and of the correlation between other changes (health, spiritual, etc.) and the shift on the E/I dimension ($p < .05$). The death of a friend or family member was correlated with an increased preference for intuition, while a change in other

aspects of life (health, spiritual, etc.) was correlated with an increased preference for extraversion.

The correlation between death of a loved one and the shift toward intuition could have been due to a reexamination of one's beliefs after a loved one died. Those who experience the death of a loved one may have begun to question the meaning of life, the existence of an afterlife, why death occurs, or other such philosophical questions. Intuition allows examination of meanings and relationships, and permits perception of possible or theoretical events which could not be perceived with the senses. In order to answer these philosophical questions, these subjects would have had to utilize their intuitive abilities, possibly leading to an increased preference for intuition.

The correlation between changes in other aspects of life and the shift toward extraversion can not be explained by this research. The data did not allow the examination of specific causes for the shift. Whether the shift was due to health changes, spiritual changes, or changes in a variety of other aspects of life could not be determined from the data gathered.

Summary of Research Question #2. The influences of the AFIT environment on type seem to have been at least partially reversed by the Air Force work environment regardless of the direction of influence while at AFIT. The data presented for investigative question 6 showed that

there was a statistically significant shift toward judgement after the students returned to the work environment, but no significant shift on the T/F dimension. This indicated that the overall shift toward perception which occurred while at AFIT was reversed after students left the program, but that the overall shift toward thinking was not reversed after students entered the work environment. These findings were confirmed by the comparison of pre-AFIT and follow-up scores which showed a significant shift toward thinking, but no shift on the J/P dimension.

The data presented in investigative question 10 provided a clearer picture of what happened. For every type other than judgement, students who shifted toward one type while at AFIT shifted significantly toward the opposite type after leaving the program. This indicated that the influences AFIT created were reversed in all cases except for those who shifted toward judgement.

Those who shifted toward perception while at AFIT shifted back toward judgement after leaving, while those who shifted toward judgement did not shift toward perception. This accounts for the significant overall shift toward judgement observed in investigative question 6. This also indicates that the preference for perception which was developed at AFIT was not retained by student after returning to the work environment, but that the preference for judgement developed at AFIT was retained.

Those who shifted toward thinking while at AFIT shifted significantly back toward feeling after leaving. However, since there was a significant shift toward thinking from the pre-AFIT to follow-up survey, the shift back toward feeling after leaving AFIT was much smaller than the shift towards thinking while at AFIT. This indicates that there was only a partial reversal of the preference for thinking developed at AFIT, and, therefore, that there was significant retention of the preference for thinking which was developed at AFIT.

These reversals of type after leaving the program were most likely the result of a shift back to the natural preferences of the students. Students entered the program close to their natural type, changed type while at AFIT to conform with the influences of the environment, and returned to their preferred type when the influences of the AFIT environment were removed. This would account for the significant reversal of the shift while at AFIT toward every type except judgement. The lack of a shift back toward perception by those who shifted toward judgement while at AFIT indicates the work environment reinforced the judgement preferences developed at AFIT.

Research Question #1 concluded that AFIT encouraged the development of thinking, judgement, and perception, along with each of these type's associated critical thinking dispositions. The critical thinking dispositions associated with thinking included: objectivity, seeking reasons,

dealing in an orderly manner with parts of a complex whole, and intellectual honesty. The dispositions associated with judgement included: systematic, decisiveness, and dealing in an orderly manner with parts of a complex whole. Finally, the critical thinking dispositions associated with perception included: trying to be well informed, intellectual curiosity, open-mindedness, and flexibility.

The data presented for this research question lead to the conclusion that the preference for thinking developed is partially retained, the preference for judgement is fully retained, and the preference for perception is not retained. From this, it can be concluded that the dispositions associated with thinking were partially retained, the dispositions associated with judgement fully retained, and those associated with perception not retained after students left the program.

The null and alternate hypotheses for Research Question #2 were as follows:

Ho: The critical thinking dispositions which are developed by AFIT/LS are not retained by students after leaving AFIT.

Ha: The critical thinking dispositions which are developed by AFIT/LS are retained by students after leaving AFIT.

Due to the data analysis and discussions presented above, the null hypothesis is rejected.

Conclusions

The following conclusions were drawn based on the data presented in Chapter IV and the discussion presented earlier in this chapter.

1. AFIT presents an environment which encourages the development of type towards extraversion and introversion. By encouraging the development of both ends of the dimension, AFIT strengthens the weaker of the two preferences.

2. AFIT has no effect on the development of type in the sensing/intuition dimension.

3. AFIT influences the development of type towards thinking at the expense of feeling.

4. AFIT presents an environment which encourages the development of type towards judgement and perception. By encouraging the development of both ends of the dimension, AFIT strengthens the weaker of the two preferences.

5. Students of the Logistics Management program do not experience the development of type toward thinking as do students of the other graduate programs offered by AFIT/LS.

6. Females in the AFIT/LS graduate program do not experience the development of type toward thinking while males do.

7. The age and rank of an AFIT student has no relation to the likelihood or direction of change in type while at AFIT.

8. Changes in type preferences on the extraversion/introversion and sensing/intuition dimensions which occur at AFIT are completely reversed after students leave AFIT. This is due to a return by the students to their naturally preferred types when the influences of AFIT are removed.

9. Changes in type preferences toward feeling which occur at AFIT are completely reversed due to a return by the students to their naturally preferred types. Changes in type preferences toward thinking which occur at AFIT are partially reversed after students leave AFIT due to a partial return by students toward their natural type preferences.

10. Changes in type preferences toward perception which occur at AFIT are completely reversed, while changes in type preferences toward judgement are not reversed, due to the influence of the Air Force work environment toward a preference for judgement.

11. The retention of type preferences developed at AFIT are not influenced by the AFIT program option in which the students are enrolled.

12. Gender, age, and rank have no relation to the likelihood of retention of the type preferences developed at AFIT.

13. AFIT encourages the development of the following critical thinking dispositions: objectivity, seeking reasons, dealing in an orderly manner with parts of a complex whole, intellectual honesty, trying to be well

informed, intellectual curiosity, open-mindedness, flexibility, systematic, and decisiveness.

14. Of the critical thinking dispositions developed by AFIT, the following are not retained by students after they leave the program: trying to be well informed, intellectual curiosity, open-mindedness, and flexibility.

Summary

This chapter presented a discussion of the twelve investigative questions and two research questions, and listed the conclusions which were drawn from this research. The next chapter will present recommendations based on this research.

VI. Summary and Recommendations

Introduction to the Chapter

This chapter summarizes the findings of this research and provides recommendations based on these findings.

Thesis Summary

The two primary missions of educational institutions are the provision of knowledge and the development of the ability to think critically. The School of Systems and Logistics of the Air Force Institute of Technology (AFIT/LS) has the same primary goals. The mission of AFIT is to equip its students with the knowledge needed to understand their technological and cultural environment and with the critical thinking abilities necessary to analyze and solve Air Force problems.

The process of critical thinking requires the abilities and dispositions to think critically. Critical thinking abilities are the tools and techniques used by a person when thinking, and include the abilities to analyze arguments, judge credibility, identify assumptions, and decide on a course of action. Critical thinking dispositions, on the other hand, are the attitudes and inclinations of a person towards using critical thinking abilities, and include the tendencies of a person to be objective, look for alternatives, remain open-minded, be well informed, and make decisions decisively when the evidence supports it.

Educational institutions with the goal of equipping students to think critically on the job need to develop both the abilities and dispositions to think critically in their students. The development of critical thinking abilities, without the development of the dispositions necessary to utilize these skills, is fruitless. For if a person has the ability to think critically, but is not disposed to do so, nothing has been gained by developing the ability in the person.

Critical thinking dispositions, being attitudes, cannot be taught. Instead, they must be developed in students over time. These dispositions can be developed by exposure to an environment which demonstrates and encourages their use. By observing an instructor or fellow student with a particular disposition, or by being encouraged to use a particular disposition to solve problems, students can be influenced toward a greater preference for that disposition. Thus, it is the environment that students are exposed to that determines the extent of development of critical thinking dispositions.

Equally important to educational institutions is the retention of these abilities and dispositions. Abilities or dispositions that are developed by the institution but abandoned when students leave may be useful for getting students through the program, but serve no value after the students enter the work environment. In order for critical thinking abilities and dispositions to be used on the job,

the educational institution must develop them is such a way that they are retained over the long term, and not abandoned as soon as students leave the institution.

This research attempted to evaluate which, if any, critical thinking dispositions were developed while students were enrolled in the AFIT/LS graduate program, and to what degree these dispositions were retained after students returned to the work environment.

It was found that students tended to increase their preference for logical, objective, and analytical decision-making over subjective, value-oriented decision-making while enrolled in the AFIT graduate program. This preference indicated the development of the following critical thinking dispositions while at AFIT: objectivity, seeking reasons, dealing in an orderly manner with parts of a complex whole, intellectual skepticism, and intellectual honesty.

These critical thinking dispositions were found to be partially retained by students after they left the program. Students left AFIT with a much stronger preference for these dispositions than when they arrived, but the preference for these dispositions decreased partially after students left. This indicated that these critical thinking dispositions were developed at AFIT, but were only partially retained after students left the program.

In addition, it was found that students who entered the program with a preference for a systematic, goal-oriented approach to problem solving became more flexible and open-

minded, while those who entered with a preference for a flexible, open-minded approach to problem solving became more systematic and goal-oriented. This indicated that the following critical thinking dispositions were developed while at AFIT: intellectual curiosity, trying to be well informed, open-mindedness, flexibility, systematic, decisiveness, and dealing in an orderly manner with parts of a complex whole.

It was found that after students left the AFIT program, they tended to shift towards a preference for the systematic, goal-oriented approach to problem solving at the expense of the preference for flexible, open-minded problem solving. This indicated that the first five dispositions (intellectual curiosity, trying to be well informed, open-mindedness, and flexibility) were not retained, but that the other dispositions (systematic, decisiveness, and dealing in an orderly manner with parts of a complex whole) were retained after the students entered the work environment.

AFIT successfully developed many of the critical thinking dispositions. The program placed a strong emphasis on those dispositions related to logical, objective thinking, and to solving problems in a flexible, open-minded, systematic, and decisive manner. The possession of these dispositions is important to good decision-making and problem solving.

However, AFIT did not influence the development of dispositions associated with intuition, such as looking for

alternatives. Looking for alternatives and the use of other creative abilities can be a very important component of the decision-making and problem solving processes. AFIT may need to evaluate the direction of the program and whether a higher priority should be placed on developing the dispositions associated with the use of creative skills.

Overall, the AFIT/LS graduate program was found to have resulted in increased preferences for many of the critical thinking dispositions. Many, but not all, of these dispositions were retained by students after leaving the program. Yet, the lack of development of the intuitive preferences associated with creativity and the lack of retention of many of the dispositions developed point to areas of possible improvement for AFIT.

Recommendations

1. It is recommended that the AFIT School of Systems and Logistics review Air Force requirements to determine whether the AFIT mission statement's emphasis on critical thinking is appropriate. If it is found to be appropriate, AFIT should develop a comprehensive program to ensure the appropriate critical thinking skills and dispositions are developed and retained. This program should include faculty training workshops, modifications to student curriculum where needed, and a means of evaluating the success of the program.

2. It is recommended that the AFIT School of Systems and Logistics review Air Force requirements for creative

decision-making and problem solving. If justified by Air Force requirements, the curriculum should be modified to place greater emphasis on the development and use of creativity.

3. It is recommended that the AFIT School of Systems and Logistics review Air Force requirements for officers who are open-minded, flexible, and curious. If Air Force requirements justify an added emphasis on these preferences, the school should find and incorporate into the curriculum ways of developing preferences that will not be reversed when students leave the program. If Air Force requirements do not justify the development of these preferences, the curriculum should be modified to place less emphasis on their development.

4. It is recommended that AFIT develop professional continuing education courses in effective decision-making, problem solving, and critical thinking, with emphasis on creativity, open-mindedness, and flexibility. These aspects of effective decision-making were found to be discouraged by the Air Force work environment. Periodic courses in effective decision-making could result in an environment more conducive to these aspects of decision-making and problem solving. It is further recommended that existing professional continuing education courses be reviewed for possible modification to enhance effective decision-making, problem solving, and critical thinking.

5. It is recommended that an AFIT graduate student, as a thesis topic, investigate the development and retention of critical thinking skills at AFIT. This research effort investigated the development and retention of critical thinking dispositions, but not critical thinking skills. Since the AFIT mission is to develop critical thinking for use in the Air Force work environment, the development of critical thinking skills is as important as the development of the dispositions. There are several widely used measures of critical thinking skills which would be appropriate for this purpose.

6. It is recommended that an AFIT graduate student, as a thesis topic, repeat this research effort every four to five years. This will necessitate the continued administration of the Myers-Briggs Type Indicator to all incoming and outgoing students of the AFIT/LS graduate program. The AFIT teaching environment and curriculum changes yearly. In addition, changes continually take place in the Air Force work environment. A repeat of this research every four to five years would allow for the continued evaluation of the effectiveness of the program at developing critical thinking dispositions which are retained.

7. It is recommended that an AFIT graduate student, as a thesis topic, investigate the reasons for the differences between the development of logical, objective decision-making for those who were enrolled in the Graduate Logistics

Management (GLM) program and those enrolled in other graduate programs. A determination of how the GLM program differed from the other programs would lead to recommendations on how to modify the GLM curriculum to develop this type of decision-making.

8. It is recommended that an AFIT graduate student, as a thesis topic, investigate the differences between males and females in how they approached the AFIT program. This research found that males were influenced significantly towards a preference for logical, objective decision-making, while females were not influenced at all. A better understanding of the differences in the perspectives and influences of male and female students would allow a curriculum to be developed which better met the needs of all students, regardless of gender.

Summary

This chapter concluded this effort. It presented a summary of this research effort and made recommendations based on the results.

Appendix A: Environmental Influences Survey

Environment Survey

Answer each of the following questions to the best of your ability by circling the appropriate answers directly on this sheet.

1. Your Name:_____

2. What graduate management program were you enrolled in at AFIT?

   a. Engineering Management (GEM)
   b. Systems Management (GSM)
   c. Cost Analysis (GCA)
   d. Logistics Management (GLM) (all options)
   e. Contracting Management (GCM)
   f. Information Resource Management (GIR)
   g. Other _____

3. How often have you used problem solving skills on the job since graduating from AFIT?

   a. All the time
   b. Frequently
   c. Occasionally
   d. Seldom
   e. Never

4. How often have you had to be creative on the job since graduating from AFIT?

   a. All the time
   b. Frequently
   c. Occasionally
   d. Seldom
   e. Never

5. How often have you experienced job-related stress?

   a. All the time
   b. Frequently
   c. Occasionally
   d. Seldom
   e. Never

ENVIRONMENTAL Survey (continued)

6. How often do you have the opportunity to socialize with co-workers while at work?

   a. All the time
   b. Frequently
   c. Occasionally
   d. Seldom
   e. Never

7. My marital status is the same as when I graduated from AFIT.

   a. Agree
   b. Neither agree nor disagree
   c. Disagree

8. The birth of a child (children) since I graduated from AFIT has changed my outlook on life.

   a. Strongly agree
   b. Moderately agree
   c. Neither agree nor disagree
   d. Moderately disagree
   e. Strongly disagree

9. The death of a friend or relative since I graduated from AFIT has changed my outlook on life.

   a. Strongly agree
   b. Moderately agree
   c. Neither agree nor disagree
   d. Moderately disagree
   e. Strongly disagree

10. Some other aspect (health, spiritual, etc.) has caused my outlook on life to change since I graduated from AFIT.

    a. Strongly agree
    b. Moderately agree
    c. Neither agree nor disagree
    d. Moderately disagree
    e. Strongly disagree

11. I believe my psychological type is the same now as when I graduated from AFIT.

    a. Strongly agree
    b. Moderately agree
    c. Neither agree nor disagree
    d. Moderately disagree
    e. Strongly disagree

Bibliography

1. The American Heritage Dictionary, Second College Edition. Boston: Houghton Mifflin Co, 1982.

2. Baron, Joan Boykoff. "Evaluating Thinking Skills in the Classroom," Teaching Thinking Skills: Theory and Practice, edited by Joan Baron and Robert Sternberg. New York: W. H. Freeman and Company, 1987.

3. Baron, Joan Boykoff and Robert Sternberg. Teaching Thinking Skills: Theory and Practice, edited by Joan Baron and Robert Sternberg. New York: W.H. Freeman and Company, 1987.

4. Baron, Jonathan. "What Kinds of Intelligence Components are Fundamental?" Thinking and Learning Skills, edited by Susan F. Chipman, Judith W. Siegal, and Robert Glaser. Hillsdale NJ: Lawrence Erlbaum Associates, Publishers, 1985.

5. Bloom, Benjamin S. and Lois J. Broder. Problem-solving Processes of College Students. Chicago: The University of Chicago Press, 1950.

6. Burton, William H., Roland B. Kimball, and Richard L. Wing. Education for Effective Thinking. New York: Appleton-Century-Crofts, Inc., 1960.

7. Cammarota, Col Richard, Educator. 10,4: 10-11 (Summer 1990)

8. Campbell, Dennis E., Associate Professor. Personal interviews. Air Force Institute of Technology (AU), Wright-Patterson AFB OH, May - August 1991.

9. Campbell, Dennis E. "Learner Perceived Change for Methods, Techniques and Devices," Association of Psychological Type Biennial International Conference, Gainesville FL, 21-28 June 1987.

10. Campbell, Dennis E. and Carl L. Davis. "Improving Learning By Combining Critical Thinking Skills With Psychological Type," Journal on Excellence in College Teaching, 1: 39-51 (1990).

11. Carr, Kathryn S. "How Can We Teach Critical Thinking?" Childhood Education, Winter 1988:69-73.

12. D'Angelo, Edward. The Teaching of Critical Thinking. Amsterdam: B. R. Gruner N. V., 1971.

13. Department of the Air Force. AFIT Catalog 1989-1991. (Publication location unknown).

14. Ennis, Robert H. "A Taxonomy of Critical Thinking Dispositions and Abilities," Teaching Thinking Skills: Theory and Practice, edited by Joan Baron and Robert Sternberg. New York: W. H. Freeman and Company, 1987.

15. Ennis, Robert H. and Stephen P. Norris. "Critical Thinking Assessments: Status, Issues, Needs," Cognitive Assessment of Language and Math Outcomes, edited by Sue Legg and James Algina. Norwood NJ: Ablex Publishing Corporation, 1990.

16. Flavell, John H. "Cognitive Changes in Adulthood," Life-Span Developmental Psychology, edited by L. R. Goulet and Paul B. Baltes. New York: Academic Press, 1970.

17. Flavell, John H. The Developmental Psychology of Jean Piaget. New York: D. Van Nostrand Company, 1963.

18. Fowler, Floyd J., Jr. Survey Research Methods. Beverly Hills: Sage Publications, 1984.

19. Frederiksen, Norman. "Implications of Cognitive Theory for Instruction in Problem Solving," Review of Educational Research, 54:363-407 (Fall 1984).

20. Gallo, Delores. "Think Metric," Thinking Skills Instruction: Concepts and Techniques, edited by Marcia Heiman and Joshua Slomianko. Washington DC: National Education Association, 1987.

21. Halpern, Diane F. "Thinking Across the Disciplines: Methods and Strategies to Promote Higher-Order Thinking in Every Classroom," Thinking Skills Instruction: Concepts and Techniques, edited by Marcia Heiman and Joshua Slomianko. Washington DC: National Education Association, 1987.

22. Halpern, Diane F. Thought and Knowledge. Hillsdale NJ: Lawrence Erlbaum Associates, Publishers, 1984.

23. Inhelder, Barbel, and Jean Piaget. The Growth of Logical Thinking From Childhood to Adolescence. Basic Books, Inc., Publishers (location unknown), 1958.

24. Karmos, Joseph S. and Ann H. Karmos. "Strategies For Active Involvement in Problem Solving," Thinking Skills Instruction: Concepts and Techniques, edited by Marcia Heiman and Joshua Slomianko. Washington DC: National Education Association, 1987.

25. Keirsey, David and Marilyn Bates. Please Understand Me. Del Mar CA: Prometheus Nemesis Book Company, 1984.

26. King, Patricia M. "Formal Reasoning in Adults: A Review and Critique," Adult Cognitive Development, edited by Robert A. Mines and Karen S. Kitchener. New York: Praeger Publishers, 1986.

27. Lawrence, Gordon. People Types and Tiger Stripes. Gainesville FL: Center for Application of Psychological Type, Inc., 1982.

28. McCaulley, Mary H. Jung's Theory of Psychological Types and the Myers-Briggs Type Indicator. Gainsville FL: Center for Application of Psychological Type, Inc., (publication date unknown).

29. McCaulley, Mary H. "The Myers-Briggs Type Indicator: A Jungian Model for Problem Solving," Development of Critical Thinking and Problem-Solving Abilities, edited by James E. Stice. San Francisco: Jossey-Bass, Inc., Publishers, 1987.

30. McCaulley, Mary H. The Myers-Briggs Type Indicator and the Teaching-Learning Process. Gainesville FL: Center For Applications of Psychological Type, Inc., 1976.

31. Meyers, Chet. Teaching Students to Think Critically. San Francisco: Jossey-Bass Publishers, 1986.

32. Morgan, Margaret K. in People Types and Tiger Stripes, by Gordon Lawrence. Gainesville FL: Center for Applications of Psychological Type, Inc., 1982.

33. Myers, Isabel Briggs. Gifts Differing. Palo Alto CA: Consulting Psychologists Press, 1984.

34. Myers, Isabel Briggs. Introduction to Type. Palo Alto CA: Consulting Psychologists Press, 1980.

35. Myers, Isabel Briggs and Mary H. McCaulley. Manual: A Guide to the Development and Use of the Myers-Briggs Type Indicator. Palo Alto CA: Consulting Psychologists Press, 1985.

36. Norris, Stephen P. "Can We Test Validly for Critical Thinking?," Educational Researcher, December, 1989: 21-26.

37. Norris, Stephen P. and Robert H. Ennis. Evaluating Critical Thinking. Pacific Grove CA: Midwest Publications, 1989.

38. Pascarella, Ernest T. "The Development of Critical Thinking: Does College Make a Difference?" Journal of College Student Development, 30: 19-26 (January 1989).

39. Paul, Richard W. "Critical Thinking and the Critical Person," Thinking: The Second International Conference, edited by D. N. Perkins, Jack Lochhead, and John Bishop. Hillsdale NJ: Lawrence Erlbaum Associates, Publishers, 1987.

40. Paul, Richard W. "Critical Thinking: Fundamental to Education for a Free Society," Educational Leadership, September 1984:4-14.

41. Perkins, D. N. "Thinking Frames: An Integrative Perspective on Teaching Cognitive Skills," Teaching Thinking Skills: Theory and Practice, edited by Joan Baron and Robert Sternberg. New York: W. H. Freeman and Company, 1987.

42. Presseisen, Barbara Z. Thinking Skills: Research and Practice. Washington DC: National Education Association, 1986.

43. Provost, Judith A. and Scott Anchors. Applications of the Myers-Briggs Type Indicator in Higher Education. Palo Alto CA: Consulting Psychologists Press, 1987.

44. Resnick, Lauren B. and Leopold E. Klopfer. "Toward the Thinking Curriculum: An Overview," Toward the Thinking Curriculum: Current Cognitive Research, edited by Lauren B. Resnick and Leopold E. Klopfer. (location unknown): Association for Supervision and Curriculum Development, 1989.

45. Siegel, Harvey. Educating Reason. New York: Routledge, 1988.

46. Smith, Daryl G. "College Classroom Interactions and Critical Thinking," Journal of Educational Psychology, 69: 180-190 (1977).

47. Swartz, Alma M. "Critical Thinking Attitudes and the Transfer Question," Thinking Skills Instruction: Concepts and Techniques, edited by Marcia Heiman and Joshua Slomianko. Washington DC: National Education Association, 1987.

48. Swartz, Robert J. "Restructuring What We Teach to Teach for Critical Thinking," Thinking Skills Instruction: Concepts and Techniques, edited by Marcia Heiman and Joshua Slomianko. Washington DC: National Education Association, 1987.

Vita

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13. ABSTRACT *(Maximum 200 words)*

This effort analyzed the development and retention of critical thinking dispositions in students of the Air Force Institute of Technology's School of Systems and Logistics graduate management program. The Myers-Briggs Type Indicator was used as a measure of subjects' dispositions. Pre-test and post-test surveys were administered when subjects entered and exited the program, and a follow-up administered two to five years later. The pre-test and post-test were administered to 427 subjects and the follow-up to 201 of those subjects. It was found that subjects increased their preference for logical, objective decision-making while enrolled in the program. Subjects also increased their preference for flexible, open-minded thinking, and for systematic, goal-oriented thinking, while enrolled in the program. After leaving the program, subjects retained part of the increase in the preference for logical, objective decision-making, none of the increased preference for flexible, open-minded thinking, and all of the increased preference for systematic, goal-oriented thinking.

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AFIT RESEARCH ASSESSMENT

The purpose of this questionnaire is to determine the potential for current and future applications of AFIT thesis research. Please return completed questionnaires to: AFIT/LSC, Wright-Patterson AFB OH 45433-6583.

1. Did this research contribute to a current research project?

   a. Yes b. No

2. Do you believe this research topic is significant enough that it would have been researched (or contracted) by your organization or another agency if AFIT had not researched it?

   a. Yes b. No

3. The benefits of AFIT research can often be expressed by the equivalent value that your agency received by virtue of AFIT performing the research. Please estimate what this research would have cost in terms of manpower and/or dollars if it had been accomplished under contract or if it had been done in-house.

   Man Years _____ $_____

4. Often it is not possible to attach equivalent dollar values to research, although the results of the research may, in fact, be important. Whether or not you were able to establish an equivalent value for this research (3 above), what is your estimate of its significance?

   a. Highly Significant b. Significant c. Slightly Significant d. Of No Significance

5. Comments

Name and Grade Organization

Position or Title Address